# Agile Gnewt Cargo: parcels deliveries with electric vehicles in Central London

## Multi-carrier central London micro-consolidation and final delivery via low carbon vehicles

**Data Report**

**Co-authors: Sam Clarke and Dr Jacques Leonardi**

MAYOR OF LONDON

# COPYRIGHT

**Greater London Authority**

**28 April 2017**

Published by

Greater London Authority

City Hall

The Queen's Walk

More London

London SE1 2AA

**www.london.gov.uk**

enquiries 020 7983 4100

minicom 020 7983 4458

ISBN



Copies of this report are available from www.london.gov.uk

# Content

# Tables

# Figures

# 1. Executive summary

This Data Report details the results and the demonstration data obtained during the business years before the project started, and during the GLA Agile 1 Gnewt Cargo project duration. Data records started from August 2014 and ended in May 2015. This report provides results and evaluates the trial performance against KPI's and project targets. It includes details on baseline, on monitoring methodology, assumptions made and provides data references. It presents a series of Tables, which form the basis for further analysis and explanations in the Final Report on "Parcels deliveries with electric vehicles in Central London".

The data gives evidence of a substantial reduction in traffic and externalities, in line with most of the targets foreseen at the inception of the demonstration project. Notably reductions of -52% total distance, -74% main axis distance, -65% in empty running distance, -88% of $CO_2$ and -81% in pollutants emissions was achieved with the business solution. The Agile 1 Data Report is presenting the data available at the end of the Agile 1 demonstration project. Some data on the situation prior to the trials is also presented.

A first period of data collection started with the beginning of the project and the opening of the new depot in Wardens Grove, in August 2014, and ended in January 2015 with a week of sample observations.

The full and finalised set of data collected and monitored was recorded at the end of April/early May 2015. As of 14 May 2015, the data collection and monitoring activities of the Agile Gnewt project operations were completed on all the case studies and generic studies.

3 chapters with a rather similar structure are presented below in Section 2 (baseline) Section 3 (Aug-Dec 2014) and Section 4 (Jan-May 2015).

Apart from the baseline study, which is setting the scene, this report consists mainly of data. Explanations and full analysis is available in the Final Report. In many case, definitions are given in summary form, without justifying the need for these data, which is presented in the Final Report.

In this Data Report, the main results demonstrate that the key performance indicators were

- a $CO_2$ emission reduction per parcel of 88%, compared to the situation before
- a distance reduction per parcel of over 52%,
- a pollutant (PM10) reduction of 81%
- a reduction in empty distance of 74%

and that the business was profitable and sustainable, lowering the overall costs for the private enterprise and the public external costs.

# 2. Introduction

The aim of the Data Report is to present the data collected at Gnewt Cargo. The data collection was performed before, and during the lifetime of the project Agile Gnewt Cargo 1, funded by GLA, and dealing with single carrier deliveries in Central London.

Original data records are presented in this report. When original data is presented, they are labelled as “raw” data or “un-processed” data.

This report presents also “Impact” data. This data is processed and the result of calculations and assumptions. All calculation and assumptions are explained in this Data Report.

This report focuses its explanations mainly to the origin of the data and it also explains the impacts and does provide some comments on the results. It also explains what we could potentially do with this data. But these explanation are fairly limited, as it does not explain in detail the trials and Case Studies.

All the in-depth analysis and presentation of the Case Studies and results, which were obtained through the usage of all this data collected, are presented in another report: the Final Report of the Gnewt Cargo Agile 1 project. Both documents can be considered independently, or together, depending on the purpose of the analysis.

The different sections of this Data Report of the Gnewt Cargo Agile 1 project correspond to different data collection, answering different questions.

The first data collection (Section 3) is allowing to be setting the scene by showing how an individual small business like Gnewt Cargo can start-up electric road freight transport activities and be demonstrating a beneficial impact already at the starting stage. The data collection presented in this first part of the report are aiming at presenting what type of business Gnewt Cargo represents, what is the baseline and what are the points presenting potential for future growth. This data is a mix of original, un-processed “raw” business data and processed impact data obtained through calculations. For details and fundamental explanations on the methods of data collection used in this project, see Leonardi et al 2012.

The beginning phase of the business was crucial to understand what effects the changes in types of clients and activities have produced from the point of view of London freight transport as a whole, and how beneficial for both business and public sector the creation and running of this type of freight company such as Gnewt Cargo really is.

The second data collection (Section 4) is presenting the “After” data obtained during the period August to December 2014, the peak Christmas demand time for logistics business.

It is necessary to show the annual fluctuation on the logistics market, and how this impacted the performance of Gnewt Cargo.

The third data collection (Section 5) is presenting the Before-After data obtained during the period January to May 2015, with a much quieter transport demand and less vehicle use.

All raw data obtained throughout the lifetime of the project are presented in this report.

Definitions and explanations of the data are given continuously throughout the report.

Due to the vast amount of data collected and explained, it was only possible to give rudimentary background information necessary to fully understand the details of the logistics business and its implications for London traffic, environment and economy.

# 3. Baseline with Before – After Monitoring Data of Agile Gnewt Cargo in the Years 2009 and 2010

## 3.1 Introduction

In the years 2009 and 2010, a comprehensive logistics data collection and survey was conducted before and after the start of Gnewt Cargo operations for the retail company Office Depot. Gnewt Cargo, at that time, was using Cargocycles and electric vans in urban freight deliveries in the City of London.

Gnewt Cargo was using electrically assisted tricycles called Cargocycles, constructed by the company La Petite Reine, and battery electric vans of small size. The two logistics systems “before and after” the introduction of the clean vehicle fleet were compared.

The Cargocycles and the battery-electric vans are replacing a large part of the delivery service previously performed by a diesel van fleet. The use of the clean vehicles required the introduction of a new consolidation centre close to the City of London, where the goods to be delivered are dropped off by truck for final delivery by the Cargocycles and the electric vans., The transport service remains identical from the point of view of the clients (in terms of delivery timings, frequency of delivery etc.).

In this Section 3, the impacts of the fleet replacement are assessed from the point of view of urban logistics. With the use of the clean vehicles, the load factor of the vehicle fleet has increased, the weight and volume transported per vehicle per day has decreased, the time taken to make all the deliveries has increased, the fuel use and the distance have been reduced, and the road and parking space occupancy has been reduced in terms of length and time of the vehicles parking during deliveries. The results provide evidence of the impacts of the trial on key economic, environmental and traffic issues. Operation of the trial and scope for extension are sensitive to the number of parcels (freight demand per day), the number of rounds per day, the size and weight of the average parcels, the kind of business and the type of product delivered.

**Context and objectives**

This Section I presents the results of a before and after evaluation of replacing urban freight deliveries using diesel vehicles with the use of electrically assisted “tricycles” and battery-electric vans. The trial was operated by Gnewt Cargo as logistics provider that was delivering a portion of Office Depot deliveries made to customers in zones EC 1 - 4 in the City of London.

The situation before the start of the trial (referred to as ‘before’ in this study) has been surveyed, and the situation after the introduction of the trial (referred to as ‘after’ in this study) has been surveyed, and analysed.

**Context**: The Gnewt Cargo Cargocycle freight trial was the first of its kind in the UK, with the exception of some smaller inconsequential pilots (TfL, 2009). Bicycle freight providers are in operation internationally, the most notable example being

La Petite Reine in France, the company which was supplying Gnewt Cargo with the Cargocycle vehicles (Mazingue, 2009).

**Objectives**: To evaluate the existing Office Depot deliveries to postcodes EC 1 - 4 using diesel vans and to compare this with the new Gnewt Cargo logistics system implemented using Cargocycles for final delivery. This Section 3 provides the results of this study.

**Trial Overview:** The starting point of the study was the decision by Office Depot[1] (OD) to test a new urban delivery system and of Gnewt Cargo to start its operations. Before the trial, OD operated the following distribution system in the City of London:

- A warehouse in an industrial area in the suburbs of London.
- Diesel-powered vans to make deliveries from the warehouse to customers in the delivery area (using own account vehicles and subcontractors).

At time of business start, end of 2009, Gnewt Cargo was a new start-up company specialising in urban freight deliveries using Cargocycles and electric vans operated from a micro-consolidation centre on the edge of the delivery area.

The Camden Clear Zone report on air quality of 2005 states that the impacts of using battery electric vehicle in City centre of London would lead to a nearly zero emission level for pollutants and for greenhouse gases, and to a far lower noise level (Clear Zone 2005). Since the purpose of the impact evaluation is to assess the logistics impacts and fuel use as only environmental indicator, the positive statements on noise, air quality and vehicle Life Cycle made in the Clear Zone study are assumed to be valid for the case observed.

Chapter 3.2 presents the survey method, Chapter 3.3 shows the results for the 'Before' situation, and Chapter 3.4 and 3.5 presents the results on the 'After' situation during the trial, first focusing on the logistics changes (Chapter 3.4) then on the impacts (Chapter 3.5 and 3.6). Chapter 3.7 summarises the situation in May 2010, a later stage of the trial, when the diesel van fleet delivering to The City of London have been fully replaced by Cargocycles and electric vans.

[1] Office Depot provides stationery products to businesses - products are ordered from Office Depot and delivery is made direct to the business address.

## 3.2 Urban freight survey method and before-after evaluation

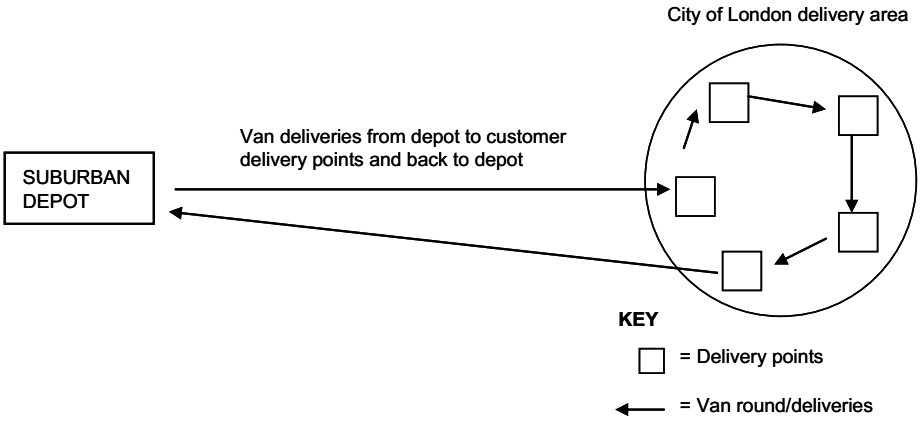
**Survey methods and data collection**

The operators before the trial were performing a daily delivery multi-drop round from the Office Depot warehouse in Heathrow to the delivery area in the City of London using diesel vans. This situation, where the depot is located in the suburbs and the deliveries are made in the city centre, is typical for deliveries in London. The term “round” has been used to refer to an urban freight delivery operation, in which the vehicle makes several deliveries and collections to and from customers in the course of its travel, necessitating several stops. During the trial, due to the total distance limitations of the Cargocycles, it was necessary for a truck to supply goods from the warehouse to the consolidation centre in the customer delivery area from which Cargocycle deliveries were made. This journey from the warehouse to the consolidation centre[2] has been referred to as the "truck trip". The characteristics of the logistics systems before and after the introduction of the trial are shown in Figures 1 and 2.

The logistics scheme before the introduction of the trial was studied by a survey in which a researcher accompanied the driver of Office Depot on a typical round in order to collect the necessary operational vehicle round data. Chapter 2.3 presents the results of this 'before' survey. Chapter 2.3 contains both a qualitative and quantitative assessment of the features of this vehicle round studied in detail. Chapter 2.3 also contains the main freight transport and logistics indicators for a typical vehicle round, and further data and analysis on the OD company. Interviews with managers of the company OD were also carried out at the depot, together with follow-up email exchanges to obtain additional data about the entire operation from the warehouse to the customers in the City of London, together with information about the fuel efficiency of the vehicles and the fuel costs.

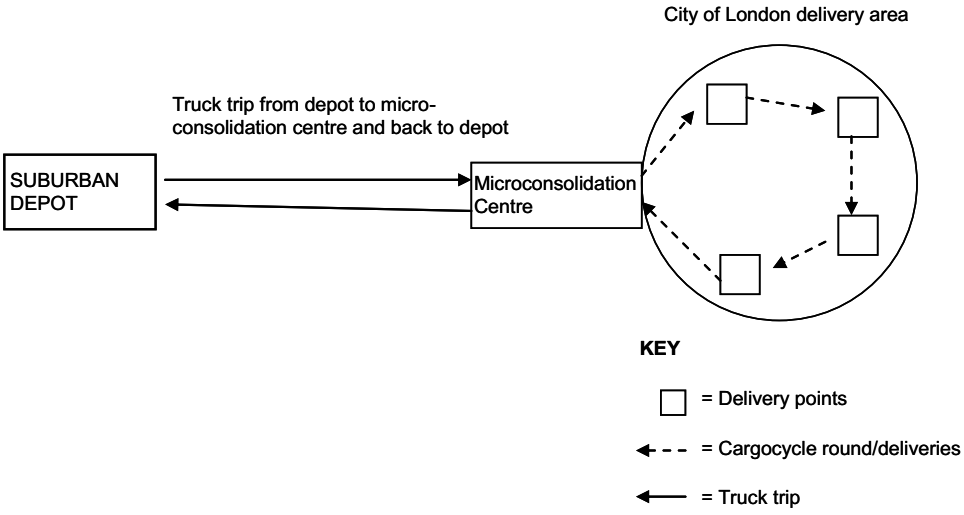
[2] The role of the consolidation centre is primarily to provide a transhipment point for the transfer of parcels between the delivery vehicle and the electric vans and Cargocycles. Because all loads are small the consolidation centre was referred to as a ‘micro-consolidation centre’ throughout the trial. This terminology is adopted in the remainder of the report.

**Figure 1: Logistics system for deliveries by diesel vans: BEFORE**




*Source: UoW survey 2010*

**Figure 2: Logistics system for deliveries by Cargocycles and electric vans: AFTER**




*Source: UoW survey 2010*

## Before-after evaluation principles

The 'before' surveys were carried out during the period February to March 2009 and the 'after' surveys followed the start of the trial in November 2009 and took place during the period November 2009 to July 2010. Data for the comparison of the situations before and after the trial were obtained through survey work for the main freight transport indicators before and after the trial. The analysis of the trial is based on real survey data on load, distance, time, vehicles, energy use etc. The comparison is possible since the methodology is identical for the data collection before and after the trial started.

## 3.3. ‘Before’ survey data about the round studied in detail

**Introduction**

Office Depot operates a national service in the UK providing a wide range of stationery products to businesses. The type of business served is very varied and therefore deliveries take place to many locations including: offices, banks, shops, cafes, bars, and educational establishments. For the purposes of the trial the company’s activities within the City of London have been considered and within this area all deliveries are business to business (i.e. there are no deliveries to private homes and addresses). The delivery pattern within the City of London is fairly standardised. According to annual data from Office Depot for this area, on a typical round approximately 145 parcels of stationery products will be delivered. Some of the deliveries will involve a pallet load but the majority are in packages (parcels). Usually delivery rounds involve one driver making the deliveries over about 6 to 6.5 hours. Deliveries are made from Monday to Friday and typically Monday is the least busy day for deliveries.

**Characteristics of establishments receiving deliveries and timing of freight operations**

The depot from which deliveries originate is situated at Heathrow in outer London approximately 20 miles from the delivery area in the City of London. The inward journey made by the van takes over one hour in the morning peak and the return trip takes 30 minutes. Therefore total ‘stem’ time is more than 90 minutes and the delivery and collection activity typically occupies a further 4 hours. Further details about the operation are summarised in Table 1.

**Table 1: General data and information on the "before" situation**

| | |
|---|---|
| **Load, type of goods** | Parcels; about 50% of the parcels are in boxes of 13 kg; weight of other parcels: <1 to 8 kg; pallet in one case. |
| **Warehousing** | The warehouse is a Regional Distribution Centre for London and surroundings. It is 300 metres long, 150 m wide, and 7 pallets height. The volume of the warehouse is almost fully used with pallet storage and parcels handling equipment. Area for return load is small, about 2-3% of the depot surface. |
| **Business** | About 1200 parcels deliveries per day to EC1-4 area. The type of business is B2B; there are no residential customers in this area. |
| **Area of delivery and traffic** | EC 1-4 postcodes in the City of London. Very busy narrow roads or, if wide road, no stopping (double red) lines and heavy traffic in the morning peak hours. Visual observation: about half of the traffic consists of vans of various size and small trucks, the other half being cars. |
| **Vehicle** | 7 diesel vans (Table 2) |
| **Drivers** | 7 drivers for covering the EC 1-4 City of London delivery area. |
| **Loading** | Takes place during the night, starting at 2:30 AM, all vans are loaded by warehouse staff. Vehicle loading time is, on average, is 45 minutes per van. The driver arrives at 6:00 AM. |
| **Collection** | The collection consists of return loads (broken, not needed, etc). |
| **Time windows for delivery** | In general the driver carries out the deliveries in the most logical geographical order. However, in a few cases, it is necessary for the driver comes back to the same street later in the delivery round to deliver to another client. This is due to a delivery time window for that client. |
| **Trolley** | Convertible 2 wheels or 4 wheels trolley, 60 cm wide, 120 cm long, often transformed into a 4 wheels trolley for heavy boxes. |
| **Walking** | Frequent longer walks on the footway, few crossing the street, because the permitted loading space is not situated close to the entrance of the client. |
| **Van mileage and age** | About 10,000 miles/year. Fleet age is variable; mostly the vans are used only up to 4 years; in some cases, up to 6 years for some subcontractors. |
| **GPS use** | All vehicles have been equipped with GPS units for 6 months. Registration of clients and parcels data, addresses and signatures. Download of GPS data to the company computer takes place after round end, each day |

*Source: UoW survey 2009-2010*

## Vehicle and fleet data

The main vehicle used is a van below 3.5 tonnes, with typical volume and weight capacity characteristics (Table 2). The van used in this delivery activity is typical for inner city parcel deliveries. Its load factor by weight is high at departure from depot, and declines progressively during the multi-drop delivery round, showing a typical pattern of van use in urban freight. The load factor by volume at departure from the depot is rather low, due to a high density load (paper products and boxes of A4 copy paper). Smaller vans are also used, but, even in these smaller

vehicles, the available cubic capacity is not reached. The capacity of the van and the design of the vehicle correspond to the type of goods transported. The vehicle data were collected by visiting Office Depot.

**Table 2: Vehicle and fleet characteristics "before"**

| | |
|---|---|
| **Vehicle type and size** | 3.5 tonne vans, long and short wheelbase, type MB Sprinter 311CDI |
| **Number of vehicles** | 90 vans for the whole London delivery area<br>7 vans (3.5t) dedicated to the City of London EC1-4 delivery area |
| **Vehicle empty weight** | 1.9 to 2.1 tonnes |
| **Vehicle capacity by volume** | About 9 to 10 cubic metres |
| **Vehicle capacity by surface** | About 5.3 square metres |
| **Vehicle surface and road space occupancy** | 5.71 metres length, 1.98 m width, about 11.3 square metres road space occupancy |
| **Vehicle capacity by weight** | About 1.6 tonnes |
| **Annual mileage** | About 10,000 miles/year |

Source: Own survey 2009

## 3.4 Vehicle rounds information

The round details were collected during the driver survey and the visit to Office Depot. Table 3 contains the summary round information.

Table 4 shows the detailed round data collected while accompanying the driver on a multi-drop delivery round in postcodes EC1-4 in the City of London on a typical day. At each stop during the round, the following six items of data were recorded: stop number, address, odometer mileage, time of arrival and departure, number of parcels delivered or collected.

The total of 168 parcels was delivered on the entire round, which is within the typical range for the company of 140-180 parcels/day. In some cases the driver made several deliveries at one stopping location. In these cases, he returned to the van to collect the parcels for each delivery in turn. The time of each of his returns to the vehicle and his departure from the vehicle to make the delivery was recorded. The stop time is calculated as total time between the vehicle arrival and departure at the stopping location.

**Table 3: Round data: information collected on one typical day and on annual data**

| | |
|---|---|
| **Type of vehicle round** | Multi drop round, with deliveries and few collections |
| **Number of stops per round** | About 20-25 in a normal day |
| **Number of rounds per day** | 1 (a few cases of an additional delivery round in the afternoon) |
| **Distance between depot and first delivery stop, (stem mileage)** | 20 miles |
| **Mean distance between stops in the destination area** | 0.3 miles |
| **Location of origin and destination, and location of the stops** | Round starting from London suburbs, delivery/pick-up stops in City of London EC1-4 |
| **Start and end time of vehicle round** | 6:30 to 11:54 (5 hours 24 duration) |
| **Round time** | 1 hour 7 mins in the morning from depot to first stop, 35 mins at lunch time from last stop back to depot; about 3 hours 41 mins delivery time in between |
| **Delay time** | No delays |
| **Vehicle speed** | Average speed (driving time only): 10.7 miles/hour |
| **Dwell time (waiting time at customer location)** | None during the round |
| **Vehicle crew size** | 1 |
| **Delays** | Traffic jams towards London in the morning, about 30 minutes delay time, but there is no delay at the arrival of the van in the first client address, because of the early start from depot. |
| **Parking and Penalty Charge Notes (PCN)** | Only in one case illegal on a red route for 1 minute, and a policeman came by, but issued no ticket. In all other cases parking on yellow line on-street, or in three cases at customer facilities, and in few cases a little on the walkway. According to the driver, PCNs are issued, but not very important |
| **Phone calls** | Only one call on the mobile phone during the whole round. However there was no change from the original tour planning mentioned on the papers |
| **Driver knowledge** | Only two cases where the driver needs to search for a new customer location. Searching time was less than a minute /client. |
| **Empty running** | No empty running, because of the 5 parcels return load, but load factor by weight was below 2% on the way back |

*Source: UoW survey 2009*

**Table 4: Diary of vehicle round starting and ending at warehouse in suburban London**

| Stop Number | Addresses: origins & destinations | Time Arrival | Departure | Driver back | Driver away | Number of parcels Load & Collection | Delivery | Driving time | Stop time |
|---|---|---|---|---|---|---|---|---|---|
| 0 | London depot | | 06:30 | | | 141 | | | |
| 1 | Fenchurch Street Station x Mark Lane | 07:37 | 07:51 | | | 4 | 20 | 01:07 | 00:14 |
| 2 | Oldbroad Street | 08:02 | | 08:10 | 08:10 | | 10 | 00:11 | |
| 2 | | | 08:14 | | | | 1 | | 00:12 |
| 3 | Austin Friars | 08:15 | | 08:18 | 08:19 | | 1 | 00:01 | |
| 3 | | | 08:27 | | | 1 | 9 | | 00:12 |
| 4 | Cowpers court | 08:35 | | 08:46 | 08:48 | | 14 | 00:08 | |
| 4 | | | | 08:54 | 08:55 | | 9 | | |
| 4 | | | 08:59 | | | | 7 | | 00:24 |
| 5 | Clement Lane | 09:00 | 09:02 | | | | 1 | 00:01 | 00:02 |
| 6 | Corbet court | 09:03 | 09:06 | | | | 1 | 00:01 | 00:03 |
| 7 | St Peters Alley | 09:15 | 09:22 | | | | 7 | 00:09 | 00:07 |
| 8 | Wistington Avenue | 09:23 | | 09:28 | 09:29 | | 13 | 00:01 | |
| 8 | | | 09:31 | | | | 1 | | 00:08 |
| 9 | Fencourt | 09:33 | 09:34 | | | | 1 | 00:02 | 00:01 |
| 10 | Billiter Street | 09:35 | 09:37 | | | | 2 | 00:01 | 00:02 |
| 11 | Mark Lane x Fenchurch Street Station | 09:42 | 09:44 | | | | 1 | 00:05 | 00:02 |
| 12 | Fencourt | 09:45 | 09:47 | | | | 1 | 00:01 | 00:02 |
| 13 | Fenchurch Street | 09:48 | | 09:57 | 09:58 | | 5 | 00:01 | |
| 13 | | | 10:00 | | | | 1 | | 00:12 |
| 14 | Underground parking | 10:01 | | 10:22 | 10:23 | | 8 | 00:01 | |
| 14 | | | 10:31 | | | 22 | 25 | | 00:30 |
| 15 | Botolph Street St Georges Lane | 10:34 | | 10:38 | 10:40 | | 4 | 00:03 | |
| 15 | | | 10:45 | | | | 5 | | 00:11 |
| 16 | Eastcheap | 10:47 | 10:49 | | | | 1 | 00:02 | 00:02 |
| 17 | Cloak Lane | 10:54 | 10:55 | | | | 1 | 00:05 | 00:01 |
| 18 | Cloak Lane | 10:56 | 10:58 | | | | 5 | 00:01 | 00:02 |
| 19 | College Street x Queen Street | 10:59 | 11:05 | | | | 8 | 00:01 | 00:06 |
| 20 | Hammett Street | 11:17 | 11:18 | | | | 1 | 00:12 | 00:01 |
| 21 | London depot | 11:54 | | | | | 5 | 00:36 | |

*Source: UoW survey 2009*

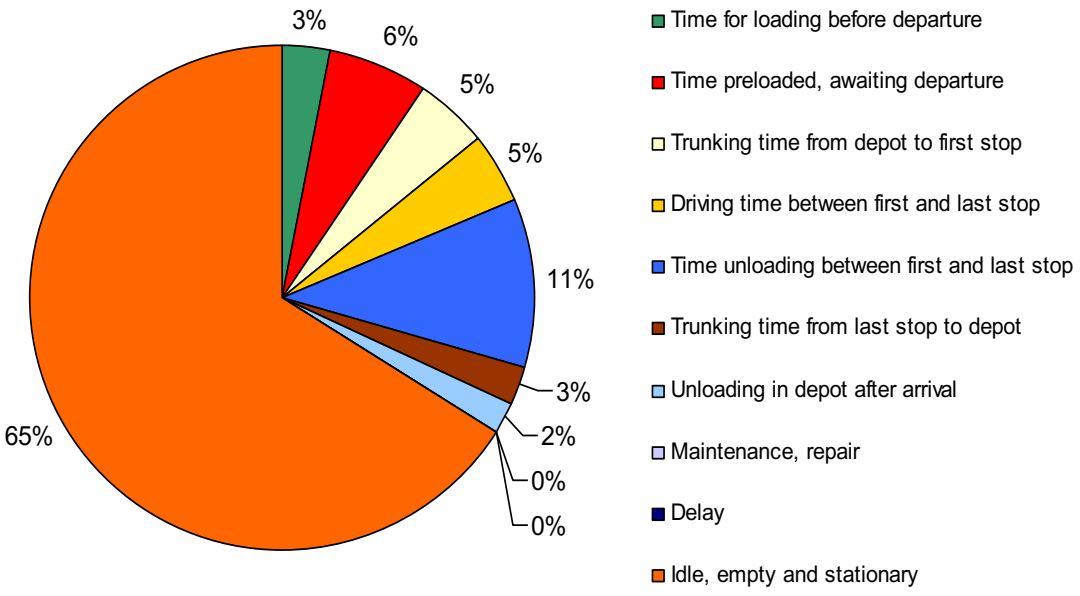
Some of the parcels delivered were not in the vehicle at the start of the round, but were collected from one delivery location in the City of London. These parcels were transported here at a previous time on a pallet by a truck, and stored in a small storage area. These 22 parcels were delivered to the client on this day by the driver together with other parcels.

**Surveyed indicators for the observed round**

Indicators have been calculated for the delivery round on which the driver was accompanied, interviews with the driver about his van and round, interviews with colleagues and fleet manager at depot, and interviews with headquarter managers on van use and on fuel use. Fuel costs data were obtained from actual UK fuel market prices in 2009. These indicators for the delivery round are shown in Table 5. The delivery round analysed is a standard round type for this company. No specific problems or delivery failures occurred on the round. The driver knows the area very well, and spends little time searching for clients or destinations.

In a previous Freightbestpractice Key Performance Indicator survey in the UK parcel sector, the KPIs were defined according to the main categories distance, load factor, empty runs, time use and fuel use (Freightbestpractice 2006). In order to survey similar indicators for Office Depot, it was necessary to adapt slightly the available methodology, by assessing many sub-indicators for each category, such as distance in inner-city area or greenhouse gas (ghg) emissions per parcel.

**Figure 3: Time utilisation of the van on the observed day**




*Source: UoW survey 2009-2010*

The time patterns of the van use in Figure 3 are presented as a percentage of a 24-hour period on the day the survey observation took place. The time spent idle

and stationary is, with 65%, longer than the result of the KPI study of Freightbestpractice (2006) that was showing a mean time spent idle and stationary of 56%. Considering a full week (including weekend days in the total time instead of considering only weekdays) or a year (including holidays), the proportion of time spent stationary could increase.

**Table 5: Before indicators for the observed round**

| *Categories* | *Indicators* | *Values* |
|---|---|---|
| **Distance** | Distance per van per day in miles (mi) | 46 |
| | Distance in inner city area (City of London) (mi) | 6 |
| | Unloading stops | 20 |
| | Number of parcels delivered and collected | 168 |
| | Parcels per stop | 8.4 |
| **Load factor** | Vehicle capacity (payload) in kg | 1320 |
| | Total load weight in kg at start | 1216 |
| | Load factor by weight at start in % | 92 |
| | Volume capacity in $m^3$ | 10 |
| | Volume used in $m^3$ at start | 2.5 |
| | Load factor by volume at start in % | 25 |
| | Deck utilisation at start in % | 50 |
| | Load weight at the end in kg | 40 |
| | Load factor by weight at the end in % | 3 |
| **Empty runs** | Empty running as % of total distance | 0 |
| **Time use** | Time for loading before departure | 00:45 |
| | Time preloaded, awaiting departure | 01:30 |
| | "Stem" driving time from depot to first stop | 01:07 |
| | Time running on the road between first and last | 01:07[3] |
| | Time unloading between first and last stop | 02:34 |
| | "Stem" driving time from last stop to depot | 00:36 |
| | Unloading in depot after arrival | 00:30 |
| | Idle, empty and stationary | 17:11 |
| **Fuel use** | Fuel use in mpg | 22 |
| | Fuel use in l/100km | 12.84 |
| | Fuel use in litres per round | 15.71 |
| | Fuel use per parcel delivered in litres | 0.096 |
| | Fuel costs in £ per round (0.97£/l) | 15.23 |
| | Fuel costs in £ per parcel | 0.093 |

*Source: UoW survey 2009*

According to the interviews, data on fuel use vary greatly from one area to another. A mean fuel use of 22 mpg was obtained. This fuel use might be optimistic, compared to the mean fuel use of a recent UK KPI van survey (Freightbestpractice 2006), in which the fuel use value for "car-derived vans" was 15.31 litres per km, corresponding to 15.36 mpg. This value of 22 mpg for Office

[3] Note: By coincidence the time spent on stem mileage and running on the road between first and last stop are the same.

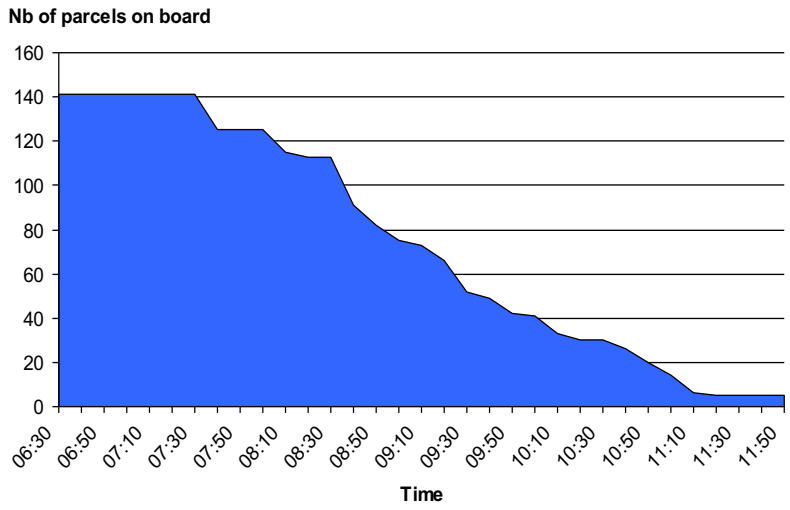
Depot and the situation "before", however, will not lead to exaggerated impacts when looking at $CO_2$ reduction through clean vehicle use in the trial.

For the total distance per vehicle per day, the company average for 7 vans is 46 miles per van per day (Table 5). The distance covered during the observed round in the City of London (Table 4) was 6 miles. There are days in which the vans make two rounds, and this explains why the average distance per day is higher than the distance of one round. On the observed day, the round was about 46 miles long. 168 parcels were delivered by one van on this day.

Based on the load information provided in the observed vehicle round, Figure 4 shows the vehicle parcel load related to time spent on the round. The effect visualised in Figure 4 is the very regular unloading activity during the morning, and the small number of parcels collected and brought back to the depot.

For reasons of graphical representation of time, the number of parcels on board is shown for the start of each 10 minutes period including the unloading activity takes place between 7:30 and 11:30 AM, the core delivery time for Office Depot in the City of London.

**Figure 4: Relationship between vehicle load and time during the round**




*Source: UoW survey 2009*

## 3.5 After situation: technical characteristics and logistics changes during the trial

### Introduction of the new vehicles

The Cargocycle vehicle deliveries trial began in the EC1-4 postcodes in the City of London in November 2009. Data collection started two weeks after these deliveries had commenced. The Cargocycles were manufactured in France by La Petite Reine, the vans by Aixam Mega (Figure 5).

**Figure 5: Cargocycle and electric van used in the City of London trial**


*Source: Gnewt Cargo 2010*

Data on the Cargocycle specifications are shown in Table 6.

**Table 6: Technical characteristics of the cycles, given from the manufacturer**

| | |
|---|---|
| **Model** | Cargocycle V2 |
| **Specifications** | Stainless steel frame, marine plywood or PVC and polyester body, Magura brakes with hydraulic disc (rear wheels) and mechanical V brake (front wheel), Shimano gearbox 3, 5 or 8 shifts, ABUS antitheft protection device |
| **Length** | 2.35 m |
| **Width** | 1.03 m |
| **Net weight (empty)** | 110 kg |
| **Maximum load** | 180 kg |
| **Maximum volume** | 1.5 cubic metres |
| **Options** | 250 Watt Heinzmann engine + 1 battery charger |
| **Speed** | 20 km/h |
| **Battery recharge time** | 4 hours from any standard main plug |

*Source: La Petite Reine 2010*

## Logistics changes in the trial

In the trial, the delivery operation was broadly the same in terms of clients served and the volumes of product delivered. However some changes including the exact timing of deliveries did take place. Other changes included the establishment of the micro-consolidation centre.

A new micro-consolidation centre (transhipment point with no storage overnight) was set up in the City of London near the Tower of London and the metro station Tower Hill. Figures 1 and 2 provide an illustration of the differences between the vehicle operations in the before and after situation.

In addition to the Cargocycle deliveries made from the micro-consolidation centre in the trial (shown in Figure 2) some customers continued to receive deliveries by vans from the suburban depot (in the same way as before the trial as shown in Figure 1). During the trial the two logistics systems of deliveries by vans and Cargocycles were operated in parallel. Therefore there was a partial changeover from vans to Cargocycles.

One 18 tonne truck was used to transport goods from the depot in Heathrow to the micro-consolidation centre in Tower Hill (for final delivery by Cargocycle).

The same information system device for registering the parcel delivery is used by van and Cargocycle drivers.

The Cargocycle deliveries start at 8:30, and end at the latest by 17:00. The total duration for Cargocycle drivers was variable, with 8.5 hours total working hours per day being a maximum.

1141 parcels were delivered on the survey day to Office Depot customers in EC1-4. The number of parcels delivered by Cargocycle were progressively increased in the trial phase, from 200 to 700/day. The trial objective was to distribute about 900/day by Cargocycle, and to replace the fleet of diesel vans by a fleet of battery electric vehicles.

The final deliveries from the micro-consolidation centre were not only made by Cargocycle. Compared to the situation before, the “after” situation includes new Cargocycles with a variable number of drivers (riders), and also, at one point, it was necessary to rely upon more electric vans. The battery-electric powered van were larger “clean” vehicles that were used more than it was expected at the starting point of the company business, because of the large size of some parcels. These larger parcels make it difficult for the operator to distribute all deliveries exclusively by Cargocycles.

## 3.6 Logistics activity records of the trial, impact and analysis

**Vehicles, load and round data in the starting phase of the trial**

The Cargocycle deliveries were observed and recorded firstly in December 2009 and then again in February 2010, in March 2010, in May 2010 and in July 2010. The delivery area observed in December 2009 was divided in three sectors, each sector being served by one Cargocycle, and at this stage of the trial, three Cargocycles were in use in total. Each Cargocycle was performing 3 or 4 rounds per day, with the Cargocycle returning to the micro-consolidation centre for reloading at the end of each round. The rounds were numbered 1.1 to 1.4 for Cargocycle one, 2.1 to 2.3 for Cargocycle two etc.

In February 2010, 7 Cargocycles and 2 vans were generally in use, but on the day selected for detailed survey observation only 6 Cargocycles and one electric van were used. The same delivery area was divided in sectors, with each Cargocycle being dedicated to one sector of the EC1-4 area of the City of London and the van being used for large parcels in all sectors

The Cargocycle activity data collected is presented in Tables 7 and 8. For each Cargocycle, the total activity for the day shown first in the row shaded grey (Total day's activity..) and for each round before its start (on board of ..). In the first row of Tables 7 and 8 the total or mean values for all Cargocycle activity during the day are calculated.

**Table 7: Activity data and load for Cargocycle distribution, Dec 2009**

| | Total number of parcels | Boxes of paper | Other products | Total load in kg | % of boxes of paper in nb of parcels | % of paper by weight |
|---|---|---|---|---|---|---|
| Total/mean day's activity | 247 | 66 | 181 | 1737 | 27 | 48 |
| Cycle 1: Total day's activity in sector 1 | 91 | 27 | 64 | 660 | 30 | 52 |
| On board of Round 1.1 | 34 | 6 | 28 | 216 | 18 | 35 |
| On board of Round 1.2 | 16 | 16 | 0 | 201 | 100 | 100 |
| On board of Round 1.3 | 21 | 5 | 16 | 143 | 24 | 44 |
| On board of Round 1.4 | 20 | 0 | 20 | 100 | 0 | 0 |
| Cycle 2: Total day's activity in sector 2 | 81 | 19 | 62 | 549 | 23 | 44 |
| On board of Round 2.1 | 32 | 10 | 22 | 236 | 31 | 53 |
| On board of Round 2.2 | 25 | 5 | 20 | 163 | 20 | 39 |
| On board of Round 2.3 | 24 | 4 | 20 | 150 | 17 | 34 |
| Cycle 3: Total day's activity in sector 3 | 75 | 20 | 55 | 527 | 27 | 48 |
| On board of Round 3.1 | 25 | 2 | 23 | 140 | 8 | 18 |
| On board of Round 3.2 | 25 | 9 | 16 | 193 | 36 | 59 |
| On board of Round 3.3 | 25 | 9 | 16 | 194 | 36 | 59 |

*Source: UoW survey 2010*

According to the interviews and the data collected, the maximum number of parcels that can be loaded on board a Cargocycle was between 30 and 50. The number of parcels that a diesel van can deliver per day (140 to 180) cannot be easily achieved by a Cargocycle for this type of business and products. This is due to the total amount of deliveries, the mean volume and mean weight of one parcel, which is determined by the nature of the freight, and the limited Cargocycle vehicle capacity of 1.5 $m^3$ and 180 kg.

The load factor by volume at departure from the micro-consolidation centre is very high: 90-100% for all 3 Cargocycles in the first morning round. The load weight is also high, ranging from 100 to 216 kg per load. The total weight of the Cargocycle is high: adding empty weight, driver weight and load weight results in a gross vehicle weight of 290 to 406 kg on the observed day.

The number of rounds per Cargocycle per day is 2, 3 or even 4 depending on the day and the size of the load. An average of 2 rounds per day seems to be, at this stage of the trial, one of the success factors, since it means that a sufficiently high number of parcels fits into the vehicle, thus enabling the deliveries to be made within the available staff time and at reasonable costs.

In the Feb. 2010 data collection (Table 8) for the 6 Cargocycles and one electric van, more attention was paid to volume data, since the volume of the parcels seems to be another important factor of success at this stage of the trial.

**Table 8: Activity data and load of 6 Cargocycles and one electric van, Feb 2010**

| | parcels | Boxes paper | Other products | load in kg | % of boxes of paper in total | % of paper by weight |
|---|---|---|---|---|---|---|
| Total/mean day's activity | 588 | 102 | 486 | 3715 | 17 | 35 |
| Total day's activity in sector 1 | 57 | 11 | 46 | 369 | 19 | 38 |
| Total day's activity in sector 2 | 98 | 9 | 89 | 558 | 9 | 20 |
| Total day's activity in sector 3 | 90 | 23 | 67 | 625 | 26 | 46 |
| Total day's activity in sector 4 | 85 | 29 | 56 | 645 | 34 | 57 |
| Total day's activity in sector 5 | 94 | 15 | 79 | 584 | 16 | 32 |
| Total day's activity in sector 6 | 63 | 0 | 63 | 315 | 0 | 0 |
| Total day's activity in all sectors for the electric van | 101 | 15 | 86 | 619 | 15 | 31 |

*Source: UoW survey 2010*

Each row corresponds to a total day's activity of one vehicle (in sector 1 for Cargocycle 1, in sector 2 for Cargocycle 2 etc. and in all sectors for the van). For each Cargocycle or van, the load show numbers of parcels per day that are similar to the December 2009 data. According to interviews on that day, it appears that the drivers are performing either 2 or 3 rounds per day in order to deliver 60 to 100 parcels each day.

This means that, with a capacity of 1.5 cubic metres, it is possible to deliver all parcels with 2 rounds on some days, but requires 3 rounds on other days, depending on the size of the parcels. In any case, a visual observation on that day revealed again that all Cargocycles were 100% full in terms of volume capacity at departure, and the same 100% load factor by volume was observed for the electric van at departure.

For the electric van used on this morning, the only noticeable difference in the load compared to the Cargocycles was its higher volume, not the higher weight (Table 8).

In order to assess the volume and weight question more in detail, further calculations were made (Table 9). The average load weight and volume were calculated under the assumption that 2 or 3 rounds were performed during one day. It was possible to calculate the mean volume per parcel loaded, since the number of parcels was recorded, and the capacity of the Cargocycle and electric van are known. Also known are the mean weight of 12.6 kg for paper parcels and 3.08 kg for other parcels, allowing to estimate the total load weight. The calculated mean weight of one parcel was 4.73 kg on this day. At a later stage in May 2010, a new record was showing an average weight of one parcel of 5.65 kg. In Table 9, in the column "mean vol/parcel", the results vary from 0.03 to 0.078 $m^3$ /parcel. According to the results of the calculations on volume, a plausible mean volume per parcel is 0.05 $m^3$.

**Table 9: Calculated variations in load weight and volume, trial in Feb 2010**

| | Paper load in kg | Other load in kg | Load weight per parcel in kg | Mean vol/parcel in $m^3$ if 2 rounds | Mean vol/parcel in $m^3$ if 3 rounds | Average load weight at start if 2 rounds | Average load weight at start if 3 rounds |
|---|---|---|---|---|---|---|---|
| Total/mean day's activity | 1285.2 | 1496.8 | 4.73 | 0.037 | 0.056 | 198.7 | 132.5 |
| Total day's activity in sector 1 | 138.6 | 141.7 | 4.92 | 0.052 | 0.078 | 140.1 | 93.4 |
| Total day's activity in sector 2 | 113.4 | 274.1 | 3.95 | 0.030 | 0.046 | 193.8 | 129.2 |
| Total day's activity in sector 3 | 289.8 | 206.4 | 5.51 | 0.033 | 0.050 | 248.1 | 165.4 |
| Total day's activity in sector 4 | 365.4 | 172.5 | 6.33 | 0.035 | 0.052 | 268.9 | 179.3 |
| Total day's activity in sector 5 | 189 | 243.3 | 4.60 | 0.031 | 0.048 | 216.2 | 144.1 |
| Total day's activity in sector 6 | 0 | 194 | 3.08 | 0.047 | 0.071 | 97 | 64.7 |
| Total day's activity in all sectors for the electric van | 189 | 264.9 | 4.49 | 0.029 | 0.044 | 226.9 | 151.3 |

*Source: UoW survey 2010*

As a consequence of these calculations, there is an issue about volume and weight limitations, which needs to be addressed. In the trial in the area observed, the parcels were not sorted by size. This means that the Cargocycles were used for all parcel sizes. This is not a very simple question, because it is a realistic

hypothesis that the use of the Cargocycle (a small vehicle) is only economically profitable for parcels of a size that is relatively small, and this maximum size limit to profitability is probably smaller than the average size of a typical Office Depot parcel.

**Energy and Greenhouse Gas survey records**

Electric vans and cycles require recharging and this consumes electricity. To survey this energy use and $CO_2$ emissions during the trial in the "after" situation, the electricity meter of Gnewt Cargo was recorded for different periods, together with the number of parcels delivered. In the first months of the trial, grid electricity was purchased. In March 2010, the electricity provider was changed in order to obtain green electricity (electricity from 100% renewable energy). The Gnewt Cargo energy record and the results of the ghg calculation assuming grid electricity are presented in Table 9. Even in the time when grid electricity was used, the $CO_2$ reduction was substantial. The difference between grid and green electricity is calculated and explained further below Table 10. The ghg calculation is based on the ghg conversion factor of DEFRA (2009), using the approach of accounting for the main greenhouse gases from motor combustion and from electricity generation. Since the DEFRA emission factors are concerning all greenhouse gases, not only carbon dioxide, the results are expressed in $kgCO_2$ equivalent ($CO_2e$). Besides the direct emissions and the grid electricity, all other emissions are excluded. Some of the indirect emissions like infrastructure, vehicle construction and maintenance, and other might be relevant for the overall life cycle and supply chain emissions, but are excluded from this calculation (see Clear Zone 2006 for details on these questions). The Gnewt Cargo electricity used for running the depot was included. It is assumed that the amount of electricity for charging the batteries is far higher than the other energy use positions like heating, light, or IT devices use. For grid electricity use, the conversion factor from electricity energy to $CO_2$ equivalent is 0.54418 $kgCO_2e$/kWh, following DEFRA (2009). For green electricity use, the emission factor for $CO_2$ emissions from electricity generation is assumed to be equal to 0.

In addition to the Gnewt Cargo Cargocycle deliveries, Office Depot was continuing to run four diesel vans for the other deliveries in London EC1-4 area in March 2010. These vehicles started their round from the West London depot, having a fuel use of 22 mpg (the same operation as in the before situation). The vans travel a distance of 46 miles/vehicle/day.

In this formula $CO_2$ emissions are calculated in $kgCO_2e$/parcel:
1 $kgCO_2e$/parcel = (diesel use per day in litres x 2.6694)/ number of parcels per day. The emission factor 1 litre of diesel = 2.6694 kgCO2e was the standard Defra unit used in Defra (2009).

The last period of the record in Table 10, starting on 17 February and ending on 16 March, shows the best ghg efficiency values for $CO_2e$ per parcel and $CO_2e$ per mile. The $CO_2e$ per day has slightly increasing due to higher amount of

freight. In case of grid electricity, 86 grams of $CO_2$e per parcel delivered for the "best" period is a very low value for urban freight deliveries (third raw from bottom in Table 10). 94 grams of $CO_2$e per parcel for the period of observation from November 2009 to mid-March 2010 (second row from bottom in Table 10) is a rather low result as well. A comparison of van and Cargocycle energy and $CO_2$ effects have been made, and the average $CO_2$e per parcel for van use observed in Feb 2010 and calculated with the same method is shown at the bottom of Table 10. Even if grid electricity is used, the ghg reductions are substantial. This confirms the result of Clear Zone Partnership (2006).

**Table 10: Survey data for the electricity use of Gnewt Cargo and $CO_2$ emission calculation for grid electricity use from November 2009 to March 2010**

| Dates | kWh | days | Par-cels/ day | Total parcels | Miles | Miles / day | kWh/ parcel | kWh/ mile | kg$CO_2$e/ parcel | kg$CO_2$e/ mile | kg$CO_2$e/ day |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 December 2009 | 51,787 | | | | | | | | | | |
| 18 January 2010 | 53,779 | | | | | | | | | | |
| Period 10/12/2009-18/01/2010 | 1991.7 | 24 | 390 | 9360 | 720 | 30 | 0.212 | 2.766 | 0.116 | 1.505 | 45.16 |
| 16 February 2010 | 55,747 | | | | | | | | | | |
| Period 18/01-16/02/2010 | 1967.7 | 20 | 610 | 12,200 | 1400 | 70 | 0.161 | 1.406 | 0.088 | 0.765 | 53.54 |
| Period 10/12/09-16/2/10 | 3959.4 | 44 | 500 | 21,560 | 2120 | 48.2 | 0.183 | 1.868 | 0.099 | 1.016 | 48.97 |
| 16 March 2010 | 57,681 | | | | | | | | | | |
| Period 17/02-16/03/2010 | 1934.6 | 20 | 613 | 12,257 | 1400 | 70 | 0.158 | 1.382 | 0.086 | 0.752 | 52.64 |
| Trial period 24/11/09-16/3/2010 | 5894.0 | 64 | 556 | 33,817 | 3520 | 55.0 | 0.174 | 1.674 | 0.095 | 0.911 | 50.12 |
| 7 vans, Feb 2009 'BEFORE'' | | | | | | | | | 0.257 | | 293.47 |

*Sources: Own survey 2010*

In Table 10, the indicator 'parcels per day' refers to Cargocycle and electric van deliveries from Gnewt Cargo only and the electricity emission factor is 0.54418 kg$CO_2$e/ kWh (DEFRA 2009 ghg emission factors for the year 2009 for grid electricity).

The results for ghg emissions are different, when looking at the whole logistics system in place and including the use of green electricity. The observation of the Gnewt Cargo trial using green electricity (after) was compared to the observation of the situation at Office Depot (before), using the fuel use data record for van and truck. The comparison of the before and after situations shows an overall $CO_2$ reduction (Tables 11 and 12).

**Table 11: Survey data $CO_2$ emissions reduction in March 2010**

| Indicators / Fleet observed | $kgCO_2e$ van/day | $kgCO_2e$ truck/day | total $kgCO_2e$/day | $CO_2$ index | $CO_2$ reduction |
|---|---|---|---|---|---|
| Before: 7 vans, no Cargocycles | 293.474 | | 293.474 | 100 | |
| After: 4 vans, 6 Cargocycles, 1 electric van, 1 truck | 167.700 | 51.579 | 219.278 | 74.7 | -25.3% |

Sources: Own survey 2010

There is an observed $CO_2$ emissions reduction of 25% in March 2010. Considering that the emission factor for green electricity used by Cargocycles and electric van is equal to 0, the $kgCO_2e$/day for 6 Cargocycles and one electric van is 0. Only the emissions of diesel vans and one truck are left.

**Impacts of fleet changes at the intermediate trial stage in March 2010**

The impacts of fleet composition changes on key indicators (Table 12) show results that are in line with the findings above. Like in Table 11, the main indicators are compared for the situation before and after the start of the implementation of the trial.

**Distance changes:** the overall distance driven by all vehicles (vans, Cargocycles, electric van and truck) per day is reduced by 25%. The distance driven by diesel vehicles in City of London delivery area is reduced even more, by 38%. This is an important traffic and clean air impact for central boroughs of London.

**Load factor:** the overall load factor by weight and load factors by volume are increased. This indicator appears to be strongly changed in the trial, especially for the average volume utilisation rate, with +191%.

**Time use change:** the total time spent by drivers appears at +64% to be much higher than the previous situation (Table 12). Driver time is represented as total driver working time in person-days per day. One person-day is representing here 7 hours working time.

For total time spent by drivers, 7 person-days/day are spent by the 7 van drivers, working 7 hours each per day, in the situation before; 11.5 person-days/day being spent in the situation after by all drivers. These 11.5 person-days corresponds to an average total driver working time per day in the trial, taking into account 7 hours for 4 van drivers, plus 8.5 hours for 6 Cargocycles and one electric van drivers, plus 4 hours for the truck driver. The 8.5 hours working time per day for the Cargocycle and electric van drivers are due to the fact that they are loading their vehicles themselves, while at the depot of the company Office Depot, the vans are loaded by dedicated staff each morning. This loading time and time loaded awaiting departure have been accounted for as vehicle use, but not as driver time for Office Depot.

Vehicle round duration for Cargocycles is slightly longer than the diesel van, since it is needed to load a Cargocycle two to three times to achieve a total load of about 60 to 100 parcels per day. About one hour more time for unloading of Cargocycles and electric vans, and an estimated 0.5 hour more for deliveries, mean that the distribution operation last longer for the Cargocycle and electric van driver coming from Gnewt Cargo micro-consolidation centre than for the diesel van driver coming from the depot. This additional time is partly due to the trial conditions; therefore the working time is estimated to be potentially reduced in the future.

Vehicle round duration of the truck providing all parcels to the small consolidation centre, is assumed to last 4 hours maximum. This additional working time needed is potentially costly, so this point needs to be looked at carefully, when a further extension of this trial is planned.

**Table 12: Before-After impact of fleet change on freight transport indicators at the intermediate trial stage in March 2010**

| | Before March 09 | After March 2010 | Change in % |
|---|---|---|---|
| Number of vehicles | 7 | 12 | 71 |
| Nb of diesel vans used for deliveries in City of London | 7 | 4 | -43 |
| Total nb of delivery stops (no change in area and clients assumed) | 140 | 140 | 0 |
| Total nb of parcels | 1141 | 1141 | 0 |
| Total distance for all vehicles per day in London | 322 | 281 | -13 |
| Distance for all vehicles in central area City of London | 42 | 89 | 112 |
| Distance for diesel vans and truck in central area City of London | 42 | 26 | -38 |
| Distance of cargocycles and electric van in miles | | 63 | |
| Distance of truck trip in miles | | 34 | |
| Daily load weight of vans at start in kg | 8512 | 4797 | -43.6 |
| Daily load weight of 6 cycles, 1 elec van, in kg | | 3715 | |
| Load weight of one cargocycle at start in kg | | 193 | |
| Average load factor by weight for cycles and elec van at start in % | | 107 | |
| Average load factor by weight for vans, cycles and elec van in % | 92 | 100 | 8.1 |
| Average load factor by volume for cycles and elec van at start in % | | 100 | |
| Average load factor by volume for all vehicles at start in % | 25 | 72.7 | 191 |
| Empty running | 0 | 0 | |
| Man-days per day (truck driver is also allocated to other areas) | 7 | 11.5 | 64 |
| Total time spent per driver per day in hours | 7 | 7.96 | 14 |
| Total use time for all vehicles in hours per day | 57.05 | 96.1 | 68 |
| Total diesel van use time in hours per day (one van = 8h09/day) | 57.05 | 32.6 | -43 |
| Total truck use time in hours per day | | 4 | |
| Total cycle+elec van use time in hours per day (7 x 8.5h) | | 59.5 | |
| Fuel use for all vans in litres per day | 66.5 | 38.0 | -42.9 |
| Fuel use per day for diesel vehicles in litres | 66.5 | 57.3 | -13.8 |
| Fuel use in litres per parcel | 0.058 | 0.050 | -13.8 |

*Source: own survey 2010*

**Fuel use change:** For fuel use and greenhouse gas emissions, the values show a reduction from 66 litres per day for all vans to 57 litres for the 4 vans and one truck. The truck trip is delivering a load of 3.7 tonnes to the micro-consolidation centre, and it is an 18 tonnes truck that could be potentially used for other deliveries as well. If it were used for other deliveries then its emissions would have to be allocated according to the load share within the total load, and the overall amount of emissions per day would be reduced.

**Impact of fleet change on space and time use of the parking space in May 2010**

The space and time occupancy for parking of freight transport vehicles of the system observed during one day are estimated by the following formula (Debrincat 1999) (Table 13 & 14):

$$C = (L_1 * h * s_1) + (L_2 * h * s_2) + (L_3 * h * s_3)$$

where:

C = Total length & time use in (meters of vehicle length x minutes) per day

$L_1$ = length occupied by the parked diesel vans (in meters)

$L_2$ = length occupied by the parked Cargocycles (in meters)

$L_3$ = length occupied by the parked electric van (in meters)

h = parking time (in minutes/stop)

$s_n$ = number of stops per vehicle type per day

The average length of a diesel van including space for loading/unloading is 5.71 m, the mean length of an electric van is 3.32 m, and the mean length of a Cargocycle is estimated to be 2.35 m.

**Data record for parking length only in May 2010**

For the period of May 2010, another record was made for parking length only (Table 13). There is about 50% less parking length requirement after the fleet substitution.

**Table 13: Impact of fleet change on parking length in May 2010**

| Date | Oct-09 | May-10 |
|---|---|---|
| Fleet | 7 vans, no cycles | 0 van, 6 cycles, 3 electric vans, 1 truck |
| Van stops/day | 140 | 0 |
| Cycles stops/day | 0 | 80 |
| Electric van stops/day | 0 | 60 |
| Parking length requirement metres for all vans | 799.4 | 0 |
| Parking length requirement metres for all cycles | 0 | 188 |
| Parking length requirement metres for all electric vans | 0 | 199.2 |
| Parking length requirement total metres/day | 799.4 | 387.2 |
| Parking length requirement index of all vehicles | 100 | 48.4 |
| **Reduction Parking length** | **-** | **-51.5%** |

Source: Own survey 2010

### New record for length and time in July 2010

The unloading time per stop is not the same for diesel vans, Cargocycles and electric vans. In the before assessment of Feb 2009, the 20 stops had a total stop duration of 2h34 min, this is 7.7 min per stop. For the 7 diesel vans in March 2009, there was an average of 8.15 deliveries per stop. In July 2010, the new records show that there are 3 parcels delivered per stop and the time is 5 min per stop for Cargocycles and electric vans. Changes in fleet and number of parcels distributed per vehicle type are taken into account for the calculation of the impact on space length, time and occupancy of the road network.

There is a decrease in the overall length of all vehicles (-56%, Table 14). Looking at the length and time occupancy for parking of Cargocycles compared to diesel vans, there is a specific reduction of -24%, from 6.3 metres x minute/parcel for diesel vans to 4.8 metres x min/parcel for Cargocycles and electric vans. This corresponds to a substantial reduction in parking length and time occupancy after fleet substitution. However, the July 2010 record show an increase of 37% in the total time spend for unloading activities compared to the before situation.

**Table 14: Impact of fleet change on parking length and time occupancy, Feb 2009 and July 2010**

| Date | Before Feb 09 | After July 2010 |
|---|---|---|
| Fleet | 7 diesel vans | 0 diesel vans, 6 Cargocycles, 3 electric van |
| All vehicles: Number of parcels per stop | 7 | 3 |
| All vehicles: Unloading time in minutes per stop | 7.7 | 5 |
| Number of diesel vans | 7 | 0 |
| Length per van in metres | 5.71 | 5.71 |
| Number of van stops/day | 140 | 0 |
| Number of parcels distributed by van per day | 980 | 0 |
| Diesel van unloading time in minutes per day | 1078 | 0 |
| **Diesel van length and time occupancy in (m x min)/parcel** | **6.3** | **0.0** |
| Number of Cargocycles | | 6 |
| Length per Cargocycles in metres | | 2.35 |
| Number of Cargocycles stops/day | | 140 |
| Number of parcels distributed by Cargocycles per day | | 420 |
| Cargocycle unloading time in minutes per day | | 700 |
| **Cargocycle length and time occupancy in (m x min)/parcel** | | **3.9** |
| Number of elec van | | 3 |
| Length per electric van in metres | | 3.32 |
| Number of electric van stops/day | | 155 |
| Number of parcels distributed by electric van | | 465 |
| Electric van unloading time in minutes per day | | 775 |
| **Electric van length and time occupancy in (m x min)/parcel** | | **5.5** |
| **Average length and time occupancy in (m x min)/parcel for all parcels and all vehicles** | **6.3** | **4.8** |
| Index length and time occupancy per parcel | 100 | 75.9 |
| **Reduction length and time occupancy per parcel** | | **-24.1%** |
| Length of all vehicles in metres | 39.97 | 17.42 |
| Change in length only | | -56.4% |
| Time of all vehicles unloading in minutes per day | 1078 | 1475 |
| Change in total time of all vehicles only | | +36.8% |

*Source: Own survey 2010*

## 3.7 Summary impacts of the fleet replacement in May 2010

In May 2010, Gnewt Cargo could manage to replace all diesel vans by battery-electric vehicles. In Table 15, the Before After impact of the replacement of a fleet of 7 diesel vans by a fleet of 6 Cargocycles and 3 electric vans is shown together with the intermediate stage in March 2010. The Before and After cases are shown for comparison purpose.

The logistics changes and the effects on distance and ghg reduction are presented. The results of the record and calculation show that a full replacement of the vehicle fleet by electric Cargocycles and electric vans lead to a reduction of about 64% of the total distance driven by all vehicles for the deliveries in London EC1-4 area. It also leads to a net $CO_2$ reduction of 62%. However, within the City of London, the total mileage would be increasing by about 98%, due to the higher number of vehicles used, the higher mileage per vehicle per day within the area, and due to the two rounds per day collection and delivery scheme. Outside the City of London, the mileage reduction is -89%, since the only mileage left is the one of the truck making his trip between depot and consolidation centre.

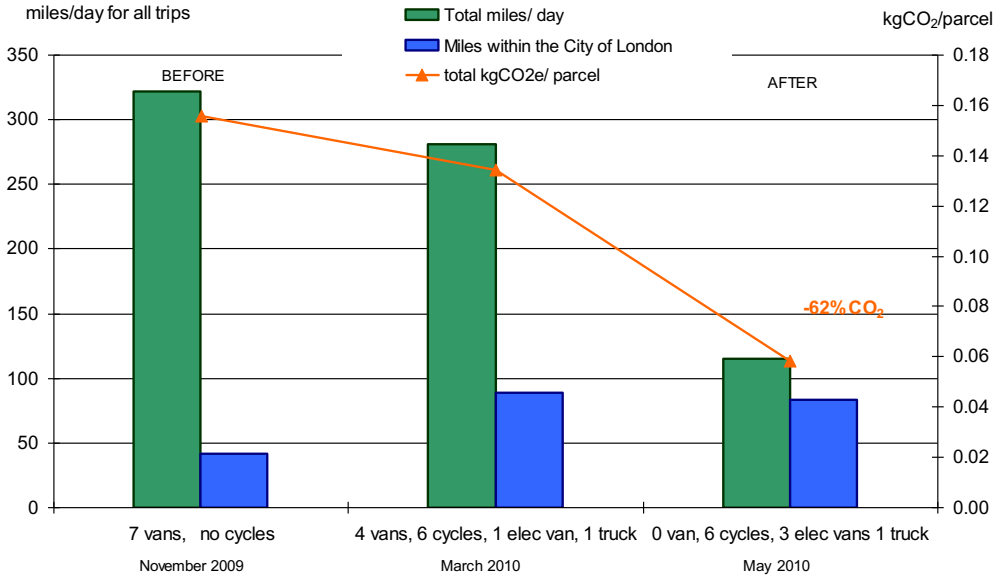
**Table 15: Impact of a 100% fleet replacement on distance, fuel use and ghg emissions**

| | October 2009 | March 2010 | May 2010 |
|---|---|---|---|
| Fleet change | 7 vans, no cycles | 4 vans, 6 cycles, 1 elec van, 1 truck | 0 van, 6 cycles, 3 elec vans 1 truck |
| % market substitution for Cargocycles | 0 | 57.0 | 77.5 |
| Parcels per day by van | 1141 | 500 | 0 |
| Parcels per day by cycle | 0 | 650 | 884 |
| All vans miles/day | 322 | 184 | 0 |
| Truck miles/day | | 34 | 34 |
| Cycles + elec van miles/day | | 63 | 81 |
| Total miles/ day in London | 322 | 281 | 115 |
| Distance index in London | 100 | 87.3 | 35.7 |
| **Reduction in total distance** | **0** | **-12.7%** | **-64.3%** |
| Miles within the City of London | 42 | 89 | 83 |
| Distance index within the City of London | 100 | 211.9 | 197.6 |
| Change in distance within City of London | 0 | +111.9% | +97.6% |
| Van litres/ parcel | 0.0583 | 0.0333 | 0.0 |
| Truck litres/parcel | 0 | 0.0169 | 0.0219 |
| kg$CO_2$e van/ parcel | 0.156 | 0.089 | 0 |
| kg$CO_2$e truck/ parcel | 0 | 0.045 | 0.058 |
| total kg$CO_2$e/ parcel | 0.156 | 0.134 | 0.058 |
| $CO_2$ index | 100 | 86.2 | 37.5 |
| **$CO_2$ reduction** | **0** | **-13.8%** | **-62.5%** |

*Source: Gnewt Cargo survey 2010*

In order to facilitate the understanding of this situation, the Figure 6 visualise the main results.

**Figure 6: Impacts of the fleet replacement by Cargocycles and electric vans**




Source: Gnewt Cargo survey 2010

The only remaining emissions are those of the truck making his return trip in the morning. It is coming from the West of London and crossing the City of London in order to reach the centre situated in the East of the City. For the city centre only, the greenhouse gas emissions in the situation After (in May 2010) are estimated to be about 70% lower than the emissions Before (before November 2009).

## 3.8 Conclusion: Potential for a trial replication and business extension in London

Looking back to the results of this study, some consequences can be drafted on the main issues associated with the changes in logistics organisation, impacts of fleet and technology changes, and future potential developments.

*Need for a micro-consolidation centre as additional transhipment point in the supply chain:* It is necessary to operate a micro-consolidation centre near to the final delivery area when using Cargocycles and electric vans, as well as the main depot. Trucks transport goods from the main depot to this micro-consolidation centre for final delivery by electric vehicle. Cargocycles and electric vans cannot operate from the main depot due to distance constraints. The creating and operating of an additional micro-consolidation centre close to the delivery area is a limitation to further expansion of the spatial area served by electric vehicles, and the economic sectors and types of businesses covered by the trial.

*Parcel and item size:* For reasons of capacity use and product density, the potential for expansion of the Cargocycle trial seems to be appropriate for smaller parcels, while heavy and voluminous orders might be less suitable. This seems to be an important condition, since it requires that the company separates its orders

by size and weight, and puts in place a system that will allocate different types of vehicles (i.e. Cargocycles and vans) for different parcels and orders.

*Density of the delivery area:* The very short distance between stops in the delivery area is one of the main conditions that will be beneficial for the use of Cargocycles. In the trial the company benefits from a very high spatial density of its clients per unit area. A high density of clients is likely to be an important success factor in using Cargocycle delivery. This can be seen as strength, but also as a limitation, because it may limit the potential for expansion to other geographical areas with lower density or to other businesses.

*Congestion and time losses:* The survey diary shows that once arrived at the delivery area, the time needed to cover the short distances between two stops varies between 50 seconds and 12 minutes, depending on traffic lights and traffic congestion on the round. This is typical for a city centre area in the peak hours. This traffic congestion makes it favourable to have a potential expansion of Cargocycle use, since it is expected that the new fleet of vehicle will have to occupy less parking space and use less street space than a corresponding diesel van fleet.

*Long stem mileage and short city centre mileage:* In the study the total van delivery distance is 46 miles/day with 6 miles/round covered during delivery operations in city centre area. This relatively short distance of 6 miles makes this type of round and business delivery area a potential future market for Cargocycle use.

*Availability of central Cargocycle parking and storage place:* Space is needed to store the Cargocycles and the parcels in the city centre. If this is to be generalised, dedicated Cargocycle parking area and parcel storage infrastructure (micro-consolidation centre) are needed.

*Adapted parcel size and weight:* Weight and volume restrictions of Cargocycles and electric vans are such that only a part of the total parcel delivery business using vans in city centres can be subject to a potential switch to electric propulsion.

*Sensitivity factors:* A few specific indicators seem to be strongly influencing the outcomes, since it appears that the fleet substitution effects are very sensitive to variations of these indicators:

- the overall number of parcels that can be delivered per day from the micro-consolidation centre to the delivery area
- the number of rounds per day possibly made by Cargocycle
- the average weight and the mean size of the parcels
- the type of business and the product transported

*Indicators of success for cycle use:* The maximum size of the parcel appears to be one of the indicators of success for the trial. Under the business conditions observed, parcels should exceed a size above 0.05 $m^3$ only in rare occasions. An average parcel size below 0.03 $m^3$ would allow the transport of >50 parcels per round by Cargocycle, and thus enable the possibility of delivering 100 parcels per day in 2 rounds. With an average parcel size below 0.02 $m^3$, the number of parcels delivered by Cargocycle per day could potentially increase to 150, a level similar to the van use previously observed in the "before" survey. At the time of the survey, the mean parcel size is 0.05 $m^3$.

This assessment, however, is based on conditions where the number of Cargocycles, riders and rounds is associated with larger parcel sizes, which thereby affects the environmental, economic and road space occupancy impact of a Cargocycle delivery system.

*Additional vehicles and their drivers:* For the trial, a higher number of vehicles overall and about 64% more working time represent a potential additional cost. In terms of public employment policy, economic and social sustainability, a more general extension of the trial would have a very strong employment effect.

*From the trial to the generalised application:* A trial always represents additional costs and experimental error effects, and these are reinforced by the small size and the lack of scale effects. As soon as scale effects, learning effects and technology effects appear, the cost situation can improve significantly. We would expect the costs to change substantially if the approach was more generally applied.

# 4. Data Monitoring for the period August – December 2014

This Monitoring period is the peak Christmas delivery business time of the year 2014. 5 years after the creation of Gnewt Cargo, a huge increase in freight demand has occurred, but most of the key elements of the logistics system remain the same. Same next day and same day parcels delivery business, same Central London delivery area.

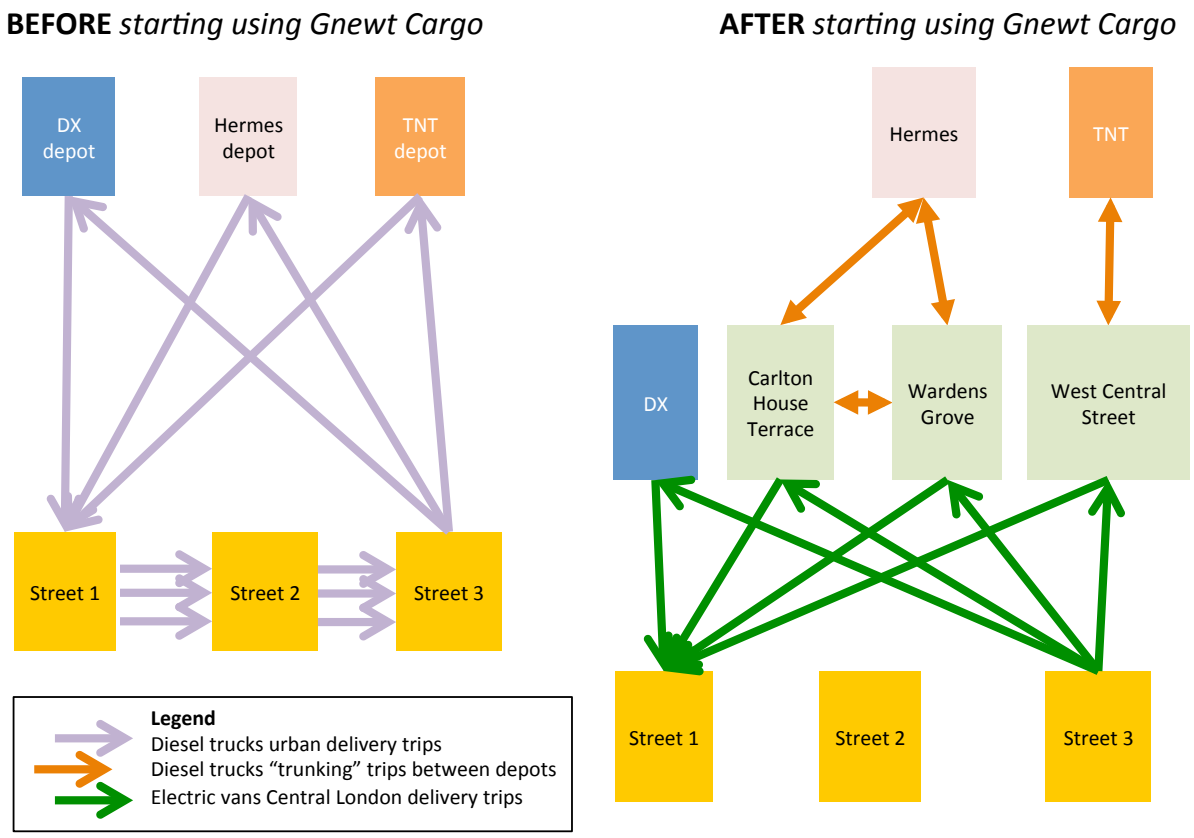
Gnewt Cargo performed in 2014 a doubling in total volume, compared to 2013, and was setting up a new depot for the newly start of Client A operations in Central London in August 2014.

The data collection is organised according to the single carrier consolidation that is now taking place (so-called “after” business situation), and allows to compare with the previous logistics system (so-called “before” situation).

The evolving logistics business of Gnewt Cargo increased its complexity in 2014, as compared to 2010 (Figures 1&2). The limits of the monitoring system are much extended when compared with the starting phase.

The differences in the logistics systems before and after starting using Gnewt Carge are summarised in Figure 7.

**Figure 7: Monitoring all operations of the Gnewt Agile demonstration with multi-carrier deliveries**




*Source: Agile Gnewt Cargo demonstration 2014-2015*

The Monitoring keeps the same structure, with the comparison of situation before and after starting using Gnewt Cargo. Also it is clear that the Monitoring of operation extends to all activities mentioned in the Figure 7, including depot and fleet operations. The limits of the system of observations extend to all diesel trips and all electric vehicle trips. It includes also all depots in both situations before and after.

The freight transport operations of Gnewt Cargo are in large parts organised as a so-called “multi-carrier” delivery system.

As explained in the Final Report, the approach used in the Case Studies is to compare the logistics business situation before and after introducing the Gnewt Cargo Agile multi-carrier operations.

The situation “Before” is shown on the left of Figure 7. The situation “After” is shown on the right part. In the situation Before, the three clients Client A, TNT and DX were running their operations with diesel vehicles, starting in the morning from suburban depots, delivering all day in city centre, and driving back empty to the depots in the afternoon.

The deliveries were performed with traditional diesel trucks and vans.

In the situation After, the three depots of the clients are still part of the logistics system, but the trucks are only driving at night towards city centre to unload the parcels at the Gnewt depots. The DX depot is close enough to the city, so it serves as additional Gnewt depot and the electric vans of Gnewt are staying at DX overnight.

The Carlton House Terrace was used for Client A operations delivering to the Western part of the Borough of Westminster. The Client A truck would deliver at night the Carlton House Terrace depot. Sometimes the same truck would also drop parcels at the Wardens Grove depot.

This Section starts with the monitoring plan at the start of the Agile 1 project (chapter 4.1). In continues with general data about the business in its current shape (chapter 4.2). It then presents intermediate data results on distance and energy (chapter 4.3). All data presented are original records, so called “raw” data that were not going to be further processed. All further processing and analysis of the datasets are presented in the Final Report with the Case Studies.

## 4.1 Data monitoring plan of the Agile Gnewt project 2014-2015

During the project the data on the 'before' situation presented in previous section was updated, adapted to the new business situation and completed.

New data were monitored during the Agile Gnewt project for the after situation in all case studies and generic studies. It was necessary to use a general (generic) method for data collection, and to use the same method in all parts of the Agile Gnewt project.

As of 17 November, the plan for data collection was prepared. On 18 January, first results were presented. And on 14 May 2015, the data collection was successfully completed and final results were obtained.

Three clients were monitored and their operations before and after joining Gnewt Cargo can be compared.

The first step of the comparison was the establishment of the operational logistics scheme with location of the depot, type of vehicle use, main area served.

The second step was to select the most suitable client for each case study.

Several templates for data collection were used. The Tables below presents the result of the data collection made with the template data records.

At the time of completion of this final report, the data have been collected, and many iterations with depot managers and clients were performed in order to obtain all data.

The observations were achieved when the fleet of new vehicles was fully operational and running according to plan.

The main survey technique was to fill in the previously developed templates while on-board the vehicle, during typical operations, during one day, to conduct interview, and to perform follow-up email exchange on data with the different depot and fleet managers.

A researcher is in charge of the observations of logistics operations and supervising the filling of the templates and questionnaires.

The list of the templates and questionnaire is:

- Driver diary template/questionnaire
- General description and additional quantitative and qualitative information collected
- Raw fuel use data from the customer fleet and the Gnewt fleet Information system

- General data and information on the trip, day, working conditions, traffic, parking
- KPI and impact data

The list of the calculated data is non-exhaustive, but encompass at least:

- Load and distance data
- Load and time data
- Before-After changes data for each case study
- Data and information for each generic study

All Tables presented in this report are relevant for the Case Studies and Generic Studies.

Main additional methodological point of the Agile Gnewt project – and main challenge tackled - was the inclusion of costs data.

This section of the Agile Gnewt Cargo Data Report is focussing on the data being made available between November 2014 and January 2015, covering the period at the end of the year 2014 and the first week of 2015.

Principal difference with the other periods is the demand peak for services targeting parcels home deliveries, with data obtained on much increased number of parcels, vehicles, drivers, and the testing/demonstration of opening of an additional depot.

As of 15 January 2015, the data collected on that period of time were monitoring of the Agile Gnewt project operations are representing the situation at the beginning of the case studies.

It was not planned, for this period, to collect all indicators for all trips, all vehicles and all depots mentioned in the Figure 7. This concept of targeting a full-scale data collection has proven too ambitious in past studies, and therefore a selection of trips and depots were made, assuming that these operations are fully representative for all other operations.

To make sure the data is representative, a distance check was performed. The average vehicle distance per week was compared to the average fleet distance per year and these numbers were matching.

On the side of costs, the total costs include all vehicles, depots and trips, for one year. Since these costs are related to the total annual distance, the Agile Gnewt project was able to calculate a value for total costs per km.

On the energy use, the data were obtained for the sample of trips.

## 4.2 General data about Gnewt Cargo demonstration

The general data are representing detailed original qualitative and quantitative business raw data observed and collected through interviews with managers and drivers for the period August to December 2014 (Table 16).

**Table 16: General data and information on the "after" situation, August to December 2014**

| | |
|---|---|
| **Load, type of goods** | On arrival at Gnewt Cargo: rollcages, sacks, pallets<br>Yellow bins were used in Winter 2014 and removed in Spring 2015, replaced by rollcages.<br>Parcels; average weight of one parcel is between 0.5 and 10 kg, average size of 130 boxes fits within vans of 4 $m^3$. This is about 0.03 $m^3$ per parcel.<br>On arrival, parcels are already sorted according to round and delivery postcode area |
| **Client A / TNT/ DX Warehousing** | The warehouses of the 3 main clients Client A, TNT and DX are Regional Distribution Centres for London and surroundings.<br>Gnewt Cargo is running delivery operation starting from the depots:<br>West Central Street depot: 10,000$ft^2$<br>Wardens Grove depot: 25,000 $ft^2$<br>DX depot by Old Street in London, 1000 $ft^2$<br>Carlton House Terrace in West End: 1000 $ft^2$<br>Main task is the recharging plug-in batteries over night<br>Prepare the sequence of orders to be delivered on the day round trips |
| **Business** | Starting from August 2014, between about 6-7000 parcels/day were delivered in normal times. During Christmas peak time, a period starting in September 2014 and ending in early January 2015, the day to day business consisted in up to 17-18,000 parcels deliveries per day,<br>The area served is exclusively the Central London Congestion Charge area.<br>The type of business is B2C and B2B; there are both business and residential customers in this area of London.<br>Each driver has a tiny area to serve in Central London. |
| **Area of delivery and traffic** | EC, SW, WC, SE postcodes in the central Boroughs of London. Mix of very busy narrow roads or, if wide road, no stopping (double red) lines and heavy traffic in the morning peak hours, and quiet residential streets.<br>Visual observation in the morning traffic: between a third and a half of the traffic consists of vans of various size and small trucks, the other half being cars. |
| **Vehicle fleet** | Chrismas peak (Aug to Dec fleet data): Up to 100 electric vans in daily use<br>Spring data about fleet at Gnewt Cargo: 61 electric vans and one cycle in daily use |
| **Drivers** | Between 53 and 110 drivers were employed in that period, covering the London delivery area. |
| **Goods arrival** | 6-7 Client A trucks, DAF FT45, deliver at night the Wardens Grove depot.<br>2 TNT trucks deliver at night the West Central Street depot.<br>DX depot is a warehouse where the goods are sorted and rounds prepared. |

| | |
|---|---|
| | Carlton House Terrace depot is a small parking area dedicated to Client A, where one or two Client A trucks delivered at night in the period October 2014-January 2015. |
| **Loading** | Takes place during the morning, starting at 07:00, all vans are loaded by Gnewt Cargo driver staff. Vehicle loading time is, on average, 45-60 minutes per van. The drivers arrive at depot around 07:00-08:00. |
| **Collection** | The collection consists of return loads (broken, not needed, etc.)<br>Between 0 and max 5 items collected per driver per day |
| **Time windows for delivery** | 08:00-18:00 is the main time window for deliveries in Central London.<br>The driver carries out the deliveries in the most logical geographical order. In few cases, it is necessary for the driver to come back to the same street later in the delivery round to deliver to another client. This is due to delivery time windows that are not coherent for all clients in the same area.<br>08:00 First drivers are leaving<br>10:00 Almost all drivers are out on delivery trips<br>18:00 Most drivers are back to the depots<br>19:00-20:00 Last drivers are returning to the Gnewt Cargo depots |
| **Trolley** | 2 wheels trolleys are in use by some driver. |
| **Walking** | Long walking time. Frequent longer walks on the footway, few crossing the street, because the permitted loading space is not situated close to the entrance of the client. Longer time needed for obtaining the delivery signature from the clients. |
| **Van mileage and age** | About 3,000 miles/year. Fleet age is mostly only up to 4 years. |
| **GPS use** | Only one vehicle is equipped with GPS onboard unit with data recording and telematics transfer to the head office. |
| **Hand device, other IT and software** | Each client gives Gnewt Cargo its own hand device for signature: No mix of goods into one single van for the majority of operations<br>No round optimisation or tour scheduling support system is in use. Postcode order is made alone by the driver according to his knowledge.<br>Driver knowledge takes about 2 months to build up to full coverage and operational efficiency. |

*Source: Agile Gnewt Cargo survey 2014-2015*

## 4.3 “Raw” data on distance

Tables 17 to 19 show the original “raw” data recorded on distance travelled starting from 3 depots. The selection of a sample of 5 vehicles for each of 3 depots was made in order to demonstrate how our targets are met. The sample selected is representative for all other Gnewt Cargo operations. The first Table 17 presents a daily breakdown. The weekly data are consistent with the daily data. In the daily data, the longest run was 25 miles per day and the shortest 2. This is a difference with a factor 12.5.

**Table 17: Carlton House Terrace: Daily depot operations, odometer readings, distance in miles per day, week 05 to 09 January 2015**

| | Mileage 05/01 | | | Mileage 06/01 | | | Mileage 07/01 | | | Mileage 08/01 | | | New | Mileage 09/01 | | | Week |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Van ID | Start | End | Total | Start | End | Total | Start | End | Total | Start | End | Total | Van ID | Start | End | Total | Total |
| 1 | 189 | 195 | 6 | 195 | 199 | 4 | 199 | 210 | 11 | 210 | 214 | 4 | 6 | 37 | 48 | 11 | 36 |
| 2 | 171 | 177 | 6 | 177 | 183 | 6 | 183 | 192 | 9 | 192 | 201 | 9 | 7 | 41 | 51 | 10 | 40 |
| 3 | 279 | 284 | 5 | 284 | 292 | 8 | 292 | 308 | 16 | 308 | 320 | 12 | 8 | 320 | 322 | 2 | 43 |
| 4 | 280 | 295 | 15 | 295 | 310 | 15 | 310 | 322 | 12 | 322 | 337 | 15 | 9 | 32 | 47 | 15 | 72 |
| 5 | 306 | 326 | 20 | 326 | 359 | 23 | 249 | 259 | 10 | 359 | 384 | 25 | 10 | 33 | 57 | 24 | 102 |

*Source: Agile Gnewt Cargo survey 2014-2015*

**Table 18: West Central Street: depot operations, odometer readings, distance in miles per day, week 05 to 09 January 2015**

| | Mileage 05/01 | Mileage 09/01 | Week distance in mi | Week distance |
|---|---|---|---|---|
| Van ID | End | End | Total | Total in km |
| 11 | 1074 | 1086 | **32** | 54 |
| 12 | 1086 | 1106 | **20** | 34 |
| 13 | 1433 | 1467 | **34** | 57 |
| 14 | 1496 | 1515 | **19** | 32 |
| 15 | 6888 | 6905 | **17** | 29 |

*Source: Agile Gnewt Cargo survey 2014-2015*

**Table 19: Wardens Grove: depot operations, odometer readings, distance in miles per day, week 05 to 09 January 2015**

| | Mileage 05/01 | Mileage 09/01 | Week distance in mi | Week distance |
|---|---|---|---|---|
| Van ID | Start | End | Total | Total in km |
| 16 | 1934 | 1977 | **43** | 72 |
| 17 | 1433 | 1488 | **55** | 92 |
| 18 | 1424 | 1462 | **38** | 64 |
| 19 | 1967 | 2003 | **36** | 60 |
| 20 | 1948 | 2009 | **61** | 102 |

*Source: Agile Gnewt Cargo survey 2014-2015*

In the weekly data, the longest run observed was 102 miles, and the shortest was 17 miles. This is a difference with a factor 6.Average distance per van per week in Carlton House Terrace: 59 miles

- Average distance per van per week at West Central Street: 24 miles
- Average distance per van per week at Wardens Grove: 47 miles
- Gnewt Cargo overall average distance per van per week: 41.9 miles
- Gnewt Cargo overall average distance per van per day: 8.4 miles

**Table 20: Delivery performances of the Carlton House Terrace depot in the period 05 to 09 Jan 2015**

| Carlton House Terrace | Weekly distance in miles | Weekly distance Total in km | Parcels delivered during period | Distance km/ parcel |
|---|---|---|---|---|
| Van 1 | 36 | 60 | 572 | 0.106 |
| Van 2 | 40 | 67 | 463 | 0.145 |
| Van 3 | 43 | 72 | 425 | 0.170 |
| Van 4 | 72 | 121 | 582 | 0.208 |
| Van 5 | 102 | 171 | 348 | 0.492 |
| *Average* | *59* | *98* | *478* | *0.224* |

*Source: Agile Gnewt Cargo survey 2014-2015*

**Table 21: Delivery performances of the West Central Street depot in the period 05 to 09 Jan 2015**

| West Central Street | Weekly distance in miles | Weekly distance Total in km | Parcels delivered during period | Distance km/ parcel |
|---|---|---|---|---|
| Van 1 | 32 | 54 | 707 | 0.076 |
| Van 2 | 20 | 34 | 586 | 0.057 |
| Van 3 | 34 | 57 | 816 | 0.070 |
| Van 4 | 19 | 32 | 1006 | 0.032 |
| Van 5 | 17 | 29 | 702 | 0.041 |
| *Average* | *24* | *41* | *763* | *0.055* |

*Source: Agile Gnewt Cargo survey 2014-2015*

**Table 22: Delivery performances of the Wardens Grove depot during the period 05 to 09 Jan 2015**

| Wardens Grove | Weekly distance in miles | Weekly distance Total in km | Parcels delivered during period | Distance km/ parcel |
|---|---|---|---|---|
| Van 1 | 55 | 92 | 641 | 0.144 |
| Van 2 | 38 | 64 | 1061 | 0.060 |
| Van 3 | 36 | 60 | 517 | 0.117 |
| Van 4 | 61 | 102 | 560 | 0.183 |
| *Average* | *48* | *80* | *695* | *0.126* |

*Source: Agile Gnewt Cargo survey 2014-2015*

## Energy data

The first raw energy data were collected in December 2014, for all operations.

- Electric van energy and transport performance: 3.6 miles per kWh, or 0.278 kWh per mile
- Electricity purchase price: £0.10 per kWh
- Fuel use of a diesel van: 10l/100km in urban delivery conditions
- Fuel price per litre, end of 2014: 1l diesel = £1.30

**Conversion factors**:

The following conversion factors are used for the whole study.

- 1 mile = 1.609344 kilometre
- 1l diesel = 3.1 kg $CO_2$ equivalent (Gov.UK 2014)
- 1 Imperial Gallon (UK) = 4.54609188 litres

**Distance records of clients**

These distances are needed for the before-after comparison of logistics systems.

From clients hubs to the Central London delivery area:

- Hub 1, Enfield: 13 miles
- Hub 2, Nuneaton: 113 miles
- Hub 3, Sydenham: 9 miles
- Hub 4, Brunswick Park: 9 miles

**Fleet and fuel use records of clients**

These vehicle records are needed for the before-after comparison.

“After” trunking trips with diesel trucks records: 7 to 8 diesel trucks of 7.5t, type DAF FT45 and 3.5t LWB Transit are used for trunking between the clients’ depots and the three depots of Gnewt Cargo.

“Before” truck deliveries fuel records: Previously used vehicle for deliveries in Central London before Gnewt Cargo was obtaining the service: LWB Transit diesel vans and DAF FT45.

Average fuel use of an LWB Transit in urban conditions: 22 mpg = 12.8 l/100km

Average fuel use of a DAF FT45 7.5t in urban conditions: 25 l/100km (DAF 2015)

## 4.4 Electric van fleet, qualitative and quantitative data

The Figures 8 and 9 are presenting the two main models of electric freight vehicles running delivery operations at Gnewt Cargo: Nissan e-NV200 and Renault Kangoo Z.E.

Common feature for all vehicles is that they are powered by full battery electric motors only, with zero tailpipe emissions.

Gnewt purchases electricity from a renewable energy provider, which enables that the electricity is also produced with zero carbon emission.

The Key specifications of the Nissan e-NV200 (Figure 6) are

- 4.2 $m^3$ load volume
- 2.04 m cargo length and 2 Euro pallets
- 770 kg payload weight
- 170 km maximum range with the battery fully charged at departure.

**Figure 8: Nissan e-NV200**


*Source: Nissan 2014*

There are two modes available for battery charging: Normal Charge (220V): ~8 hours (full charge); Quick Charge (400V): 30 min (80% charge).

**Figure 9: Renault Kangoo Van Z.E.**


*Source: Renault 2014*

The key specifications of the Renault Kangoo Van Z.E. (Figure 7) are

- 3.4 $m^3$ load volume
- 650 kg payload
- 106 miles range in normal weather and urban/suburban driving conditions.

The range is reduced for inner-city driving and could come down to 50 miles in extreme winter conditions. There is a version 'Maxi Van' with 4.6$m^3$ volume and 650 kg payload.

The fleet of Renault Kangoo is running the vast majority of operations at Gnewt Cargo Wardens Grove depot (Figure 10).

**Figure 10: The fleet of Renault Kangoo at the Wardens Grove depot**


*Agile Gnewt Cargo demonstration 2014-2015*

# 5. Data report for the period January to May 2015

In Section 5, the “raw” data recorded for the period January to May 2015 are presented.

After the end of the Christmas peak period, the business is returning to a more typical situation with less demand and less vehicles in operation.

It is necessary to obtain a better view on the annual fluctuations in the management of multiple clients and depots and vehicles.

The main difference with previous period is the closure of the depot in Carlton House Terrace (see case studies report).

In this section, impact data were collected more in-depth, for both situations before and after trial starts. All before data and all after data were collected for the period starting in January 2015 and ending in May 2015, following the logic presented in Figure 7 and Box 1.

**Box 1: Definition of “Before” and “After” in Tables and Figures**

In all Tables mentioning “Before” and “After”, both words always refers to the two standard business situations:

- **Before means before Agile Gnewt Cargo started**: the diesel business with a DAF FT45 7.5t delivery trucks, starting at a depot in Ealing, making deliveries in Central London

- **After means after Agile Gnewt Cargo started**: the electric van delivery business with Trunking from Ealing + electric vans starting from the consolidation depot at Wardens Grove, making deliveries to clients in Central London

## 5.1 Qualitative and quantitative basic data on Gnewt Cargo operations 2014 and 2015

On 27 January 2015, a day of raw data collection was performed. Interviews, observations and records were made on a typical round trip to a Central London area, starting from Wardens Grove depot with a Nissan van. Nothing special happened so this can be considered a representative, typical round trip of the Gnewt Cargo parcels delivery business. The main objective was to assess the logistics performances and explain the details.

**Table 23: Round data on logistics and delivery performance, monitored on one typical day, 27 Jan 2015, & on annual data**

| | |
|---|---|
| **Type of vehicle round** | Multi drop round, with deliveries and few collections |
| **Number of stops per round** | About 60-80 in a normal day |
| **Number of rounds per day** | 1 (a few cases of an additional delivery round in the afternoon) |
| **Distance between depot and first stop, (stem mileage)** | 1.5 km |
| **Mean distance between stops in the destination area** | 50-100 metres |
| **Location of origin and destination, and location of the stops** | Round starting from Wardens Grove, delivery stops in Borough of Westminster, Pimlico area, no collection |
| **Start and end time of vehicle round** | 09:56 to 13:16 (observation time)<br>16:30 arrival time at depot |
| **Round time** | 11 minutes in the morning from depot to first stop; about 6 hours delivery time. |
| **Delay time** | No delays |
| **Vehicle speed, driving time and stop time** | Average speed (driving time only): less than 5 miles/hour on average, with an average driving time of about 1-2 minute between 2 stops, and a maximum of 4 minutes driving time after the first stop.<br>Total delivery time observed: 3h20<br>Driving time: 50 minutes (1 Quarter of the Total delivery time is spent driving on the road and impacting traffic)<br>Stop time: 2h30 (3 Quarter of the Total delivery time is spent with the vehicle stopped at the client location, either on a public parking space or at a private loading bay)<br>Stop time was measured as the time taken between motor stop and motor start, with an average of 5 ½ minute per stop. |
| **Dwell time (waiting at customer location)** | None during the round |
| **Vehicle crew size** | 1 |
| **Delays** | No traffic jams towards delivery area in West Central London in the morning, no delay time, and the first delivery can be performed straight away on arrival. |
| **Parking and Penalty Charge Notes (PCN)** | PCNs are issued frequently, and takes an important management time to process. |
| **Phone calls** | No phone call and no change in delivery round operation took place on that day. |

| | |
|---|---|
| **Driver knowledge** | No case was observed where the driver would need to search for a new customer location. Searching time was less than a minute per client, if any. |
| **Empty running** | No empty running |

*Source: Agile Gnewt Cargo survey 2014-2015*

## 5.2 Before – after demonstration data April-May 2015: Fleet, load and distance

**Table 24: Before – after data on fleet vehicle numbers and logistics systems in use**

| Units<br>Description of logistics system | Number of delivery trucks | Number trunking trucks | Number electric vans |
|---|---|---|---|
| Before: DAF FT45 7.5t delivery trucks + depot Ealing | 35 | 0 | 0 |
| After: Trunking from Ealing + Electric van delivery + depot Wardens Grove | 0 | 8 | 35 |

*Source: Agile Gnewt Cargo survey 2014-2015*

This section presents the original before-after data collected in the Agile Gnewt Cargo project.

In following Tables 25-26, Table 34, and Tables 37-42, the same Before-After definition is used, like in Table 24 above.

Further description of the logistics systems before and after are found above in Figure 7, Box 1 and details are explained and presented in the Final Report.

**Table 25: Before – after data on average load unit**

| Units | Parcels per day in delivery trucks | Parcels per day in trunking trucks | Parcels per day in electric vans | Total parcels delivered per day | Index parcels per day |
|---|---|---|---|---|---|
| Before | 4500 | 0 | 0 | 4500 | 100 |
| After | 0 | 4500 | 4500 | 4500 | 100 |

*Source: Agile Gnewt Cargo survey 2014-2015*

**Table 26: Before – after data on distance according to vehicle type and load**

| Units | km/day in delivery trucks | km/day in trunking trucks | km/day in electric vans | km/day in total all vehicles | Distance in km per parcel | Index distance per parcel |
|---|---|---|---|---|---|---|
| Before | 1724 | | 0 | 1724 | 0.38 | 100 |
| After | 0 | 335 | 484 | 819 | 0.18 | **48** |

*Source: Agile Gnewt Cargo survey 2014-2015*

## 5.3 AFTER demonstration: Detailed data records on distance April-May 2015

Raw data is the original data record of mileage covered by 5 vans on 3 depots during two weeks, 20 April to 1st of May 2015, for 10 working days of Central London delivery rounds. These detailed original data records presented in Tables 27-29 are allowing to perform the calculation of total distance (Tables 30-33). All the further calculation of total distance are presented below in Tables 31-33, and are corresponding to the detailed original data records from Table 27-29.

**Table 27: Raw data on distance driven from DX depot**

| | **Mileage 20-24/04** | | | **Mileage 27/04-01/05** | | | **2 weeks** |
|---|---|---|---|---|---|---|---|
| Area of London | Start | End | Total | Start | End | Total | Total miles |
| EC4 | 2841 | 2879 | 38 | 2879 | 2920 | 41 | 79 |
| EC3/2 | 3680 | 3722 | 42 | 3722 | 3761 | 39 | 81 |
| EC2 | 3688 | 3728 | 40 | 3728 | 3771 | 43 | 83 |
| EC4 | 4035 | 4075 | 40 | 4075 | 4113 | 38 | 78 |
| EC2 | 6390 | 6436 | 46 | 6436 | 6481 | 45 | 91 |

*Source: Agile Gnewt Cargo survey 2014-2015*

**Table 28: Raw data on distance driven from West Central Street**

| | **Mileage 20-24/04** | | | **Mileage 27/04-01/05** | | | **2 weeks** |
|---|---|---|---|---|---|---|---|
| **Area of London** | **Start** | **End** | **Total** | **Start** | **End** | **Total** | **Total miles** |
| EC1 | 2718 | 2850 | 132 | 2850 | 2995 | 145 | 277 |
| EC2A,M,Y,EC1Y | 4584 | 4732 | 148 | 4732 | 4872 | 140 | 288 |
| EC | 8447 | 8572 | 125 | 8572 | 8693 | 121 | 246 |
| EC3,EC2R,EC2N | 3155 | 3227 | 72 | 3227 | 3302 | 75 | 147 |
| EC4, EC2V | 3068 | 3209 | 141 | 3209 | 3347 | 138 | 279 |

*Source: Agile Gnewt Cargo survey 2014-2015*

**Table 29: Raw data on distance driven from Wardens Grove**

| | Mileage 5 weekdays 20-24/04 | | | Mileage 5 weekdays 27/04-01/05 | | |
|---|---|---|---|---|---|---|
| Area of London | Start | End | Total | Start | End | Total |
| SW1P | 2375 | 2419 | 44 | 2419 | 2456 | 37 |
| SW1E | 2413 | 2457 | 44 | 2457 | 2495 | 38 |
| EC1N | 2273 | 2325 | 52 | 2325 | 2355 | 30 |
| WC1A | 2746 | 2800 | 54 | 2800 | 2851 | 51 |
| SE1 | 1009 | 1057 | 48 | 1057 | 1089 | 32 |

*Source: Agile Gnewt Cargo survey 2014-2015*

## 5.4 "After": Distance data analysis for April-May datasets recorded at 3 depots.

The data in Table 30 is a calculated impact analysis of the raw data presented in Table 27. Table 31 do the same for Table 28 and Table 32 refers to raw data in Table 28.

**Table 30: DX depot KPI and mileage data analysis 10 weekdays 20/04-01/05 2015**

| Van ID | Total miles | km total | km/ day | Parcels delivered during period | parcels/ day | km/ parcel |
|---|---|---|---|---|---|---|
| 1 | 79 | 127 | 12.714 | 1370 | 137 | 0.093 |
| 2 | 81 | 130 | 13.036 | 1208 | 121 | 0.108 |
| 3 | 83 | 134 | 13.358 | 1421 | 142 | 0.094 |
| 4 | 78 | 126 | 12.553 | 1085 | 109 | 0.116 |
| 5 | 91 | 146 | 14.645 | 1437 | 144 | 0.102 |
| *Average* | *82* | *133* | *13.261* | *1304* | *130* | *0.102* |

*Source: Agile Gnewt Cargo survey 2014-2015*

**Table 31: West Central Street KPI & mileage data analysis 10 weekdays 20/04-01/05 2015**

| Van ID | Total miles | km total | km/day | Parcels delivered during period | parcels/day | km/parcel |
|---|---|---|---|---|---|---|
| 1 | 277 | 446 | 44.579 | 698 | 70 | 0.639 |
| 2 | 288 | 463 | 46.349 | 745 | 75 | 0.622 |
| 3 | 246 | 396 | 39.590 | 679 | 68 | 0.583 |
| 4 | 147 | 237 | 23.657 | 489 | 49 | 0.484 |
| 5 | 279 | 449 | 44.901 | 782 | 78 | 0.574 |
| *Average* | *247* | *398* | *39.815* | *679* | *68* | *0.580* |

*Source: Agile Gnewt Cargo survey 2014-2015*

**Table 32: Wardens Grove KPI & mileage data analysis 10 weekdays 20/04-01/05, random sample**

| Van ID | Total miles | km total | km/day | Parcels delivered during period | parcels/day | km/parcel |
|---|---|---|---|---|---|---|
| 1 | 81 | 130 | 13.036 | 1154 | 115 | 0.113 |
| 2 | 82 | 132 | 13.197 | 2032 | 203 | 0.065 |
| 3 | 82 | 132 | 13.197 | 2022 | 202 | 0.065 |
| 4 | 105 | 169 | 16.898 | 2458 | 246 | 0.069 |
| 5 | 80 | 129 | 12.875 | 1958 | 196 | 0.066 |
| *Average* | *86* | *138* | *13.840* | *1925* | *192* | *0.076* |

*Source: Agile Gnewt Cargo survey 2014-2015*

**Table 33: Average one week KPI analysis for all 3 depots, Winter 2014 and Spring 2015**

| Period of raw data record | Average miles/ week | Average parcels delivered during 1 week | Average km/ week | Average km/ day | Average parcels/ day | Average km/ parcel | Index km/ parcel |
|---|---|---|---|---|---|---|---|
| August-December 2014 | 43 | 642 | 73 | 15 | 128 | 0.113 | 100 |
| January-May 2015 | 69 | 651 | 112 | 22 | 130 | 0.171 | 152 |

*Source: Agile Gnewt Cargo survey 2014-2015*

Main difference between the data recorded for the period August-December 2014 (average from sample in week 05-09 Jan.) and January- May 2015 (average from sample in weeks 20 Apr-01 May) is that there is a +52% increase in the average distance per parcel. Average weekly miles increases around 50%, but number of parcels remains stable at 128 and 130 per day. Reason is the overall decrease in demand, compared to the Christmas peak period. when measured in terms of total number of parcels delivered per week. This effect leads to a decrease in density of clients and therefore to longer trips for the same amount of parcels.

The impact assessment data below is for all depots and uses the central value of 13.8km per day as distance average for Wardens Grove depot.

## 5.5 Monitoring data on Energy and $CO_2$ in April-May 2015

**Table 34: Agile Gnewt Cargo demonstration data on fuel use and $CO_2$**

| | Litres diesel/ day | kWh/ day | kg $CO_2$e/ day | kg $CO_2$e/ parcel | Index kg$CO_2$e/ parcel | Reduction in $CO_2$e/ parcel |
|---|---|---|---|---|---|---|
| Before | 431 | 0 | 1336 | 0.297 | 100 | - |
| After | 50 | 525 | 156 | 0.035 | 12 | -88% |

*Source: Agile Gnewt Cargo survey 2014-2015*

The indicator Litres diesels per day refers to the fuel use by all trucks in the fleet sample performance recorded “before” and “after” and presented in Tables 24 to 26.

The kWh/day is the reading of the electricity metering system at Wardens Grove, used by all electric vans “after” presented in Tables 24 to 26.

The column with kg $CO_2$e per day is the total $CO_2$ emitted by all vehicles during one day.

The column with kg $CO_2$e per parcel relates the real emission with the real deliveries performed.

The column index and the column Reduction are identical with the column on kg $CO_2$e per parcel, but it only gives a clear view on how the data are calculated. So the reader can understand that, when speaking about an 88% reduction in $CO_2$ per parcel, this means that the factor 100, from which the reduction is calculated, corresponds to the 297 grams emitted per parcel in the situation “Before”.

## 5.6 Constant values used to monitor costs and calculate impacts

At night or in early morning, daily “trunking” operations are performed between the clients’ depot and the depots of Gnewt Cargo. Eight 7.5t diesel trucks of the type DAF FT45 are coming from the Client A depot in Enfield to Wardens Grove at night/early morning. Fuel use data were estimated. The diesel $CO_2$ and costs were calculated out of the estimates.

It is assumed that no electricity $CO_2$ is generated by the use of electric vans, because of the purchase of electricity from 100% regenerative energy sources.

Number of staff per truck is uncertain: it is assumed that one third of a working day is spent by each truck driver to deliver at night/ealy morning for the trunking trip one way from Enfield to Wardens Grove.

**Table 35: Constant values used for calculation of costs and impacts “before” and “after”(a)**

| Distance Before: Delivery trip Enfield depot-city centre border. in km | Distance After: trunking Enfield Depot to Gnewt depot. in km | Distance before and after: delivery trip part in city centre/van round trip in km | Fuel use DAF LF45 truck for delivery trips in l/100km | Fuel use. DAF LF45 trunking trips in l/100km | Emission factor kg $CO_2$e/l diesel |
|---|---|---|---|---|---|
| 17.7 | 20.9 | 13.8 | 25 | 15 | 3.1 |

*Source: Agile Gnewt Cargo survey 2014-2015*

**Table 36: Constant values used for calculation of costs and impacts “before” and “after” (b)**

| Number Staff per van or per truck | Staff costs/day in £ | Prix £/l diesel | Fixed costs for vans + depots+ variable others in £/km | Electricity price in £/kWh | Electricity use in kWh/day per electric van | Annual Wardens Grove depot rental costs (included in fixed costs) in £ |
|---|---|---|---|---|---|---|
| 1.0 | 66 | 1.2 | 1.5 | 0.12 | 15 | 200 000 |

*Source: Agile Gnewt Cargo survey 2014-2015*

The number of staff per van is taken from the Gnewt Cargo business practices in all the years 2009-2015. While this number might fluctuate a little, the standard rule remains 1 driver for 1 van.

The staff costs are 66£ per day and this value is an average for 2014 and is including gross salary costs.

The fuel costs is an average diesel price for UK in 2014.

The electricity price is updated for May 2015.

The fixed costs include all other costs except staff and energy. This value was calculated as a standard value for 2014 across all businesses, all vans and all depot operations.

The fixed costs for running the depots of the clients could not be obtained. An indication of the highest position of the fixed costs is given with the rental costs of the depot in Wardens Grove.

The fixed costs for the annual spent on vehicle purchase have proven identical “before” and “after”.

It is likely, however, that the total costs of all depots increased in the operations “after”. It is also likely that the additional annual depot rental costs are compensated by a series of costs reduction in other areas such as vehicle taxes, Congestion Charge, etc.

The absence of a fully detailed costs breakdown for all depots and all vehicle operations has led to the assumption that the fixed costs for vans, depots and variable other costs can be considered identical in the “before” and “after” situations.

## 5.7 Before-after impact data on staff changes and costs reductions

**Table 37: Data on staff changes and costs (in £)**

| | Number staff | Index no staff | Parcels delivered per staff per day | Total costs per staff/day in £ | Total costs energy/day in £ | Other fixed and variable costs /day | Grand total costs/day | Total costs per parcel | Index total costs per parcel |
|---|---|---|---|---|---|---|---|---|---|
| Before | 35.0 | 100 | 129 | 2320 | 517 | 2585 | 5422 | 1.20 | 100 |
| After | 37.4 | **107** | 120 | 2479 | 123 | 1229 | 3831 | 0.85 | **71** |

*Source: Agile 1 Gnewt Cargo survey 2014-2015*

An overall business cost reduction of 29% was estimated for the Agile demonstration. An estimated increase of +7% was estimated as employment effect. The additional staff is required for the trunking leg, at night. The business model is competitive on the market, sustainable in terms of long term profitability.

The before-after difference in the other fixed and variable costs per day are a direct result of the reduction in miles travelled, since the costs are calculated with a fixed assumed ratio of 1.5£/km, as presented above in Table 36.

The exact operating costs for each vehicle category used by Gnewt Cargo and its clients could not be determined. Instead, an average operating costs value for all costs other than staff and energy was obtained.

## 5.8 Detailed distance reduction impacts of the Agile demonstration

**Table 38: Data on detailed distance reduction for day time traffic**

| | Day time distance in km | Night time distance in km | Total distance in km | Index day time distance | Reduction day time distance in % |
|---|---|---|---|---|---|
| Before | 1724 | 0 | 1724 | 100 | - |
| After | 484 | 335 | 819 | 48 | **-52%** |

*Source: Agile 1 Gnewt Cargo survey 2014-2015*

**Table 39: Data on detailed reduction for empty running distance**

| | Empty running distance | Empty running in % of total | Index empty running distance | Reduction empty running distance in % | Loaded distance | Total distance |
|---|---|---|---|---|---|---|
| Before | 620 | 36 | 100 | 0 | 1104 | 1724 |
| After | 220 | 27 | 35 | **-65%** | 599 | 819 |

*Source: Agile 1 Gnewt Cargo survey 2014-2015*

**Table 40: Data on detailed distance reduction for main axis and major roads towards city centre**

| | Main axis distance | City Centre distance | Total distance in km | Index main axis distance | Reduction main axis distance in % |
|---|---|---|---|---|---|
| Before | 1239 | 484 | 1724 | 100 | 0 |
| After | 319 | 500 | 819 | 26 | **-74%** |

*Source: Agile 1 Gnewt Cargo survey 2014-201*

**Table 41: Data on reduction for total distance driven in London per day**

| | Total distance per day in km | Index total distance per day | Reduction in total distance per day in % |
|---|---|---|---|
| Before | 1724 | 100 | 0 |
| After | 819 | 48 | **-52%** |

*Source: Agile 1 Gnewt Cargo survey 2014-2015*

The analysis and definitions of empty running and main axis distance are explained in the final Agile 1 report. This monitoring data is including all trips in whole of London. Total distance is one of the key impacts and key project targets.

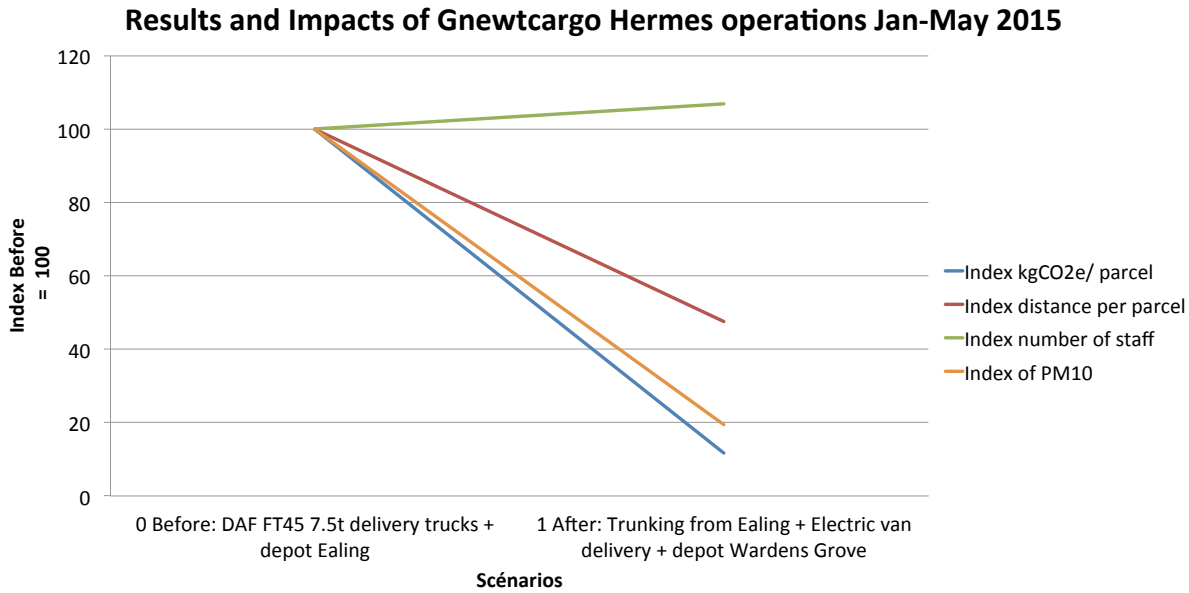
**Table 42: Data on reduction for distance per parcel**

| | Total distance in km per parcel delivered | Reduction in parcel distance in % |
|---|---|---|
| Before | 0.383 | 0 |
| After | 0.182 | **-52%** |

*Source: Agile 1 Gnewt Cargo survey 2014-2015*

## 5.9 Overview of impacts and targets

**Figure 11: Impacts on Agile targets and key performance indicators**




*Source: Agile Gnewt Cargo survey 2014-2015*

Detailed impact presentation and analysis of the targets and results are available in the Final Report.

**Table 43: Key performance Indicators of Agile Gnewt Cargo period Jan-May 2015**

| Indicators | Achieved | Targets |
|---|---|---|
| Reduction in the main axis distance | -74% | n.a. |
| Less kilometres travelled | -52% | -69% |
| Reduction in NOx | -81% | -71% |
| Reduction in PM | -81% | -87% |
| Reduction in $CO_2$ emissions | -88% | -67% |
| Reduction in empty vehicle distance | -65% | n.a. |

*Source: Agile Gnewt Cargo survey 2014-2015*

The targets were set as a constitutive element of the Agile Gnewt Cargo demonstration project.

The targets reduction in number of vehicle and the target reduction in number of empty trips could not be met, due to the configuration of the urban freight business for multi-carrier deliveries.

# ANNEX

## References

Browne, M. and Allen J., 2006: BESTUFS Best Practice in data collection, modelling approaches and application fields for urban commercial transport models. Urban freight data collection - synthesis report. Available from: http://www.bestufs.net/bestufs2_data.html Accessed Mai 2017)

Clear Zone Partnership, 2006: Life Cycle Assessment of Vehicle Fuels and Technologies. Report for the Clear Zone Partnership. London

Defra - Department for Environmental Food and Rural Affairs, 2009. Guidelines for Company Reporting on Greenhouse Gas Emissions Annexes Annex 1 - Fuel Conversion Factors, London: Defra

Debrincat L., 1998: *The costs of mobility in the Paris region*. European Transport Conference 1998. Available from: http://abstracts.aetransport.org/paper/index/id/750/confid/4 (Accessed Mai 2017)

Edwards, J.B., McKinnon, A.C. and Cullinane, S.L., 2009; *Carbon Auditing the 'Last Mile': Modelling the Environmental Impacts of Conventional and Online Non-food Shopping* March 2009, Edinburgh, Available from: http://www.greenlogistics.org/SiteResources/Edwards-LastMile.pdf (Accessed Mai 2017)

Freightbestpractice, 2006; Key Performance Indicators for Non-Food Retail Distribution. Benchmarking Guide. Available from: http://www.freightbestpractice.org.uk/performance-management (Accessed Mai 2017)

GOV.UK (2014): Measuring and reporting environmental impacts: guidance for businesses. https://www.gov.uk/measuring-and-reporting-environmental-impacts-guidance-for-businesses (Accessed Mai 2017)

La Petite Reine, 2010: *Commercial Vehicle, Cargocycle Transport*. Available from http://www.lapetitereine.com/ (Accessed Mai 2017)

Leonardi, J., Browne, M. & Allen, J., 2012: Before-after assessment of a logistics trial with clean urban freight vehicles: A case study in London, Procedia - Social and Behavioral Sciences 39, 146-157.

Mazingue, 2009: *Cargocycle presentation*. SUGAR workshop, City of Paris

McKinnon A.C. and Piecyk M., 2009: Measurement of $CO_2$ emissions from road freight transport: A review of UK experience. Energy Policy 37 (2009) 3733-3742.

Nissan, 2014; Nissan e-NV200

Renault, 2014; Renault Kangoo Z.E

TfL - Transport for London, 2009; Cycle Freight in London - A Scoping Study A joint report commissioned by Cycling, Walking and Accessibility and the Freight Unit, Transport for London May 2009

# List of abbreviations

| | |
|---|---|
| Agile 1 | Agile 1 Demonstrator project |
| B2B | Business to Business trade |
| B2C | Business to Consumer trade |
| $CO_2$ | carbon dioxide |
| $CO_2e$ | carbon dioxide equivalent |
| Defra | Department for Environment, Food and Rural Affairs |
| DfT | Department for Transport |
| EC | East Central London (UK Postcode area in London) |
| EU | European Union |
| EV | electric vehicle |
| $ft^2$ | square feet |
| GHG | greenhouse gas |
| GLA | Greater London Authority |
| goe | gram of oil equivalent |
| GOV.UK | Government central website www.gov.uk |
| GPS | Geo Positioning System |
| h | hour |
| ID | Identification Number |
| Km | kilometre |
| Kg | kilogramme |
| $KgCO_2e$ | kilogramme of $CO_2$ equivalent |
| Kgoe | kilogramme of oil equivalent |
| KPI | Key Performance Indicators |
| kWh | kilowatt-hour |
| $m^3$ | cubic metre |
| m | million |
| mi | mile |
| min | minute |
| mpg | miles per gallon |
| n.a. | not available; data not available |
| NAEI | National Atmospheric Emission Inventory |
| $NO_x$ | nitrogen oxides |
| PM | particulate matters |
| PM10 | particulate matters with a size <10 micron |
| R&D | research and development |
| SE | South East London (UK Postcode area in London) |
| SOC | State of Charge (of battery) |
| SUGAR | Sustainable Urban Goods Achieved by Regional and Local Policies. |
| SW | South West London (UK Postcode area in London) |
| t | tonne |
| TfL | Transport for London |
| UK | United Kingdom |
| veh | Vehicle |
| W | West London (UK Postcode area in London) |
| WC | West Central London (UK Postcode area in London) |

GREATER**LONDON**AUTHORITY