Potential for e-cargo bikes to reduce congestion and pollution from vans in cities

Paper 3 in a series to develop the evidence base on the contribution of the bicycle industry to Britain's industrial strategy

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July 2019

transport for quality of life

Document name:	Potential for (e-)cargo bikes to reduce congestion and pollution from vans in cities
Project name:	Developing the evidence base on the contribution of the bicycle industry to Britain's industrial strategy
Paper number:	3
Client:	Bicycle Association
Date:	October 2018; revised July 2019

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Foreword

Congestion in cities is a growing problem. Even in London, rush hour traffic speeds are falling despite the existence of world-class alternatives to driving and the central London congestion charge.

One of the main reasons for worsening congestion is the growth in van traffic. Since 2008, van mileage has increased by a fifth, and vans now make up about 15% of traffic and cause over 30% of NOx and particulate emissions.

Electrically-assisted cargo bikes offer a solution to the van problem. They take up less road space, are zero-emission, and are less intrusive than vans in city centres. The government is offering grants to organisations that want to purchase e-cargo bikes, and this is very welcome. But for our cities to take full advantage of the potential for e-cargo bikes to cut van traffic, we need a complete re-think of how goods are delivered. We need to show how e-cargo bikes could work when used on a large scale.

This evidence review by Transport for Quality of Life suggests that the government should work with a few towns and cities to set up 'Sustainable Freight Demonstration Towns'. These could be like the highly successful Sustainable Travel Demonstration Towns which, between 2004 and 2009, showed how it was possible to change individual travel behaviour away from driving and towards 'smarter' travel options including cycling, walking and public transport. The lessons learned in the Sustainable Travel Demonstration Towns led directly to the Local Sustainable Transport Fund, which mainstreamed sustainable travel in around 100 towns and cities across England.

A similar coordinated and comprehensive approach for urban freight, focussed on the potential for e-cargo bikes, is long overdue. It need not be expensive – the three Sustainable Travel Demonstration Towns cost just £10 million over five years. By coordinating effort across the public sector and businesses, and concentrating on just a few towns and cities, it would have maximum impact. It could also help cities in breach of air quality legislation to make their air breathable again.

Steve Garidis

Executive Director, Bicycle Association

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Executive Summary

Cargo bikes and electrically-assisted cargo bikes have significant potential to replace vans in urban areas, and to help reduce congestion and pollution.

Scale and nature of the opportunity

Vans (light goods vehicles) already account for about 15% of motorised vehicle miles in urban areas in Britain, and rapid growth of van traffic is a cause of worsening traffic congestion. In large cities, up to a quarter (25%) of all traffic may be trips by delivery and service companies in vans, cars and lorries, according to European research.

Estimates suggest about 10-30% of trips by delivery and service companies might be substitutable by (e-)cargo bikes. The potential is likely to be greater in areas where traffic is restricted, for reasons such as poor air quality.

Taken together, these figures suggest that there is potential for traffic mileage in urban areas to be reduced by about 1.5-7.5%, if (e-)cargo bikes took over from delivery and service vehicles for suitable trips.

E-cargo bikes are particularly suitable for dense urban areas, where there is a high concentration of suitable delivery work and individual trips are short. In some cases, use of e-cargo bikes might be a straight switch; in others, it could involve re-organisation of supply chains, including use of micro-consolidation centres, with (e-)cargo bikes used for the last part of the deliveries.

The mail and parcel delivery sector has received the greatest attention. However, there is also significant potential for the use of (e-)cargo bikes for delivery of both food and non-food items, by tradesmen and service providers, by public sector workers, and (for smaller items) by the construction industry.

There is also substantial potential for use of (e-)cargo bikes for personal journeys, in particular for shopping and transporting children.

Benefits of (e-)cargo bikes

(E-)cargo bikes take up less road-space than conventional vans, and can often make use of cycle lanes. When making deliveries, their smaller size also means that they can be conveniently parked.

Vans emit over 30% of all NOx and particulates from road vehicle exhausts, and so replacing vans with (e-)cargo bikes disproportionately improves air quality. Replacing vans with (e-)cargo bikes also reduces emissions of greenhouse gases. Vans in the parcel and delivery sector may each emit more than 10 tonnes of CO_2 per year. Trials by DHL, where two vans are replaced by a 'City Hub' and four e-cargo bikes, are estimated to reduce CO_2 emissions by 16 tonnes p.a.. In Maastricht, four companies that replaced a conventional van with an e-cargo bike saved more than a tonne of CO_2 in six months. In London, a butcher that began using an e-cargo bike instead of a van whenever possible was able to reduce CO_2 emissions by 75%.

(E-)cargo bikes are also efficient. They can take shorter, faster routes (using cycle and bus lanes, or being wheeled through pedestrianised areas); they are easier to park and so deliveries can be made more quickly; and they are cheaper to buy, insure and repair than vans. Restaurants using e-cargo bikes to deliver take-away meals report that it is easier to recruit riders than van drivers or moped riders.

Measures to encourage take-up of (e-)cargo bikes

In Europe, use of e-cargo bikes is growing fast, but in the UK, numbers are small. The recent grants for (e-)cargo bikes announced by the Department for Transport should encourage take-up. Similar (e-)cargo bike grants at national and city level in other European countries have been successful.

However, grants are unlikely to be enough on their own. The government could also set up Sustainable Freight Demonstration Towns to show how e-cargo bikes work and how much difference they can make when used on a large scale.

Sustainable Freight Demonstration Towns could:

- Trial micro-depots in urban areas, from which cycle logistics companies can operate, drawing on experience of cities like Berlin.
- Set up city-wide information sharing networks for (e-)cargo bike operators, and other shared services such as repair services.
- Provide dedicated parking for (e-)cargo bikes and shared (e-)cargo bike schemes.
- Encourage use of (e-)cargo bikes by the public sector and businesses.
- Improve cycle infrastructure, including ensuring cycle lanes are of adequate width (which will also benefit other cyclists).
- Restrict the use of conventional vans for deliveries in central areas.
- Provide additional grant funding for individuals, who may wish to purchase an (e-)cargo bike for transport of children, shopping or other items.

Other actions that would encourage take-up are:

- Greater clarity that (e-)cargo bikes qualify for enhanced capital allowances, and, possibly an interest-free loan system similar to that in Scotland.
- Development and accreditation of a safety training course for (e-)cargo bike users.
- Sharing of knowledge and experience, particularly with non-users who may be sceptical about investing.

1. Introduction

This report sets out an investigation of the scope for cargo bikes, and electrically-assisted cargo bikes, to replace vans, particularly in congested and polluted urban areas.

The EU CycleLogistics Ahead project[1] defines four main types of bike design (either with or without electrical assistance) that can be used for goods transport, including:

- Conventional bike (with rider bag or panniers), typically able to transport up to 25kg
- Conventional bike with trailer, typically able to transport up to 70kg
- Two-wheeled cargo bike, including storage container, typically able to transport up to 80kg/0.5m^3
- Three or four wheeled cargo trike or quad, including storage container, typically able to transport up to 250kg/1.5m^3

In the UK, electrically-assisted cargo bikes can then be divided into those with a power output of less than 250W, that are subject to the same regulations as bicycles; and those with a power rating of more than 250W, which need a licence, insurance and safety equipment.

This is an area of rapid development and innovation, with a growing number of electrically-assisted bike models, together with a proliferation, and some moves towards standardisation, of containers, security options, track-and-trace systems and battery technologies. From a survey conducted in 2016[1], the European Cycle Logistics Federation reported that 66% of its members had started in the last seven years, and that, between 2015 and 2016, there had been a 30% growth in the number of staff working in cycle logistics companies. Grant schemes specifically for e-cargo bikes have dramatically proliferated since that time. In the last two years, schemes have been introduced in places including Vienna, Germany, Maastricht, The Hague, Oslo, Scotland and Paris, leading up to the recent grants programme announced by the Department for Transport.

Before exploring the literature available about the potential for (e-)cargo bikes, some background information on the general significance of freight traffic is given.

2. Background information about van traffic

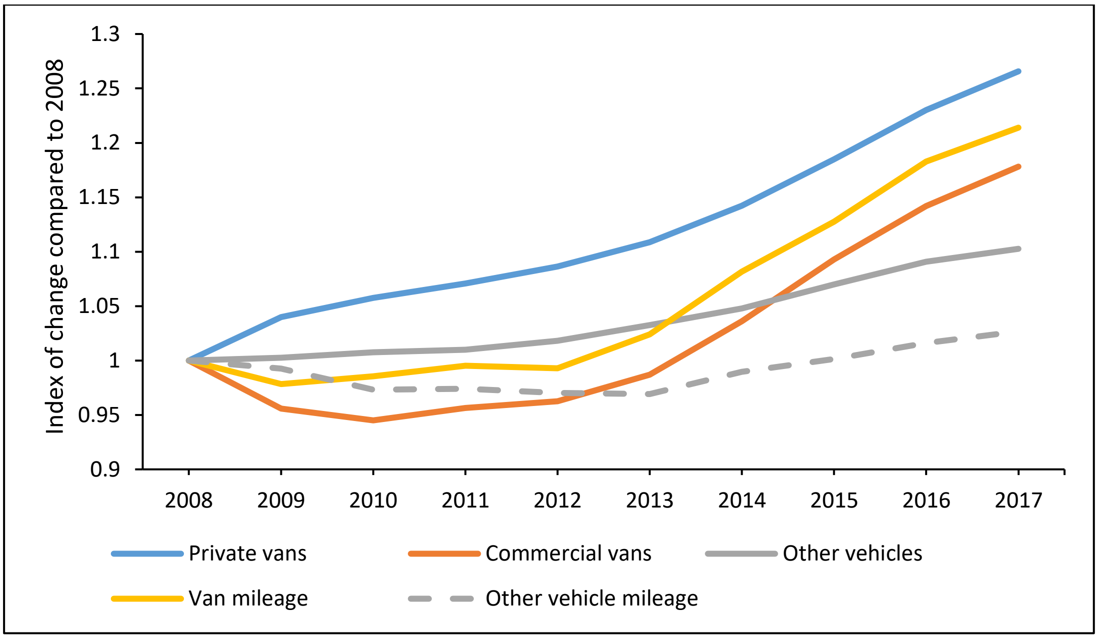
2.1 Van numbers and usage

According to Department for Transport vehicle statistics[2], in 2018, there were 4,009,887 licensed light goods vehicles in Great Britain (i.e. 4-wheeled vehicles of up to 3.5 tonnes constructed for carrying goods, referred to from here as 'vans'), of which about half were in company ownership[i]. Collectively, these accounted for about 10% of licensed vehicles. According to Department for Transport road traffic statistics[3], in

[i] Ownership status is based on whether the vehicle is registered to an individual, or to a company name. It is likely that many vans registered to individuals are still used for work purposes.

2017, vans accounted for about 15% of motor vehicle miles in Great Britain in both urban and rural areas (a total of 50.5 billion vehicle miles), and about a third of van mileage was on urban roads. Moreover, both van numbers and mileage are growing more rapidly than the growth of other vehicles, as shown in Figure 1. For example, in the last 10 years, van mileage has increased by 21%, whilst mileage by other types of vehicles has increased by only 3%. Indeed, the growth of van traffic is of sufficient concern that it was made the focus of a technical annex in the 2018 progress report from the Committee on Climate Change[4].

Figure 1: Changes in the number of vans and their mileage, compared with changes for all vehicles



Data taken from DfT tables VEH0102, VEH0402 and TRA0104

2.2 Environmental impacts of van traffic

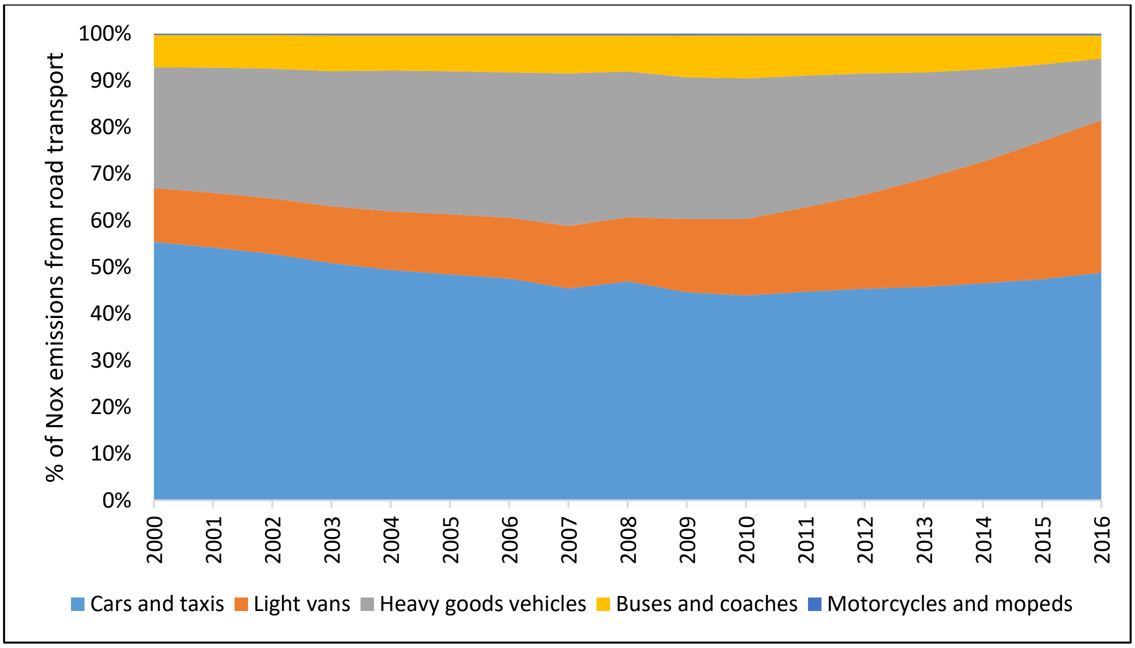
Per mile travelled, vans emit more carbon dioxide than cars. According to DBEIS[5], in 2018, average van emissions were 262gCO_2e/km compared to 140gCO_2e/km for a diesel car and 154gCO_2e/km for a petrol car. Collectively, van emissions accounted for 17% of greenhouse gas emissions from road transport (19MtCO_2e) in 2016[ii]. This implies average annual emissions of about 5 tonnes CO_2e per van. However, vans in company ownership typically travel nearly double the distance of those in private ownership[iii, 6], and vans used in the parcel and delivery sector travel particularly long distances. Braithwaite (2017)[7] estimates typical mileages for vans in the parcel and delivery sector of 25,000 miles per year, which, if producing average van emissions, would equate to 10.5 tonnes CO_2e p.a..

[ii] Data taken from Table ENV0201. In 2016, whilst cars accounted for 78% of mileage they only accounted for 62% of greenhouse gas emissions. For HGVs, the figures were 5% and 18% respectively (using data from ENV0201 and TRA0104).

[iii] The MOT dataset indicated an average mileage for LGVs of 8,043 for those in private ownership and 14,361 for those in company ownership in 2011 in GB (Cairns et al, 2017)..

In 2016[8], vans also accounted for 33% of NOx emissions from road transport for the UK, with absolute emissions increasing from 62ktonnes in 2010 to 98ktonnes in 2016, a period when absolute NOx emissions from all other road transport sectors fell. Figure 2 demonstrates their changing share.

Figure 2: Increasing contribution of vans to NOx road transport pollution



Data taken from DfT table ENV0301.

Calculations of their contribution to particulate pollution are more complex, given that 'tyre and brake wear' and 'road abrasion' are both listed separately as sources of these pollutants from road transport. Looking just at tailpipe emissions from road transport (i.e. excluding tyre and brake wear and road abrasion), vans accounted for 31% of particulates (both PM_{10} and $PM_{2.5}$) in 2016.

Meanwhile, congestion problems (caused by all vehicle types) are also getting worse. Between 2010 and 2015, average morning rush hour speeds on locally managed A-roads in England decreased by 5.6%[iv], with a further fall of 2.9% between 2015 and 2018 – implying a cumulative reduction of 8.3% over 8 years. Speeds on urban roads fell by 4.8% between 2015 and 2018.

2.3 FTA information on vans

The Freight Transport Association[9] states ***"growth in the activity of vans is contributing to traffic congestion. Levels of congestion on the network have a massive effect on the productivity of logistics***[v]*. In an analysis of traffic on every road*

[iv] Table CGN0205 indicates that 12 month average morning rush hour speeds on locally managed A-roads in England changed from 25.1mph for the year ending June 2010, to 23.7mph for the year ending June 2015. Following methodology changes, Table CGN0501 indicates that the same metric changed from 24.2mph for the year ending June 2015 to 23.5 for the year ending in June 2018 (July figure not available). For urban A-roads, the figure changed from 19mph to 18.1mph over the same period (probably for all day speeds rather than morning peak speeds, although the data source is unclear).

[v] Bolding of text in the quotations added for this report.

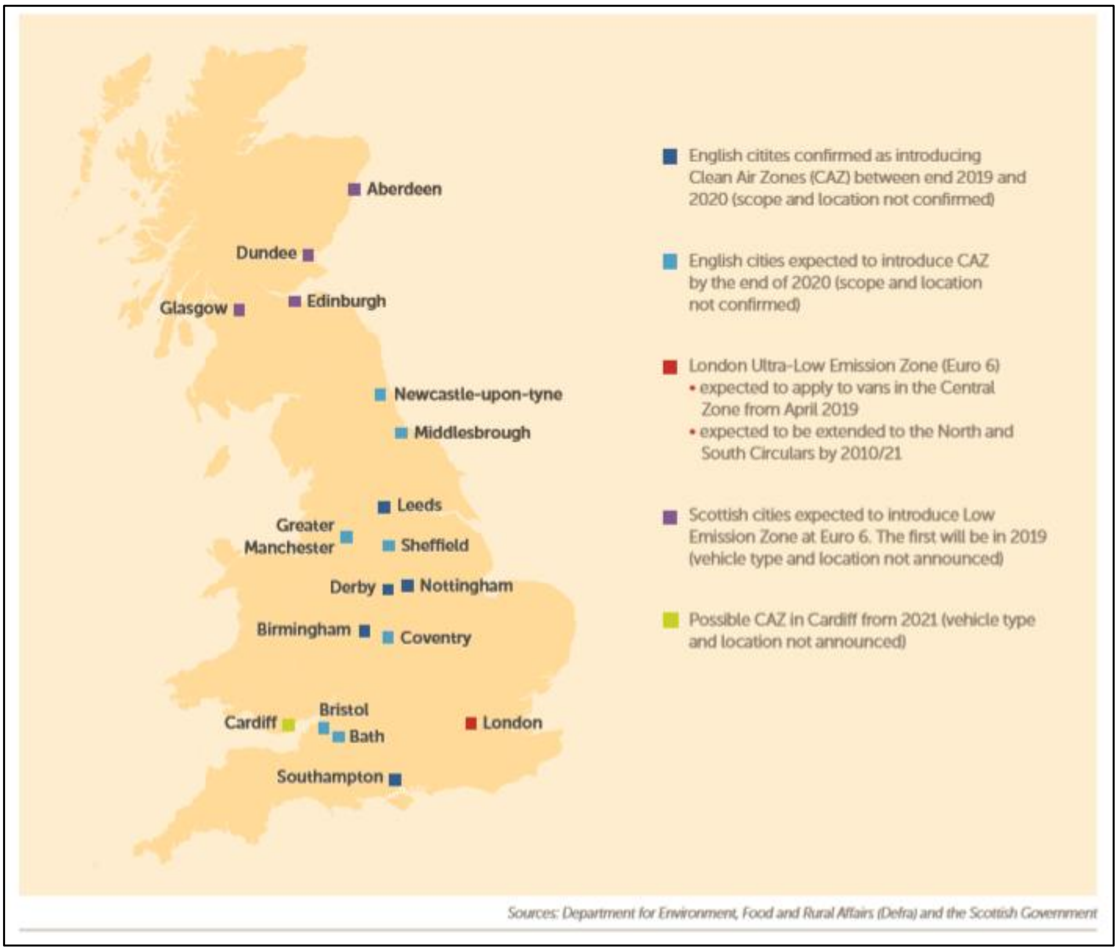
in 123 European cities, the data company Inrix found that the UK topped the list of the most traffic-congested EU cities. There were 20,300 so-called 'traffic hotspots' in UK cities – well over double the number in Germany and twice that in France." (p18)

It also highlights the importance of air pollution and potential issues for the use of vans as a result:

***"Cities in England and Wales will start levying prohibitively high charges on older HGVs and vans, for air quality reasons**, between early 2019 and the end of 2020. In Scotland non-compliant vehicles will be banned in designated areas starting in 2019. **Van users will need to plan procurement or other coping strategies now to ensure the business impact is minimised**, as where restrictions are introduced the engine emissions standard will be Euro 6." (p28)*

It provides the map given in Figure 3, implying that it envisages air quality concerns will lead to restrictions on van operations in 18 UK cities, including London, Cardiff, Edinburgh, Southampton, Bristol, Bath, Birmingham, Coventry, Derby, Nottingham, Sheffield, Greater Manchester, Leeds, Middlesbrough, Newcastle-upon-Tyne, Glasgow, Dundee and Aberdeen.

Figure 3: Anticipated access restrictions for vans due to air quality

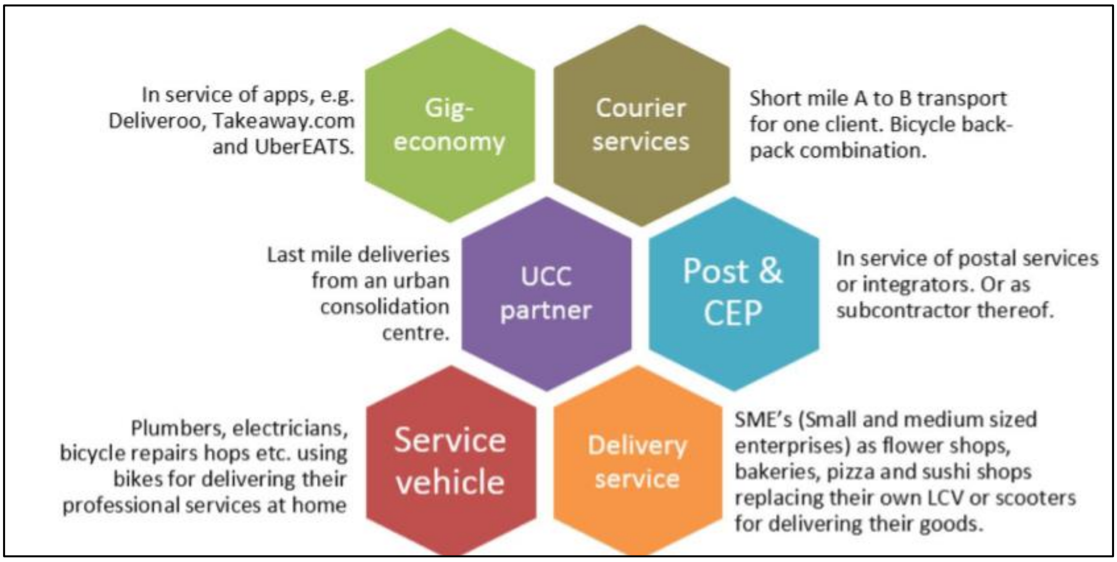


Source: Reproduced from FTA (2018), Van report 2017-18, 'Air quality access restrictions', p28[9].

3. How could (e-)cargo bikes contribute to van replacement and city logistics?

Maes (2018)[10] provides one typology of where (e-)cargo bikes could potentially replace vans, and other vehicles, and play a role in city logistics, as shown in Figure 4. This highlights the potential for both third-party cycle logistics companies, and for existing organisations choosing to use (e-)cargo bikes in preference to another vehicle.

Figure 4: Potential opportunities for using cycle logistics



Source: Reproduced from Maes (2018), slide 9[10].

Meanwhile, the European 'Cyclelogistics Ahead' project[1] focuses particularly on cycle logistics companies providing delivery services, and highlights that these can include:

- Food delivery (e.g. Deliveroo)
- Providing point-to-point operations (e.g. Big Blue Bike in Cardiff)
- Providing 'last mile delivery' for other companies (e.g. Outspoken Delivery in Cambridge[vi])
- Delivering mail (e.g. Yellow Jersey Delivery in Coventry)
- Bike-train-bike services (e.g. 5PL, UK)
- First mile (on-forwarding) services (e.g. Outspoken Delivery in Cambridge)

Throughout the literature, there is a general consensus that **cycle logistics are most suited to dense urban areas**, **with relatively high concentrations of suitable delivery work, or where individual trips are relatively short.**

The need for micro-consolidation centres has received particular attention. Whilst urban consolidation centres on the outskirts of towns and cities have been

[vi] Outspoken Delivery have now merged with Recharge Cargo to form Zedify, operating out of depots in London, Cambridge, Brighton, Norwich, Waltham Forest and Glasgow. http://www.argyllenvironmental.co.uk/blog/zedify-business-positively-impacting-air-quality

increasingly established as part of freight logistics over a relatively long period, it is argued that 'micro consolidation centres' (MCCs) are now required as additional transhipment points within dense urban areas, serving relatively small areas, which can enable larger freight vehicles to drop off consolidated loads in one go, at less congested times, whilst cycle logistics can then perform the last mile deliveries.

The main advantages of (e-)cargo bikes, compared with use of conventional vehicles, are seen as being that they are:

- **Less polluting**
- **Take up less road-space**
- **Can be parked more easily** (including, in many cases, on the pavements), and, often, closer to destinations than is possible with conventional vehicles. This is particularly relevant in urban areas where substantial parking restrictions are in place.
- May often be able to **take shorter routes** (given that they can use cycle lanes, bus lanes and potentially other areas where general vehicle traffic is restricted)
- May be able to **undertake activities more quickly and efficiently**, given the potential to take shorter routes, to be less affected by congestion, and to be parked more quickly and easily, closer to destinations.
- May **cost less**, given that vehicle purchase costs, vehicle repair and insurance are cheaper, and that drivers require less qualifications.
- Offer **health advantages** for their users

Some of these benefits are explicitly reported in relation to the case study evidence given in Section 6.

4. The potential scale of trip substitution by cycle logistics

4.1 Key findings

Two major European projects have assessed the scale of city van and car travel that could be suitable for transfer to (e-)cargo bikes. The first considered all motorised trips made in cities (including those made by cars and HGVs, as well as vans); the second focused on delivery van trips. The findings of the studies are described in sections 4.2 and 4.3 below.

In summary, the studies suggest perhaps 10-30% of trips made by delivery/service companies may have the potential to be replaced by (e-)cargo bikes[vii] [11].

If trips by delivery/service companies constitute 15-25% of all urban vehicle mileage (with the lower figure based on DfT estimates of van mileage in urban areas, and the upper figure based on estimated motorised delivery and service trips from the

[vii] These figures are also reasonably consistent with earlier estimates by Lenz and Riehle (2013). Their work involved a survey of 116 experts including 38 cycle freight companies, and reported that 25% of goods in cities and 50% of light goods might be transported by cycle freight. Their paper also reports on various other estimates, including a table taken from early CycleLogistics work suggesting 33% of urban goods transport could be replaced by cycle freight, and an estimate for German cities of 15% of city freight transport.

Cyclelogistics study described in section 4.2[viii]), then (e-)cargo bikes have the potential to replace perhaps 1.5-7.5% of all urban vehicle mileage, and a higher proportion of vehicle-related urban pollution.

There is considerable uncertainty in these estimates, but they do suggest that the potential benefit of (e-)cargo bikes in reducing carbon emissions and improving air quality in cities may be significant.

Recent, more specific work for Transport for London suggests that up to 14% of vans could be replaced by cycle freight by 2025 in areas where LGVs contribute to more than 60% of traffic – i.e. they may have a particular role to play in delivery hotspots[12].

Meanwhile, (e-)cargo bikes may also have a significant role to play in personal transportation. The CycleLogistics study found that a high proportion of personal motorised trips could potentially switch to (e-)cargo bikes, and a US study of 2,500 individuals buying cargo bikes found that the proportion listing bike or cargo bike as their 'primary' mode of travel increased from 29% to 79% after purchase, with substantial associated reductions in the numbers of car trips[13]. The Swedish company Voi, which provides public e-scooter sharing schemes, has recently announced that it will be adding e-bikes and e-cargo bikes to its e-scooter fleets[14].

4.2 CycleLogistics project

The CycleLogistics European project[15] estimated that about 25% of all motorised city trips were being undertaken by delivery and service companies.

This seems high, given the previous UK data indicating that only 15% of miles in urban areas are by vans. However, the difference may partly be related to the fact that larger cities have a higher proportion of trips by non-motorised modes and that trips by delivery and service companies can also be undertaken by cars or HGVs.

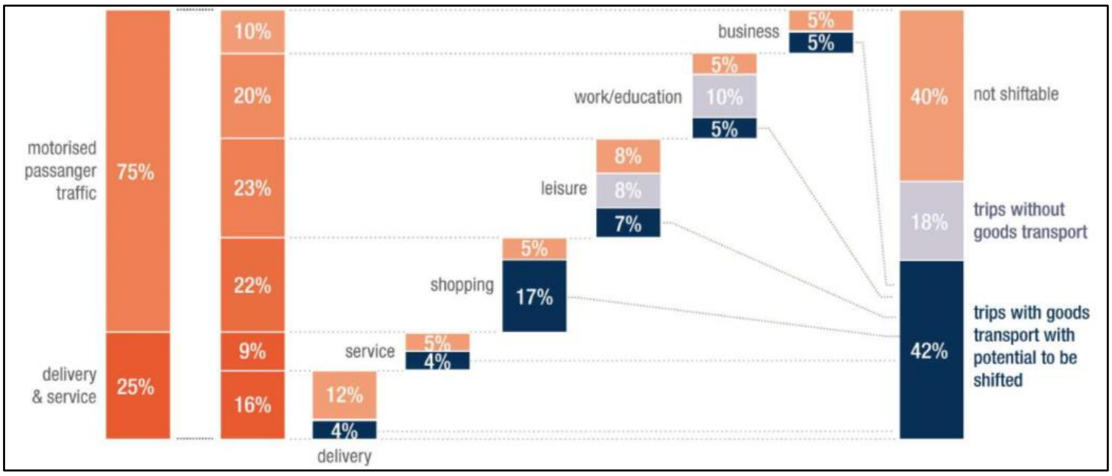
The same study identified 'goods-related trips that could shift to bike or e-bike' as being those that involved the transport of 'more than a handbag; less than 200kg'; up to 5km by bike or 7km by e-bike; and were not part of a complex chain requiring a car.

From various city surveys, they estimated that about 1 in 4 delivery trips could switch to some form of bike trip, together with 44% of service trips. Of personal motorised trips, 69% were potentially shiftable to bike or e-bike (including those both with and without goods transport). Taken together, the study estimated that about 51% of all motorised trips involving goods transport could shift to bike/e-bike.

The basis of these calculations is shown in Figure 5. This implies that, of city trips being undertaken by delivery and service companies, about 32% could shift to bikes or e-bikes.

[viii] This assumes that the share of trips represent the share of mileage, in the absence of any specific information with which to make adjustments. Note that the original source document, in places, includes the business trips given in Figure 5, within the 'company trips' segment. They have been excluded here, to ensure greater comparability with the other report, which seems unlikely to have included these.

Figure 5: Estimates of the potential of different trip types to shift to bikes or e-bikes



Source: Reproduced from p12, Figure D7.1 of the CycleLogistics baseline study[15].

4.3 LEFV-LOGIC project

The LEFV-LOGIC project[16], running 2016-18, estimated that 10-15% of delivery vehicle trips in a city are suitable for cost-effective deployment of light electric freight vehicles, including potential for use for trips for food, construction, services, non-food-retail and post/parcel deliveries. A breakdown of their estimate is shown in Figure 6. They also noted that the potential *"becomes higher when municipalities impose more space restrictions that limit the access of delivery vans".*

4.4 UK evidence

National data that can be compared to the European evidence is limited, although there is some. In particular:

- Data from the Freight Transport Association[9] (Table 2.2) which suggests 32% of vans in company ownership are used by the construction industry – which is reasonably similar to the 25% of vans reported in the LEFV-LOGIC report.
- Data from a van activity baseline survey undertaken by the DfT in 2008[17] indicated that the primary purpose of 21% of van use was to deliver/collect goods and 50% was to carry equipment, again highlighting the potential role of (e-) cargo bikes as service vehicles not just delivery vehicles.
- Work by Braithwaite (2017)[7] for the RAC Foundation estimated that deliveries of parcels and grocery orders account for about 10% of van traffic, again matching well with the LEFV-LOGIC estimate of the packages and post sector.
- Work for the Committee on Climate Change (2018)[4] estimated that on-line retail deliveries account for about 8% of van kilometres (although about 22% of the *increase* in van kilometres since 2000). Around 60% of the growth in van kilometres since 2000 is estimated to be attributable to growth in GDP and self-employment in sectors associated with high van use such as construction, transport, utilities, ICT, wholesale, retail and food (although no estimate for their total share is given).

Figure 6: LEFV-LOGIC estimates of the potential to replace van trips with light electric freight vehicles

Segment	Percentage of delivery vans in cities	Potential deploy-ment of LEFVs in cities	Potential	Potential for LEFVs of the total number of delivery van trips in cities
Food	25%	15%	• Smaller shipments, back orders, orders for additional items or return order corrections to hospitality and catering businesses • Local-for-local delivery (fresh) • Groceries home delivery (limited, considering the growth of the market and the resulting loading capacity)	4,5%
Service	25%	20%	• Conditional upon the adaptation of logistics concepts and clustering of journeys • Potential: independent entrepreneurs delivering witin limited geographical areas	4,0%
Con-struction	25%	10%	• Conditional upon the adaptation of logistics concepts • Back orders, orders for additional items or return order corrections	2,5%
Packages and post	10%	20%	• For extremely busy areas and in the vicinity of transshipment points • Just-in-time deliveries	2,0%
Retail non-food	5%	10%	• Deliveries come from large distances away and are often heavy or large • Little support among retailers for delivery via hubs and LEFVs • Potential: new local-for-local concepts (from store to customer at home)	0,3%
Private	10%	Outside the scope of this research		
Total	**100%**			**10 to 15%**

Source: Reproduced from p99 of Ploos van Amstel et al, 2018 op cit.[16]

Braithwaite's work provides a number of further insights into the UK parcel market. In particular, he reports that 2.7 billion parcels were delivered in the UK in 2016, forecast to increase to 3.5 billion by 2020. Over two-thirds (68%) of the parcels delivered in 2016 were from companies to individuals, (with 11% going to click and collect locations), implying an average of 60 parcels p.a. being delivered directly to each household[ix].

Braithwaite suggests that 80 parcels a day is a typical delivery load per van, albeit that Hermes couriers and Royal Mail postmen can be making as few as 20-80 parcel deliveries per day; whilst Amazon drivers are expected to deliver 150 parcels a day; and companies like Yodel and Interlink/DPD have a parcel target of 120-150 per van day.

Of the vans used for deliveries, Braithwaite's data suggests that 38% are owned by the post office; 15% are owned by Hermes, Amazon or Yodel; 21% are owned by 10 large delivery companies (such as DHL and TNT); 10% are owned by 8 grocery home delivery companies; whilst only 16% are operated by smaller companies[x]. He estimates that typical mileages are 20-30,000p.a. for parcel operators, and 25-50,000 for grocery home delivery companies.

5. The scale and nature of cycle logistics in Europe

The European Cycle Logistics Federation (ECLF) represents and supports the needs of cycle logistics companies across Europe. In 2016, 84 member companies responded to a survey about their activities[1]. Key findings were:

- Commercial cycle logistics companies were operating in 93 towns and cities across 17 European countries.
- Over 900 standard bikes, trailers, cargo bikes, cargo trikes and quads were in use.
- 66% of businesses had started in the last seven years.
- 48% of respondents were providing first/last mile delivery services for traditional logistics companies.
- 11% of respondents were being subsidised by local municipalities, authorities etc.
- Over 1,250 staff were employed (compared to 960 in the previous year).
- Over 16,000 items were being delivered per day (compared to 7,500 in the previous year) to over 10,000 locations.
- Reported turnover ranged from £10,000 to over £1 million p.a.
- 17% claimed to make a profit; 46% were only breaking even; and many 'preferred not to say'.

[ix] Figure calculated for this paper on the basis that in 2016, there were 27.1 million households in the UK, https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/families/bulletins/familiesandhouseholds/2016#average-household-size-remains-stable-over-the-decade-to-2016

[x] Figures calculated from Table 2.3, p13

Meanwhile, data are also available about DHL (presumably not an ECLF member). According to the European Pro-Ebike project[18], DHL were one of the first major logistics companies to incorporate cycles into their operating model, and at the time of reporting (c. 2015/16), had over 26,000 bikes, of which 9,000 were electric bikes or trikes. A 2017 press release from DHL[19] reported that they were using bicycles in more than 80 cities in 13 European countries, replacing up to 60% of inner-city vehicle routes with cargo bikes in some cases. John Pearson, CEO, DHL Express Europe was reported as saying: *"Bicycles offer a number of advantages in express delivery operations: they can bypass traffic congestion and make up to two times as many stops per hour than a delivery vehicle. The total cost of ownership over their lifetime is less than half of a van. And crucially, they generate zero emissions…"*

The Pro-E-Bike report also reported that, in 2015 or 16, the French La Post fleet included 20,000 e-bikes, with plans to expand to 30,000 by 2017.

The Pro-E-Bike project itself involved 40 businesses from 20 cities in 7 European countries, who tried out e-bikes (of various types) to assess whether they were a viable delivery choice. At the end of the project, the fleet of 79 trial bikes expanded to 267 bikes, as many of the businesses chose to continue using them and/or to invest in additional bikes.

Meanwhile, the decision by the UK Royal Mail company to phase out its 24,000 strong bike fleet, starting in 2009, and completed in 2014, contrasts with these stories, albeit that Royal Mail is now exploring the potential to reintroduce partially pedal-powered vehicles, given the benefits offered by new electrically-assisted designs.

6. Case study evidence on (e-)cargo bikes

The Annex to this report includes 16 case studies illustrating how (e)-cargo bikes could substitute for van travel (with or without new micro-consolidation centres) – including evidence from academic modelling case studies, real-world experiments, and operating businesses. These are summarised in Figure 7. The case studies provide a number of insights on the potential for (e-)cargo bike operations and impacts as discussed in the following sections.

Figure 7: Summary of case study evidence about the potential for (e-)cargo bikes, and associated impacts

Nature of evidence	Scale of activities/ substitution	Associated impacts
Micro-consolidation centres and cargo bikes		
Data from **Gnewt Cargo** (2015)[20] – a company using micro-hubs **in London** and electric vans to do the local part of the delivery for major parcel companies	Delivers 6-7,000 parcels a day, rising to 17-18,000 in the run up to Christmas. In Jan 2015, on average, vans delivered 125 parcels per day, making 60-80 stops, averaging 13.5km/day and 4mph. Stop time (i.e. the time between the motor stopping and being re-started) was 5.5 minutes. For one parcel company (Hermes), 35-50 diesel vans have been replaced with 8 7.5t trucks and 35 Gnewt vans.	1742km/day in the Hermes vans replaced by 335km in the trucks and 484km in the Gnewt vans. Diesel mileage reduced by 81%; fuel use reduced by 88%; distance travelled per parcel reduced by 52%.
DPD in **London** (2018/19) – a company using micro-hubs and all electric vehicles[21, 22, 23]	At the micro-depot, parcels are dropped by two 7.5 tonne electric lorries, and final deliveries are carried out by 10 electric vans and eight electrically-powered micro-vehicles (albeit not e-cargo bikes). Each micro-depot is capable of handling 2,000 parcels per day.	At the time of opening the first depot, an initial reduction of 45 tonnes CO_2 p.a. was expected.
DHL pilot of CityHub and Cubicycles **in Frankfurt and Utrecht** (2017) [19]	CityHub transports 4 containers to a central location, which are then each loaded onto a Cubicycle e-bike (which can carry 125kg, and averages 50km a day) for delivery of contents	Each hub anticipated to replace 2 conventional delivery vehicles, and save >16 tonnes CO_2 p.a.
UPS use of four micro-depots **in Hamburg** (c2016) [24]	70% of city centre covered; 500-600 parcels per swap body per day.	Use has expanded over time, from one depot in 2012, given their value, and the same model is being trialled in Dublin and Leuven.
DPD/GLS use of two micro-depots **in Nuremburg** (2016) [24]	Bikes capable of making 15 stops per hour; up to 100 stops per day, with 10 minutes to reload. Pilot phase involved switch from 10 trucks, to 5 bikes and 6 trucks. Possible shift to 8 bikes and 3 trucks.	Pilot phase (from November 2016) reported savings of "65kg NOx, 8kg PM_{10} and 56t CO_2". The pilot phase led to permanent operation in March 2017.

Nature of evidence	Scale of activities/ substitution	Associated impacts
Outspoken in Cambridge – introduction of a micro-depot for the science and business park (2017?)[1]	The site served comprised over 200 companies and 7000 staff. Over 3 months, 3,000 consignments were delivered to the micro-depot (from one company) and delivered in 330 cargo bike trips.	12 miles a day in cycling distance saved, compared to making deliveries from their main site on the other side of the city.
Berlin micro-depot (2018)[25]	In June 2018, Berlin opened a pilot micro-depot run by a neutral organisation, with dedicated facilities for 5 major parcel companies, supported by city and federal funding, with 800,000 people within a 5km radius.	
Simulation using data from **Portland** and tricycle delivery company **B-line** which uses a micro-depot in the city centre (2014) [26]	B-line averages 80 deliveries per day, done in 8-10 round trips. Two scenarios explored: Average customer requires 50lb of goods – requires 2:1 ratio of trikes to vans Deliveries needed in a four hour timeslot – requires a 1:1 ratio of trikes to vans	Relative costs of trikes vs vans influenced by small changes in operational parameters (e.g. average distance between depot and delivery points), indicating it should be possible to design viable cycle logistics offerings.
Simulation of potential to undertake deliveries to shops in central **Grenoble,** from consolidation centre 12km outside the city, (2017)[27]	127 of 183 shops required only parcel-load deliveries. More than 80% required delivery between 6-10am. Cargo bike capacity estimated as a tenth of a van. 3-4 micro-depots assumed to be introduced, leading to replacement of 3 vans with 1 truck and 6 cargo bikes. With 3, average trip length was 3.3km; with 4 it was 2.5km.	Motorised mileage reduced by about 55%. Deliveries by bikes were quicker, such that bikes could meet the time constraints, providing the truck started early enough, and there was sufficient storage space at the micro-depots.

Nature of evidence	Scale of activities/ substitution	Associated impacts
Simulation of **DHL** deliveries in **Berlin Wilmersdorf** (2018) [28]	In an area of about 70,000 people, DHL delivers 3,700 parcels a day, including 2,519 commercial parcels. The simulation considered the effect of delivering the commercial parcels to the 24 post offices in the area, with subsequent delivery by cargo bike between 12 and 18.00. In this scenario, 22 vans would be replaced by 13 vans and 32 cargo bikes, with the bikes making 121 tours carrying 21 parcels each.	The overall effect was estimated to be a cost reduction of 29%, an emissions reduction of 22% and a 58% reduction in the van operating time.
Cargo bikes without micro-consolidation centres		
Sainsburys working in partnership **with e-Cargobikes.com in London** (2018) [29]	Five e-cargo bikes located at the Streatham Common store, delivering up to 100 orders a day to local on-line customers	97% orders could be fulfilled by an individual bike. Route length, travel time and parking time all reduced.
Subsidy scheme in **Maastricht** (June 2017), with 4 companies swapping a van for a cargo bike (a mobile hairdressers, events agency, student services company and a coffee-roasting company)[16]	Average ride length was 3.9km and 1,211 journeys were made during a 6 month monitoring period.	Car/van routes were 20% longer than the cycle routes taken. 5,720 car/van kilometres and 1.15tonnes CO_2 was saved. Two organisations decided to permanently get rid of their van; another postponed buying a new car.

Nature of evidence	Scale of activities/ substitution	Associated impacts
Drings, a butcher in Greenwich, substituting a van for an e-cargo bike (2018)[30]	1:1 substitution, but 4 staff members needed to be trained to use the bike.	Over a trial period, 95% of local deliveries under 5km were made by the bike, travelling over 200km in total (whilst longer journeys were still done by van). CO_2 emitted fell by 75%, equating to a potential saving of 2,171kg p.a.. The bike was regularly faster, particularly during rush hour. There were also savings in fuel, and staff fitness benefits (with an additional 1,250kcals collectively burnt per week).
Eskuta[31], supplying electrically-assisted bikes to Dominoes and Just Eat	Eskuta report that restaurants buying the e-cargo bikes typically replace about half of their two-wheeled delivery fleet, in order to supply customers within 3km.	Recruitment of riders for e-cargo bikes was reported to be considerably easier than for mopeds/motorbikes.
Simulation of replacing freight trips with cargo bikes in part of **Porto** (Portugal) of roughly 2km^2 (2017) between 8.30 and 9.30am (2017)[32].	Estimated that 1:1 replacement of vans by bikes could take place, given loads.	Well-to-wheel CO_2 emissions estimated to reduce by up to 73%. Savings estimated to be 250kg (for 10% replacement) rising to 746kg CO_2 (for 100% replacement. Up to 10% replacement calculated to improve traffic speeds; higher levels calculated to reduce them.

6.1. Number of (e-)cargo bikes required to replace delivery vans

In some cases, (e-)cargo bikes may be able to provide a direct replacement for delivery vans. For example, in their work studying goods vehicles operating in the morning peak in Porto, Melo and Baptista estimate that (relatively low) loadings mean a 1:1 replacement could take place. In Maastricht, the four companies involved were able to directly substitute their vans for e-cargo bikes. Eskuta reports that restaurants buying their e-cargo bikes typically replace about half their fleet, and use them for deliveries within 3km.

In relation to the parcel sector, as already reported, Braithwaite (2017) estimates that typical van loading is 80 parcels per day (going up to as high as 150). E-cargo bikes are unlikely to be able to carry that number of parcels (with parcel loads of 10-20 more commonly reported), but may be able to deliver the same amount in a day by making multiple tours. This is partly because the mileage travelled by delivery vans in urban areas may be relatively low. Hence, Bogdanski (2017)[24] estimates that 1-3 cargo bikes are required to substitute for a courier/express parcel delivery van.

Figures for typical delivery loads, mileages, tours and substitution rates are as follows:

- Tricycle delivery company B-line in Portland uses a micro-depot within the city centre, and typically averages 80 deliveries per day, done in 8-10 round trips.
- Zhang et al (2018) estimate that for DHL deliveries in Berlin-Wilmersdorf, 22 vans, carrying 195 parcels each, could be replaced by 13 vans (delivering to post offices), with 32 cargo bikes providing final delivery, with the cargo bikes making 121 tours carrying 21 parcels each.
- DHL reports that each City Hub plus four Cubicycles replaces two conventional vans, and that their Cubicycle bikes were averaging 50km a day in Frankfurt and Utrecht in 2015.
- Work by Hofmann et al in relation to Grenoble assumes that the capacity of the cargo bikes is about a tenth of a conventional van; and their scenarios estimated that 3 vans might be replaced by 1 truck and 6 cargo bikes (with an average bike tour length of 2.5-3.3km).
- Outspoken in Cambridge reported delivering 3000 consignments in 330 bike trips over a three-month period, from a new micro-depot near the science and business park.
- Two micro-depots introduced in Nuremburg involved switching from 10 trucks, to 6 trucks and 5 bikes, with the potential to progress to 3 trucks and 8 bikes. The cargo bikes were reported to be making up to 100 stops per day.

Work by Sainsburys with e-Cargobikes.com involved a fleet of 5 bikes delivering up to 100 orders per day, with 97% orders deliverable with a single bike. Although not a company using e-cargo bikes, the experience of Gnewt Cargo is also relevant, given that they are a London-based company providing ‘last mile delivery’ from a number of micro-depots. In particular, their statistics suggest that use of (e-)cargo bikes should be viable in such a context, since their vehicles travel an average of 13.5km a day, averaging 125 parcels, 60-80 stops and an average driving speed of only 4mph.

Similarly, DPD's London figures provide some insight, as incoming parcels in two 7.5t trucks are then onwards delivered by 10 electric vans and 8 micro-vehicles.

Various other projects in London also provide some indication of the potential scale when local authorities start up dedicated cargo bikes services[33]. Waltham Forest has set up its 'ZED' scheme involving 6 cargo bikes and an electric van for deliveries in Walthamstow (utilising commercial space under its railway arches as a hub); Greenwich has provided funding for Recharge Cargo to operate 3 e-cargo bikes offering deliveries across a 4km area (and has also provided support for setting up a container as a micro-distribution depot); and the City of London has launched a cargo bike delivery scheme, providing 6 dedicated parking spaces in Smithfields market.

6.2 Impacts on mileage

One advantage of (e-)cargo bikes is that they may be able to undertake shorter, faster routes. Four of the case studies demonstrate this, specifically:

- In Maastricht, for the four companies swapping a e-cargo bike for a van, the car routes replaced were estimated to be 20% longer than the bike routes taken.
- In London, in Sainsbury's work with e-Cargobikes.com, delivery route lengths and times reduced.
- In London, the Drings trial showed that the cargo bike was typically quicker than the van, especially in rush hour, partly because the bike could take advantage of quieter routes with general traffic restrictions.
- In the Grenoble simulation, the cargo bikes were assumed to be able to use shorter routes.

Shorter delivery windows may also be achieved, given the ease of parking the cargo bikes. For example, in the Sainsburys work, shorter doorstep times were recorded.

Notably, Gnewt vans stop for an average of 5.5 minutes every stop, given the time needed to park and deliver, and parking is reported to be an issue. In contrast, for example, Bogdanski reports on 15 stops an hour for e-cargo bikes in Nuremburg (although the comparability of the two situations is unclear).

Where (e-)cargo bikes are a direct replacement for a van, the reduction in van travel will be 100%. Meanwhile, with the use of micro-consolidation centres, some van mileage is retained (or potentially replaced with mileage by larger vehicles). However, substantial potential reductions in motorised mileage are still reported as follows:

- From work in Grenoble, Hoffman et al estimate that a combination of micro-consolidation points and cargo bikes could reduce motorised mileage for delivery of goods to shops by 55%.
- For Hermes, one of the operators using Gnewt, 35-50 diesel vans have been replaced by 8 larger trucks travelling to and from a micro-hub (mostly very early morning), with mileage done in Hermes vehicles reduced by 81% and (surprisingly) fuel use reducing by 88% (presumably a bigger saving because the replacement travel is taking place in less congested conditions). The

distance travelled per parcel (including the onward transport by Gnewt vehicles) has reduced by 52%.

6.3 Impacts on emissions

The European 'Cyclelogistics Ahead' project[1] states that "*an electric van can carry 10 times as much payload as a cargo bike, but it weighs 60 times as much. As a result, e-vans require motors delivering more than 80 kW, when a cargo bike does the job with one fourth of a kW (plus a tenth of a kW from the rider).*"

Estimates or reports of reduced emissions from direct substitution of vans for e-cargo bikes include:

- An estimated reduction of up to 73% well-to-wheel CO_2 emissions for goods delivery in a 2km^2 area of Porto, with savings of up 746kg for the morning peak period[xi].
- Savings of 1.15tonnes CO_2 and 5720 car or van kms for four companies replacing vans with cargo bikes in Maastricht, for a six month period.
- A reduction of 75% CO_2 emissions for Drings, a butcher in Greenwich, as a result of using an e-cargo bike instead of a van whenever possible, equivalent to a potential annual saving of 2,171kg CO_2 p.a..
- Work for TfL indicating that replacing one 7.5 tonne HGV with cycle freight in central London could save 9.8 tonnes of CO_2 emissions and at least 7.4kg NO_X and 60g PM per year[12]. (This is reasonably close to our earlier calculation using Braithwaite's data, which suggests that a typical parcel delivery van will emit about 10.5tCO_2ep.a..)

Meanwhile, for companies replacing direct van deliveries with some form of consolidation and onwards deliveries, reported savings include:

- Simulation results suggesting a 22% emissions reduction and a 29% cost reduction from delivering DHL parcels to their nearest post-office in Berlin-Wilmersdorf for onward delivery by cargo bike
- 16 tonnes CO_2 p.a. from replacing 2 conventional DHL vans with a City Hub and four Cubicycles (based on work in Frankfurt and Utrecht)
- 65kg NOx, 8kg PM_{10} and 56tCO_2 during a four-month pilot phase of introducing two micro-depots, with onward delivery by cargo bike, in Nuremburg (used by DPD and GLS)

Lenz and Riehle (2013)[11] conducted a survey of 38 companies across Europe using cycle freight vehicles, and quote reported savings of 17tCO_2 from two years of operation by Ecopostale (a Belgium delivery company); 18.75kgCO_2 per day by Eco Green Company; 203tCO_2 delivering 1 million packages in 2008 by La Petit Reine (a delivery service operating Paris since 2001); and 3.2tCO_2 in 2 years by Recicleta (a waste paper collection service in Romania).

[xi] This is presumed to be an estimated daily saving for the morning peak hour – however, the original source is unclear.

6.4 Other impacts

Work on electrically-assisted bikes has shown that they require sufficient exertion to count as moderate or vigorous physical activity, and are therefore likely to provide health benefits for their riders (Simons et al 2009[34]. Gojanovic et al 2011[35], Langford et al 2017[36], Höchsmann et al 2018[37]). This is also likely to be the case for e-cargo bike riders, and several schemes anecdotally report that their riders value the exercise they get from their jobs. For example, in the Maastricht pilot, two participants explicitly reported that they felt fitter as a result of riding the bikes, and in the Drings trial, those involved were reported to collectively burn an additional 1,250kcals per week.

Where employees are enabled to use the bikes outside business hours for personal use, this may also start to impact on personal trips, for example for shopping.

(E-)cargo bikes are also reported to be relatively resilient to changing weather conditions. For example, Greenlink York reports that it has been operating every working day for nearly 20 years, in all weathers including floods and snow[31].

7. Support strategies for cycle logistics

The extent to which a city restricts or encourages general motorised traffic will play a key role in whether cycle logistics companies are likely to flourish. Meanwhile, there are also a number of specific options which may encourage greater use of such vehicles.

7.1 Funding options

The GB Bicycle Association estimates that two-wheeled (e-)cargo bikes typically cost £2-5,000, whilst heavier trikes with greater load-carrying capacity will typically cost £5-10,000[31].

The Department for Transport has announced a £2 million fund for the purchase of e-cargo bikes by organisations[38,39], which will contribute 20% of the purchase price of new e-cargo bikes (including VAT), up to a threshold of £1,000 per bike and £50,000 per organisation.

This follows on from an initiative in Scotland. Specifically, in June 2018, the Scottish Government's eBike Grant Fund made funding available for local authorities, public sector agencies, community organisations, colleges and universities for e-bike and e-cargo bike adoption, with 50% matched funding and a commitment to monitoring required. In October 2018, it was announced that £470,000 had been allocated to 19 projects, funding a total of 219 e-bikes, 6 e-cargo bikes, 8 e-trikes and 1 trailer[40]. In February 2019, a further £462,000 was allocated to 27 organisations, funding a total of 252 e-bikes and 6 e-cargo bikes[41]. A third round of funding is now available[42].

Other countries have already run successful subsidy programmes. Since 2014, the Croatian Fund for Environmental Protection and Energy Efficiency has supported the acquisition of electric vehicles by businesses and local authorities, covering 40-80% of the cost[18] For example, Hrvatska Pošta, the Croatian national postal service, invested in 180 electric bicycles, costing around €500,000, of which €150,000 was provided by the Fund. The use of the bicycles was expected to save 100 tonnes of CO_2 p.a., and to result in considerable fuel cost savings.

The German Federal Government offers a subsidy of up to 30% or a maximum value of €2,500 per bike, for cargo bikes with a payload (cargo and rider) of at least 150kg, and 1m³ capacity[43]. Sweden also has a successful electrically-assisted bike subsidy[44] (although it is unclear how many cargo bikes have been purchased through the scheme).

Meanwhile, subsidies may also be provided at city level – as has happened in Graz, contributing 50% of a purchase price of up to €1000[1818]; Munich, contributing 25%[18]; Paris, offering €600[45]; Oslo, offering up to 25%/10,000NOK[46]; and Berlin, offering subsidies of €500-1000[47] (announced at the 2018 ECLF conference).

Vienna has provided €300,000 for direct funding of 322 cargo bikes, including 15 community bikes, together with funding for marketing and to support the 2017 ECLF conference. The direct funding was for individuals or companies whose main residence was in Vienna, to a maximum of 50% of the purchase price, or €800 for cargo bikes, and €1000 for e-cargo bikes. Applicants received a sticker 'Funded by the City of Vienna' and had to include a photo of the bike with the sticker in the application documents (to be submitted within 3 months of purchase). 85% of bikes were for private use; 15% for commercial use[48].

The LEFV-LOGIC project[16] provides the following table of subsidies available for light electric freight vehicles in different parts of the Netherlands.

Figure 8: Examples of Dutch subsidy measures for light electric freight vehicles

Region	Conditions	Subsidy amount
Den Haag (The Hague) (2017)	The applicant must be based in The Hague and drive at least 3,000 kilometres per year with the vehicle.	€1,500
Utrecht (2016)	For the frequent business user, a minimum of 3,000 kilometres per year must be driven (for commuter traffic 2,000 kilometres).	€1,000
Zwolle-Kampen, Twente and Steden-driehoek (2017/2018)	• The entrepreneur must use the cargo bike (or bike courier) to replace trips taken by freight vans using fossil fuels or in connection with a growth in delivery. • Trip registration is required to demonstrate the reduction of the number of kilometres driven by vans.	€1,500
Maastricht (2017)	• Cargo bike must lead to a reduction of car kilometres during rush hour • Rides with the cargo bike are monitored for six months with a GPS logger	€4,000
Amsterdam (2016-2018)	• Delivery van (N1 category), or similar and with a loading capacity of at least 2m² / 2m³ • Driving 8,000 kilometres per year in Amsterdam • 3 times a week in Amsterdam	€5,000 + €5,500

Source: Reproduced from p119 of Ploos van Amstel et al, 2018[16]. Note that the Amsterdam subsidy is only for light electric vans.

As well as grant schemes, there are other ways in which the Government could provide support for purchase of (e-)cargo bikes. For example, it could ensure that business purchases of (e-)cargo bikes are explicitly identified as zero emission goods vehicles that are eligible for enhanced capital allowance[49] i.e. so that the entire cost of their purchase can be set against profits in the year of purchase.

It could also offer interest free loans, similar to the programme running in Scotland, for bike purchasing by business[50].

7.2 Creation of micro consolidation centres

The European 'Cyclelogistics Ahead' project[1] argues that *"Cities aiming at promoting cycle logistics models could secure space for micro-hubs in policy, planning and zoning strategies, identify and adapt some key public spaces for micro-consolidation purposes… as well as testing low-cost mobile micro-hubs and shared facilities in co-operation with cycle logistics companies".*

It argues sites may be available in small warehouses or former commercial premises (e.g. a former mechanics workshop); at retailers of packing, shipping, postal, printing and business services with backroom space; in car parks; at railway stations; or in shipping containers or other mobile depots. It also mentions the possibility of establishing more basic facilities at on-street automated parcel stations; in on-street loading bays allowing both van and cargo bike parking; and at kiosks or other convenience stores.

It notes that such centres require space for short-term storage and sorting of goods; freight-cycle entry/exit and secure parking; the parking and manoeuvring space required for a larger freight vehicle; loading and unloading facilities; and potentially office and rest space for riders. Braithwaite (2017) highlights potential advantages from combining such facilities with 'click and collect' points – a point also made in a recent paper by Arnold et al (2018)[51].

The previous case study section includes examples of micro-hubs being used in London, Cambridge, Frankfurt, Utrecht, Hamburg, Nuremburg and Berlin, including DHL's mobile City Hub; Outspoken's use of a container unit in Cambridge; Berlin's multi-operator micro-depot run by a neutral organisation; Gnewt Cargo and DPD's use of micro-hubs in London (in conjunction with onward electric vehicles, rather than cargo bikes); and various small-scale London local authority pilot hubs. In London, the Mayor of London and Transport for London are planning to make more land available for a network of micro-consolidation centres in key locations, as part of their Freight and Servicing Action Plan announced in March 2019[12]. (Other measures include making more parcel pick-up locations available across the transport network, and encouraging businesses to incentivise individuals to choose delivery slots that enable greater load consolidation.)

In relation to micro-consolidation centres, previous work on larger-scale freight consolidation centres is of particular relevance. For example, Allen et al (2012)[52] highlight both the potential to reduce vehicle mileage and emissions, but also that financial viability can be problematic, and initial public subsidy can often be important, to enable an adequate volume of trade to build up.

7.3 Creation of city-wide support organisations and services

The European 'Cyclelogistics Ahead' project[1] argues that it can be valuable to create a city-wide discussion forum for discussing issues relating to cycle logistics. Cambridgeshire County Council is cited as an example, where a range of stakeholders meet to discuss how cycling is currently used in their business context; the advantages, issues and challenges; and what could be done to incentivise the use of cargo bikes. The availability of repair services for e-cargo bikes can be an issue helpfully resolved at city level, since ensuring bike reliability is key to viable operations.

In Nantes, France, 'Les Boites à Vélo' has set up – a group of local businesses using cargo bikes, who provide each other with mutual support and help in relation to cargo bike use. This model has since been repeated in Grenoble and Paris[31].

7.4 Public procurement strategies encouraging use of cycle logistics companies for local authority services

The 'Guidelines for Green Public Procurement Criteria of the European Commission relating to Transport and Food & Catering Services' remind authorities of the option of having items delivered by cargo bike whenever possible.

When revising the 'Government buying standards for transport' procurement guidelines[53], Government could ensure that e-cargo bikes are explicitly cited as an option. There could also be a more pro-active strategy to encourage use of (e-)cargo bikes by councils and other public bodies.

Local Government Shared Services arrangements could also explicitly refer to cargo bikes.

7.5 Dedicated cargo bike parking and shared cargo bike schemes

Dedicated parking for (e-)cargo bikes, and shared (e-)cargo bike schemes, enabling companies to trial or rent bikes, may both help increase (e-)cargo bike take-up and use.

Cambridge has dedicated cargo bike parking within its cycle parking facilities at places like the train station, and was reported to be launching a shared cargo-bike scheme in April 2017 on a busy shopping street[1]. Sustrans operates a cargo bike library in Scotland[54], with four different bikes that companies can trial. Velogut, a German firm, loans out (e-)cargo bikes in Berlin, and is reported to have loaned them to over 150 companies since 2017[43].

Wrighton (2018)[48] reports on a system of 15 community cargo bikes in Vienna, available for hire for up to 24 hours with a €50 deposit and valid photo ID, funded by the city. The bikes are stationed at a range of host organisations (restaurants, neighbourhood organisations, bike shops, co-working spaces, mobility points etc.) who are responsible for their maintenance. Bikes are booked online.

7.6 (E-)cargo bike safety training and other safety measures

Safety is an important priority both for logistics providers and their customers. As discussed in the Annex, safety was one of the reasons given by the Royal Mail plc for phasing out their use of bikes. Many existing cycle logistics companies do train riders using either Bikeability guidance or bespoke training, but there is currently no national syllabus, accreditation or qualification specific to (e-)cargo-bikes. The development and national certification of such training could therefore help to allay such concerns, and assist cycle logistics companies in making their case to partners, customers and/or insurance companies.

Greater standardisation in a range of cargo bike characteristics relating to safety may also be helpful, as discussed in relation to a new ISO standard on the safety requirements for electrically-assisted pedal cycles[55]. CEN committee TC333 is also working towards developing a new European cargo bike structural and safety standard.

7.7 Improved urban environments for cycling

A variety of minor adjustments to street layout or infrastructure may facilitate (e-) cargo bikes, including ensuring cycle lanes are of adequate width (thereby also facilitating travel by peak commuter flows, riders with disabilities or people transporting children), removing obstacles such as inappropriately placed bollards or providing dropped kerbs where required.

7.8 Sharing of experience and best practice

Businesses, particularly SMEs, will typically see (e-)cargo bikes as a risk, with a lack of knowledge about the economics and other aspects of operating them, meaning that advice, guidance and encouragement may help take-up. For example, based on interviews with 10 cycle logistics companies across 5 UK cities, Schliwa et al (2015)[56] report that their potential customers often underestimated the ability of bikes to carry significant volumes or weight.

Rapid developments in vehicle design and performance mean that there is a role for the public sector in evaluating and disseminating information about newly emerging options – including information about any standardisation of containers, battery charging technology or track-and-trace systems. The EU-funded CityChanger-CargoBike programme[57] (which includes Cambridge) aims to encourage knowledge sharing about (e-)cargo bikes.

8. The potential benefits of setting up Sustainable Freight Demonstration Towns

To achieve the full benefits of a shift from vans to e-cargo bikes, a combination of measures will be required. The recent grants for e-cargo bikes announced by the Department for Transport should encourage take-up. However, these grants are likely to be too thinly spread across the country to result in major changes to mainstream logistics.

There could be great benefit in complementing the grant scheme with concentrated effort in a few places. The government could do this by setting up a Sustainable Freight Demonstration Towns programme in, say, 3-5 towns and cities. This could show how e-cargo bikes work and how much difference they can make when used on a large scale.

Sustainable Freight Demonstration Towns could:

- Trial micro-depots in urban areas, from which cycle logistics companies can operate, drawing on experience of cities like Berlin.
- Set up city-wide information sharing networks for (e-)cargo bike operators, and other shared services such as repair services.
- Provide dedicated parking for (e-)cargo bikes and shared (e-)cargo bike schemes.
- Encourage use of (e-)cargo bikes by the public sector and businesses.
- Improve cycle infrastructure, including ensuring cycle lanes are of adequate width (which would also benefit other cyclists).
- Restrict the use of conventional vans for deliveries in central areas.
- Provide additional support to individuals, who want to use (e-)cargo bikes for personal travel.

A demonstration programme would probably need to run for about five years to have maximum effect. It could go alongside a publicity programme which shared lessons with other interested towns and cities and with relevant organisations. It could have particular value in towns and cities that are in breach of air quality legislation.

ANNEX: Case Studies

CASE STUDY 1: Gnewt Cargo, London

Gnewt Cargo began operations in London in 2009, with a fleet of 8 cargo cycles and one van[56]. It now has a fleet of electric vehicles (mostly vans) and, in 2017, delivered over 3 million parcels[58]. It operates a number of micro-hubs which serve parcel operators (including Hermes, TNT and DX). Operators can drop off parcels in bulk at a time which avoids peak-time traffic and the congestion charge, which Gnewt then delivers in a series of local rounds.

In 2014, it received funding from the GLA to demonstrate and evaluate the role for micro-consolidation centres in central London[20]. The evaluation focused both on the benefits of opening an additional temporary hub, to cope with peak parcel demand at Christmas, and the impacts of Gnewt's usual operations. Although Gnewt's operation is almost entirely based on van deliveries, the evidence gathered is relevant to the viability of cycle logistics in a London setting.

During the 2014/15 evaluation period, Gnewt was typically delivering 6-7,000 parcels a day, rising by over 10,000, to 17-18,000 per day in the run up to Christmas. Parcels typically varied between 0.5 to 10kg, and averaged 0.03m^3. In January 2015, vans were typically doing relatively low mileages – 13.5km a day, averaging 125 parcels per day, 60-80 stops, only 50-100 metres between stops, an average driving speed of only 4mph, and an average of 5.5 minutes per stop (i.e. the time between the motor stopping and being restarted). Parking was noted as a particular issue.

Hermes data illustrates how operations have changed using Gnewt. They had previously had a fleet of 35-50 diesel vans driving into London from their depot to deliver parcels (depending on time of year). With Gnewt, this had been replaced by 8 7.5 tonne trucks driving between their depot and the Gnewt hub, for onward delivery by 35 Gnewt vans. Seven of these truck movements were made between 3 and 6.30am (and could potentially be consolidated into three larger vehicles at times other than the Christmas period). For April/May 2015, this had led to a reduction of 1724km/day in the Hermes vans, replaced by 335km in the Hermes trucks, plus onward travel of 484km in the Gnewt vans – a reduction of 81% for the Hermes van travel. Meanwhile, fuel use was reported to have gone from 431 litres to 50 litres, a reduction of 88% in fuel use - presumably a bigger reduction because the replacement travel was taking place in less congested conditions. The total distance travelled per parcel reduced by 52%. Savings were greater for the depots and time periods where stop densities were greater (due to more dense housing or higher levels of demand). The addition of an extra depot at Christmas time was estimated to have further reduced the van mileage required for deliveries.

CASE STUDY 2: Portland

Tipgornwong & Figliozzi (2014)[26] looked at the potential trade-off between vans and tricycles, using Portland as a case study, and data from an existing tricycle delivery company 'B-line'. The company uses a micro-depot within the city centre, and averages 80 deliveries per day, done in 8-10 round trips. Two scenarios were explored

– one where the average customer requires 50lb of goods (to represent food and office supplies) and the second where deliveries have to take place within a 4-hour timeslot (to represent morning courier services). The first required a 2:1 ratio of trikes to vans, whilst the second required a 1:1 ratio. In the former, van costs were estimated to be lower; in the latter, trike costs were estimated to be lower. The authors argue that small changes in the parameters of the scenario (e.g. average distance between the depot and the delivery points) significantly changed results – implying that creating the conditions for cycle logistics to thrive in dense urban areas should be possible. They also highlighted the synergies between promoting active travel and cycle logistics. One interesting assumption of the work is that the ownership of delivery vehicles is typically 12 years, whereas the ownership of freight tricycles is 5 years.

CASE STUDY 3: Grenoble

Hofmann et al (2017)[27] looked at the potential use of cargo bikes for goods delivery to shops in central Grenoble, France. Survey data were available for the logistic requirements of 183 shops, of which 127 were selected (excluding those with load units other than parcels, and pharmacies). More than 80% preferred delivery between 6 and 10am. It was assumed that all incoming goods were consolidated at an urban consolidation centre already established 12km north west of Grenoble. The capacity of the cargo bikes was assumed to be about a tenth of that of a conventional van. Two scenarios were explored – one involving four points for micro-consolidation, to be served by a bigger truck; and one involving three. Three vans were replaced by one truck and 6 cargo bikes. In both scenarios, the total motorised mileage for the delivery of goods to shops reduced by about 55%. In the first scenario, the maximum cargo bike tour length was 2.5km; in the second, it was 3.3km. The delivery time required by the cargo bikes was estimated to be lower than that required by the vans, given their ability to use shorter routes, and their proximity to transfer points, and this meant that time constraints could be met by the cargo bikes, provided that the truck started early enough, and there was sufficient storage space at the transfer points.

CASE STUDY 4: Porto

Melo & Baptista (2017)[32] assessed the potential to replace freight trips by cargo bikes in an area of 12-30 blocks in Porto, Portugal (a maximum linear distance of about 2km, 26km of road network), using a traffic model. Based on trips simulated through and within the area, the potential for replacing diesel van trips carrying goods, with a maximum distance of 2km, taking place between 8.30 and 9.30am, was explored. (The processes needed for transferring goods between vans and bikes was reported to be outside the scope of the paper.) A replacement rate of 1:1 van:bike was assumed, based on data about the actual size of delivery loads. The simulations suggested replacing up to 10% of freight movements by cargo bikes would reduce delays for all vehicles; higher proportions would reduce vehicle speeds. Large savings in energy consumption and well-to-wheel CO_2 emissions could result – estimated to be about 73% CO_2 emissions, ranging from about 250kg CO_2 in a 10% replacement scenario to

746kg CO_2[xii] in a 100% replacement scenario (excluding the effects of increased or reduced CO_2 emissions by other vehicles if speeds change).

CASE STUDY 5: Berlin-Wilmersdorf

Zhang et al (2018)[28] report on an assessment of DHL deliveries in Berlin-Wilmersdorf, an area of 68,925 inhabitants, 1,629 commercial clients, a distribution centre, 24 post offices and 6 'packstation' lockerbanks. DHL delivers approximately 3,700 parcels a day in this area, including 1,188 private parcels and 2,519 commercial parcels.

In their first evaluation, they hypothesized that all the commercial parcels were delivered to the nearest post office, and then delivered by cargo bike (with the bike delivery to take place between 12.00 and 18.00). The result was to replace 22 vans, (each making 22 tours carrying 195 parcels) with 13 vans and 32 cargo bikes, with the vans still making 20 tours, but the cargo bikes also making 121 tours carrying 21 parcels each[xiii]. The overall effect was a cost reduction of about 29%, and an emissions reduction of 22%, with a 58% reduction in the operating time of the vans.

CASE STUDY 6: Maastricht

The LEFV-LOGIC project[16] reports on data from a grant scheme in Maastricht, launched in June 2017, in conjunction with the closure of a major road bridge, to encourage companies to exchange their delivery van for a cargo bike. Conditions of the grant were that participants would be monitored with a GPS logger for 6 months, keep a logbook for 2 weeks, and participate in two telephone interviews. Four organisations took up the offer – a mobile hairdressers; an events agency; a student services company and a coffee roasting company. The four participants' average ride length was 3.9km. During the monitoring period, they made 1,211 journeys and cycled 4,753km. 5,720 car/van kilometres and 1.15tonnes CO_2 were avoided, as, on average, car routes were 20% longer than the cycle routes. Two of the organisations decided to get rid of their delivery van as a result of the trial; one of the others has postponed buying a new car. Two of the participants also reported that they enjoyed using the e-cargo bikes, and felt fitter as a result.

CASE STUDY 7: Outspoken in Cambridge

Outspoken (now Zedify) is a cycle courier service based in Cambridge[1]. As well as their main depot to the south of the city, they located a 20ft container by the roadside in the north of the city, to act as a micro-consolidation centre for the science and business park (a site with 200 companies, and over 7,000 staff). One of the major logistics companies that they work with then dropped off loads to the container in the morning, for delivery by a cargo-bike (stored in the container overnight). Over a three-month period, 3,000 consignments were delivered to the container, and were subsequently delivered in about 330 cargo bike trips. It was estimated that use of the container saved 12 miles a day in cycling distance, compared to cycling the goods from the southern depot.

[xii] The implication is that this is the saving for the area for one morning peak hour.

[xiii] The time period of the scenario is unclear since it suggests total deliveries of over 80,000 parcels.

CASE STUDY 8: J Sainsbury in London

Earlier in 2018, Sainsburys took part in a trial to use electric cargo bikes to deliver groceries, in partnership with e-Cargobikes.com[29]. Five e-cargo bikes were located at the Streatham Common store, delivering up to 100 orders a day to local customers who ordered online. In the trial, 97% of orders could be fulfilled in a single e-cargo bike drop. In addition, there was a reduction in delivery route length and time (given the ability of the cargo bikes to use bike and bus lanes), and shorter doorstep times, due to relative ease of parking the cargo bikes.

CASE STUDY 9: Drings in Greenwich

Drings, a butcher in Greenwich, undertook a trial in 2018, in collaboration with Sustrans, the Royal Borough of Greenwich and Imperial College London, involving substituting a van for an e-cargo bike. It was funded through the Mayor of London's Air Quality Fund[30]. During the trial, 95% of local deliveries under 5km were made by the e-cargo bike, travelling over 200km in total (whilst longer journeys were still done by van). CO_2 emitted fell by an estimated 75%, equating to a potential annual saving of 2,171kg. When comparing like-for-like journeys, the e-cargo bike regularly came out as faster and more economical, especially during peak rush hour, partly because it could take advantage of routes where general motor traffic was restricted. During the trial, the butcher saved money on fuel equivalent to £829 for a year. Based on a two-week before and during comparison, employees were reported to have collectively burned an additional 2,500kcals (equivalent to 1,250kcals per week). Sustrans is now calling for the Government to deliver additional demonstration projects and build the evidence to show businesses the benefits and competitiveness of cargo bikes.

CASE STUDY 10: DHL City Hub and Cubicycles

In early 2017, DHL Express began piloting the 'City Hub' – a customised trailer capable of carrying up to 4 standardised containers for the DHL Cubicycle (an e-cargo bike capable of carrying a load of up to 125kg, introduced in 2015, typically averaging 50km a day)[19]. Pilot work began in Frankfurt and Utrecht. A van delivers the City Hub to a central location, then allowing last mile delivery by the Cubicycles. The press release reported that each City Hub replaces up to two standard delivery vehicles, saving over 16 tonnes of CO_2 p.a., together with a reduction in other emissions, and that 14 Cubicycles were being used in 7 cities at the time of the press release.

CASE STUDY 11: UPS in Hamburg

UPS[24] makes use of four mobile micro-depots in Hamburg, covering 70% of the city centre, with a capacity of 500-600 parcels per swap body per day. Operations started with one depot in 2012, and have expanded over time. They now also use a similar model in Dublin and Leuven[59].

CASE STUDY 12: Nuremburg

Two micro-depots in Nuremburg, used by DPD and GLS, were piloted in November 2016, leading to permanent operation in March 2017[24]. The pilot phase involved 5 bikes and 6 trucks, and was reported to save 65kg NO_x, 8kg of PM_{10} and 56kg CO_2e. The cargo bikes proved capable of undertaking approximately 15 stops per hour, and up to 100 stops per day, with 10 minutes required to reload bikes.

CASE STUDY 13: KoMoDo, Berlin

In June 2018, a central transhipment centre opened in Berlin, with 800,000 residents within a 5km radius[25]. Five major parcel delivery companies – DHL, Hermes, DPD, UPS and LGS – all have a 14m³ container enabling them to transfer loads, which are then transported by cycle logistics companies. The site is managed by a neutral company, BEHALA. €400,000 in funding was provided by the Federal Government under the National Climate Initiative, together with support from the City. The project is being evaluated with plans to roll it out to other German cities if successful.

CASE STUDY 14: Eskuta

Eskuta provide electrically-assisted pedal bikes styled to look like petrol scooters or mopeds[31]. Last year, they supplied over 500 to restaurants for food delivery, including Dominoes and Just Eat. Eskuta report that the restaurants buying bikes typically replace about half of their powered two-wheeler fleet, for deliveries within about 3km (whilst further deliveries are done by mopeds or cars). Advantages include less noise than mopeds; savings in purchase, fuel, insurance and maintenance costs; the capacity to store the vehicles inside and ease of recruiting riders. One business reported that advertising for people qualified to ride a moped or motorcycle only led to two applications, whilst advertising for e-cargo bike riders led to 80.

CASE STUDY 15: Royal Mail plc

Until recently, the main UK mail and postal services provider (now Royal Mail plc), with a universal service obligation (USO) to deliver to any address in the country six days a week, operated one of the largest bicycle fleets in the world. Peace (2010) reports that Royal Mail owned 24,000 bikes in 2010[60].

However, in 2009, it announced that it was reducing its use of bicycles, in favour of more use of vans and trolleys. Tests were reported in Cambridge, Plymouth, Durham and Lincoln, involving up to 3 postmen driving a van to a particular area, delivering around that area (sometimes using trolleys to carry mail/parcels) and then moving on to the next area[61]. In 2014, the decision was made to phase out bikes entirely[62]. According to Braithwaite (2017)[7], Royal Mail now owns 38% of all vans used for parcel delivery in the UK (including vans used food shopping).

Reasons given for the change included:

- Efficiency gains
- Concern that the increasing volume and weight of parcels (as compared to letters), which has substantially changed the nature of mail deliveries, was making bikes more unstable[63], and that trolleys would be better able to take the loads, and would ensure that the mail was stored securely whilst individual items were delivered[64].

- Concern that cycling was unsafe. A letter from Royal Mail Chief Executive Adam Crozier to Lord Berkeley was quoted in the House of Lords on 29th March 2010, saying: "*These bicycles pose the wider safety risk associated with busy street networks, where the rider is exposed to greater risk than other vehicle users… We expect to see a reduction in the number of delivery accidents as a result of our rollout of the new delivery technology, as a substantial proportion of accidents are linked to the use of bicycles on busy road networks.*" [60xiv].
- Concern that trikes would be unable to handle hilly terrain. The letter described above also stated: "*Royal Mail has previously assessed the viability of manual freight tricycles and concluded that they would be inappropriate for the type and range of deliveries our people make… The use of freight tricycles is problematic unless terrain is extremely flat, which is why they are commonly used by Dutch and Danish postal operators… Of course, the UK consists of far more variable terrain over which our postmen and women must deliver, making the use of manual freight tricycles impractical.*" [65]

There is no indication that opposition to using bikes was coming from frontline staff. Indeed, in 2009, in reaction to the proposals, BikeRadar[60] reports on an unofficial strike in Lincoln. Cycling Charity CTC ran a campaign called 'Keep Posties Cycling'[66], which included letters of support for keeping bikes from a number of postmen and women[67], and old post-office bikes are sufficiently desirable that people are able to buy reconditioned versions (also resulting in bike donation to Malawi)[68].

Since that time, there has been rapid innovation in vehicle design. Consequently, Royal Mail is now trialling eight e-trikes in Stratford (East London), Cambridge and Sutton Coldfield, for six months. The trikes are powered by a battery-operated motor, which is recharged both by mains power and solar panels on the trike[69] and they are able to carry a considerable volume of letters and parcels.

CASE STUDY 16: DPD in London

In October 2018, delivery company DPD opened a micro-depot in Westminster, on TfL land, serving a two-square mile delivery radius and capable of handling 2,000 parcels a day. Incoming parcels are dropped by two 7.5 tonne electric lorries, and final deliveries are carried out by a fleet of 10 electric vans and eight electrically-powered micro-vehicles. DPD invested £500,000 in the site, including extensive charging infrastructure. Since that time, a second site has opened in Shoreditch, and a third has been agreed in Park Lane. DPD's activity was featured as part of the Mayor of London and Transport for London's 'Freight and Servicing Action Plan'. Whilst the micro vehicles are not e-cargo bikes, the activity does show the potential for micro-depots. At the time of opening the Westminster depot, DPD reported that they were expecting to achieve an initial reduction of 45 tonnes of CO_2 per annum[21, 22, 23].

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