

Low Carbon Vehicle Public Procurement Programme Summary Report



cenex



Office for
Low Emission
Vehicles



Authored: Peter Speers, Robert Evans, Chris Walsh, Adrian Vinsome
Approved: Chris Walsh
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Introduction

The Low Carbon Vehicle Public Procurement Programme (LCVPPP) which ran from 2008 to 2013 was one of the largest trials of electric and hybrid commercial vehicles carried out in the UK to date. Funded by the Department for Transport's (DfT) Office for Low Emission Vehicles (OLEV), and managed by Cenex, LCVPPP placed 700 hybrid and electric panel vans from four different manufacturers within 77 public sector fleets.

The objectives of the LCVPPP were to:

- Create demand for low CO₂ vehicles.
- Foster a culture change in public sector fleets.
- Manage the risk of trialling new vehicles for the fleets involved.
- Promote innovation and unit cost reduction.
- Test and validate low CO₂ vehicles in real-world driving conditions.

The vehicle manufacturers and operators that participated in the LCVPPP were chosen through a rigorous process designed to meet a programme specification for range, performance and carbon reduction described in detail in the report *Low Carbon Vehicle Public Procurement Programme: Lessons learnt for the practice of Innovation Orientated Procurement in a fleet context*.¹ Alongside these activities a thorough technical analysis of the performance of the low carbon vehicles was undertaken, detailed in the report *Low Carbon Vehicle Public Procurement Programme, 2010–2013, Final Technical Report*.²

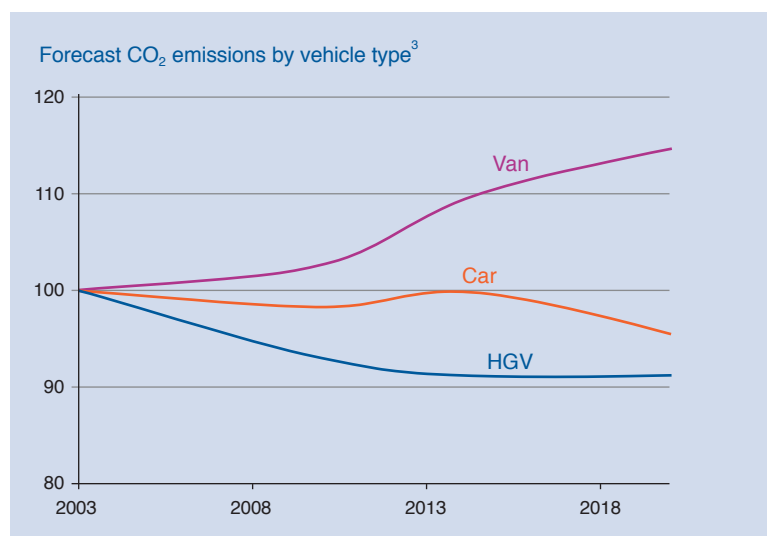
This report provides a brief summary of the main LCVPPP outputs and achievements, including:

- The design and implementation of the Programme.
- The number of vehicles deployed and public sector fleets involved.
- The outputs of the two-stages of technical analysis² of the Programme:
 - In the **first stage** (to 2011) each of the four types of vehicle underwent laboratory testing to assess their performance, and were subject to an initial assessment of their real-world performance in fleet deployment. By the end of this stage, one of the electric van suppliers ceased trading, and a second van was being used by too few fleets to provide sufficient data for a thorough study of its performance. Therefore only two vehicles were carried through to the second stage of analysis.
 - The **second stage** (2012–2013) therefore focused on a longitudinal performance study of the Ashwoods Hybrid and Smith Electric vehicles that were integrated into 17 public sector fleets.
- A Life Cycle Assessment (LCA) of the Ashwoods van compared to that of an equivalent Ford Transit van.
- The perceptions of the van owners and users.

Why vans?

Drawing on previous work such as that of the *Environmental Innovations Action Group* (EIAG), the DfT had identified vans as its preferred target for LCVPPP based on factors including:

- Volume of the market: Initial DfT market data had found that >300,000 vans were being used by the public sector, with 90,000 vans bought each year.
- Growing CO₂ emissions seen from the van sector, attributed to market trends including increased home delivery.
- No existing low carbon van in the market place.
- Vans fell outside the scope of other policy measures (EU CO₂ regulation).



Van emissions were projected to rise in the coming years³ based on:

- A 41% rise in van traffic between 1995–2005.
- Van journeys are generally longer than other vehicle types.
- No established policy measure in place designed to cut van CO₂ emissions at the time.

1 Department for Transport, 2015.

2 Department for Transport, 2015.

3 Department for Transport, 2008.

Design and implementation of LCVPPP

The central feature of the LCVPPP was a vehicle procurement exercise encouraging the deployment of low carbon vans across public sector fleets. The Programme was designed to use *Innovation Oriented Procurement* to help pull forward innovative technology into the marketplace. Innovation Oriented Procurement (IOP) is defined by the Manchester Institute of Innovation Research as *any public procurement activities that aim at stimulating the creation, improvement, adaption and diffusion of innovative solutions (technological or organisational)*.

The Programme funded the incremental costs of eligible low carbon vehicles over a comparable conventionally-fuelled vehicle.

LCVPPP was implemented as a two-Phase programme as illustrated below.⁴ Phase 2 of the procurement project was designed to extend the reach of the programme to a wider audience of public sector fleets. Suppliers proving their capability during the Phase 1 activity would be awarded a Phase 2 contract.

4 The design and implementation of the Programme is described in detail in the report *Low Carbon Vehicle Public Procurement Programme: Lessons learnt for the practice of Innovation Orientated Procurement in a fleet context*, Department for Transport, 2015.

Programme timeline		Aims	Activities	
2008	PHASE 1 <ul style="list-style-type: none"> • Small numbers of demonstrator vehicles • Intensive monitoring of real-world performance of trial vehicles • Build confidence with operators and technology providers 		Start up and Programme design	
2009			Vehicle and Stakeholder fleet selection, procurement and deployment	
2010			<i>By the end of Stage 1 (2011), one electric van supplier had ceased trading, and a second van was being used by insufficient fleets. Therefore only two vehicles were carried through to the second stage of analysis.</i>	Stage 1 performance assessment, comprising: <ul style="list-style-type: none"> • Laboratory testing of vehicles under controlled conditions • Initial real-world assessment of deployment of all four manufacturers' vans with public fleets
2011				
2012				Stage 2 performance assessment: <ul style="list-style-type: none"> • Longitudinal study of the real-world performance of the Ashwoods Hybrid and Smith Electric vans with public sector fleets
2013	PHASE 2 <ul style="list-style-type: none"> • Wider public sector fleet rollout • Support deployment with less intensive monitoring • Higher production volumes and economies of scale reduce costs for public and private sector fleets 		Project close out and reporting	
2014				

Vehicles included in the LCVPPP

Ashwoods Hybrid transit



Parallel hybrid
1.2kWh LiFePO₄ battery
9.1kW / 50Nm electric motor

Smith Edison S002



Electric drive
50kWh LiFePO₄ battery
64kW / 170Nm electric motor

Allied Peugeot eBoxer



Electric drive
54kWh LiFePO₄ battery
60kW / 130Nm electric motor

Modec LWB panel van



Electric drive
84kWh NaNiCl₂ ZEBRA battery
76kW / 300Nm electric motor

Headline outputs

Only the Ashwoods Hybrid van conversion met the price and performance criteria for inclusion in Phase 2 of the Programme.

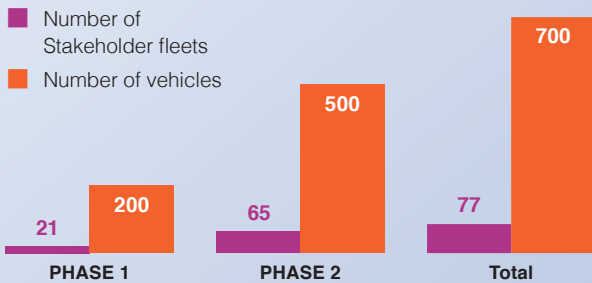
Vehicles deployed

Vehicle type	Manufacturer and type	Number deployed	
		PHASE 1	PHASE 2
Hybrid	Ashwoods	137	500
Electric	Smith	43	-
	Allied	16	-
	Modec	4	-
Total		200	500

Vehicle deployments

Phase 1 of LCVPPP deployed four types of van (three electric and one hybrid) amongst a relatively small trial group of public sector fleets. Phase 2 of LCVPPP deployed an additional 500 Ashwoods Hybrid vans and significantly increased the geographical outreach of the Programme, including bringing in public sector fleets from Northern Ireland and Wales for the first time.

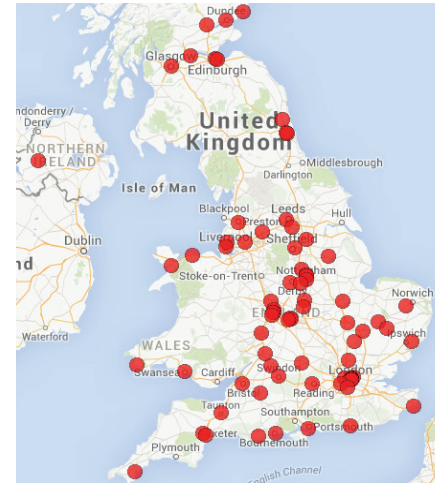
Vehicle deployment and Stakeholder fleet involvement in LCVPPP



Phase 1:
200 vehicles
deployed with 21
Stakeholder fleets



Phases 1 & 2:
700 vehicles
deployed with 77
Stakeholder fleets



Phase 2 of LCVPPP marked a significant increase in low carbon vehicle deployment and the number of Stakeholder fleets involved in the Programme grew almost fourfold. Nine fleets were involved in both Phases of the Programme.

Measuring success

Original success criteria

ACHIEVED

Successful demonstration of a range of vehicles which have significantly lower CO₂ emissions (for a given vehicle size, performance specification or type) than those currently widely available on the market

200 vans demonstrated in Phase 1 ✓

Creation of opportunities to validate and test new technologies in real world conditions in respect of their environmental and emissions performance

Validation and test work on vans in real world operation ✓

Evidence of innovation benefits in terms of learning, cost and risk reduction and the securing of economies of scale in relation to new technologies

- Evidence of learning, cost reduction and economies of scale for Ashwoods
- Learning for Allied and Smith in terms of improvements in manufacturing processes and vehicle performance verification in real-world operation
- Learning for fleet operators

Significant subsequent orders for additional vehicles from both public sector and private sector organisations

Subsequent progression to Phase 2 with 500 fulfilled orders for Ashwoods ✓

Technical summary outputs

Vehicle distance driven

The data sets collected from on-vehicle telemetry systems during the two analysis stages of LCVPPP are summarised below in Table 1.

By the end of Stage 1 (2011), one of the electric van suppliers had ceased trading, and a second van was being used by too few fleets to provide sufficient data for a thorough study of its performance. Therefore only two vehicles were carried through to the second stage of analysis which ran from 2012–2013.

The first analysis stage also collected data from 25 diesel vehicles that covered over 278,000km for comparison purposes.

Vehicle testing

All the vehicle models in the Programme were tested in controlled test facility conditions before entering into service, and after six and twelve months of use – see Table 2 below. There were two reasons for this:

- To confirm the achievement of minimum performance requirements for programme inclusion.
- To provide a benchmark for analysis of real-world performance.

The testing undertaken was split into two categories:

- Track-based performance testing (e.g. acceleration, maximum speed).
- Laboratory emissions testing for diesel/hybrid vehicles, and range and energy consumption tests for electric vehicles.

The hybrid vehicles achieved a 14–15% CO₂ saving, compared to a comparator diesel vehicle over the NEDC (savings up to 20% were achieved on other drive-cycles).



Based on their lab-tested energy use over the same cycles, and the current carbon intensity of UK grid electricity,⁵ the Allied and Smith electric vans (shown in aggregated form below) achieved similar levels of emissions to the hybrids. Data is not shown for the Modec van.

⁵ DEFRA Emission Factors, 2012 and 2013.

TABLE 1: Vehicle distance driven

Vehicle type	Manufacturer	Number deployed	Number of Stakeholder fleets	Distance covered (km)	Time period analysed
Hybrid	Ashwoods	137	14	3,635,00	2011–13
Electric	Smith	43	18	528,000	
	Allied	16	10	64,000	2011
	Modec	4	4	15,000	
Total		200	21 *	4,242,000	

* A number of the fleets deployed more than one vehicle type

TABLE 2: Vehicle testing

Test cycle	Ashwoods SWB	Ashwoods LWB	Electric	Diesel SWB	Diesel LWB
NEDC (gCO ₂ /km)	228	229	210	266	266
Artemis urban (gCO ₂ /km)	279	287	293	326	344

Detailed analysis of fleet hybrid van usage over three years

Ashwoods vehicle data summary

The following table summarises the statistics of the 113 Ashwoods vehicles for which a comprehensive dataset was available which are analysed in this report.

Ashwoods fleet summary: January 2011 – December 2013

Total no. of vehicles	113
Total no. of fleets	10
Total no. of re-fuelling events	7,017
Total gallons refuelled	92,000
Total distance covered	3,635,000km
Average distance between re-fuelling events	518km
Tailpipe CO ₂ e emissions	304 gCO ₂ e/km
WTW ⁶ CO ₂ e emissions	369 gCO ₂ e/km

The Ashwoods vehicles travelled a total distance of 3,650,000km, completed 7,000+ refuelling events and fuelled with 92,000 gallons of diesel. The average distance between re-fuelling events was 518km. Two-thirds of the refuelling events consisted of drivers refuelling more than 13 gallons (Tank capacity: 17.6 gallons) and the average distance between these events was 576km.

Vehicle usage

Graph 1 below shows the total distance travelled of all the Ashwoods vehicles and distance travelled per vehicle per month.

From the graph, it is clear that the total distance travelled was lower in 2011 than in 2012 and 2013. However, it must be noted that the number of vehicles reporting data was also lower in 2011 than in 2012 and 2013.

The distance per vehicle gives a better representation of the distance the Ashwoods vehicles are being driven. The graph illustrates that Ashwoods vehicles were driving approximately 1,190km per month in 2012 and 2013 and 1,060km per month in 2011. The consistent use of the vehicles shows that they were well integrated into the fleets.

The total distance travelled in the August and December months is generally lower than the other months due to holiday periods.

Fuel efficiency by month

Graph 2 below shows the fuel efficiency and the UK's average temperature per month and year.

This graph compares the average monthly energy consumption to that measured over the NEDC (New European Drive Cycle) and Artemis Urban Drive Cycle during laboratory testing. SWB (Short Wheel Base) and LWB (Long Wheel Base) configurations were tested. The NEDC drive cycle is the accepted cycle used across Europe for emissions tests, whereas the Artemis Urban Drive Cycle is an industry standard cycle considered representative of city driving. The UK's average monthly temperature⁷ is also included in the secondary axis.

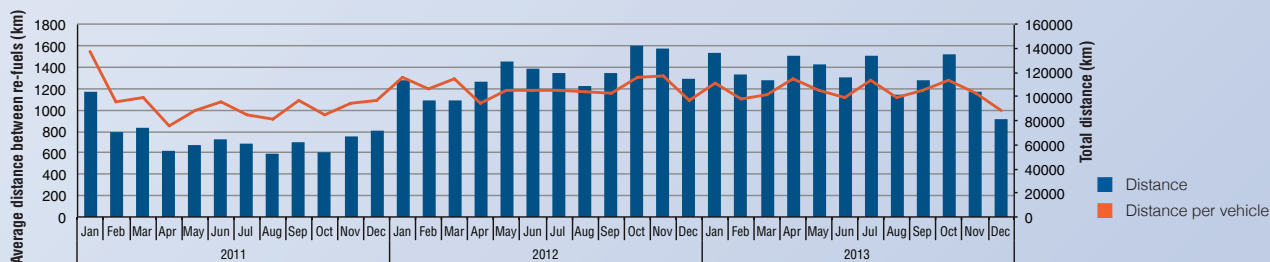
The real-world fuel consumption was significantly poorer than that measured over the NEDC under test conditions (31.9mpg), but compared closely to that measured for the LWB (Long Wheel Base) over the Artemis Urban Cycles (25.4mpg).

A slight improvement in the fuel consumption can be seen during the summer months (Jun–Aug) compared to the winter months (Dec–Feb); especially during 2012 and 2013. This is likely to be due to reduced rolling and wind resistance in the summer months.

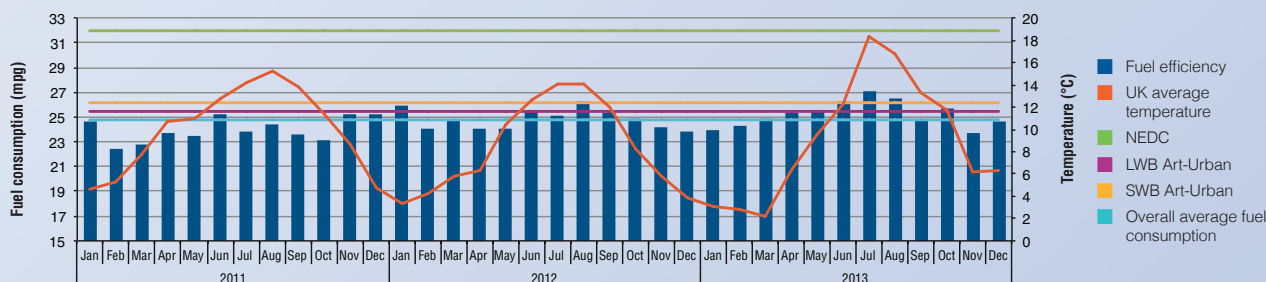
6 Measurements of Well To Wheel emission include greenhouse gas emissions resulting from the extraction, refining and distribution of the fuel.

7 Monthly mean national temperature is taken from the Met office website, published February 2014.

GRAPH 1: Ashwoods Hybrid vehicle usage per month



GRAPH 2: Fuel consumption and average temperature per month for Ashwoods Hybrid vehicle



Detailed analysis of fleet electric van usage over three years

Vehicle data summary

The table summarises the performance of 42 Smith vehicles that operated in 10 different public sector fleets that are analysed in this section.

Smith fleet summary: January 2011–December 2013

Total no. of vehicles	42
Total no. of fleets	10
Total days of operation	15,770
Total distance covered	528,000km
Average daily distance per vehicle	33.5km
Tailpipe CO ₂ e emissions	0 gCO ₂ e/km
WTW CO ₂ e emissions	280 gCO ₂ e/km

The Smith vehicles cumulatively travelled a total distance of 527,979km over 15,770 days. Across the three years the total distance travelled by all the Smith vehicles was approximately 14,700km per month; hence, the total distance travelled per month per vehicle was 350km. When considering the days of operation, the average daily distance per vehicle was 33.5km, which is well within the 150km range of the vehicle. This implies that the fleets' operation consisted mainly of short distance journeys or that the drivers were reluctant to exhaust the range.

It should be noted that a large proportion (45%) of data was covered by the London Borough of Islington and Gateshead City Council due to the high number of vehicles being operated in these fleets.

The Smith Electric vehicles do not produce carbon emissions directly from the vehicle, however production and delivery of electricity in the current UK grid is relatively carbon intensive, and hence the vehicles produce 280gCO₂e/km (determined using 2012 DEFRA emission factors) on a WTW basis. Emissions from the Smiths will reduce inline with electricity grid decarbonisation.

Vehicle usage

Graph 3 below shows the total distance travelled and the average daily distance per vehicle by month. It shows that the total distance travelled per month was much lower in the earlier part of 2011 compared to any other period across the 3 years. The average distance covered per month was 8,000km between January and April 2011, whereas, across the three years it was 14,700km. Also during the earlier months of 2011, the average daily distance per vehicle shows more variations per month. The discrepancies in the data during these months are likely to be due to drivers and fleets acting relatively cautiously, as these new vehicles were being integrated into the fleet's operations. However, following the initial period, the total distance and average daily distance per vehicle becomes more consistent per month.

Similar to Ashwoods vehicles, there was a general reduction in the average daily distance and total distance during the August and December months, coinciding with the holiday periods. The average total distance travelled during the holiday months was 11,900km.

Energy efficiency by month

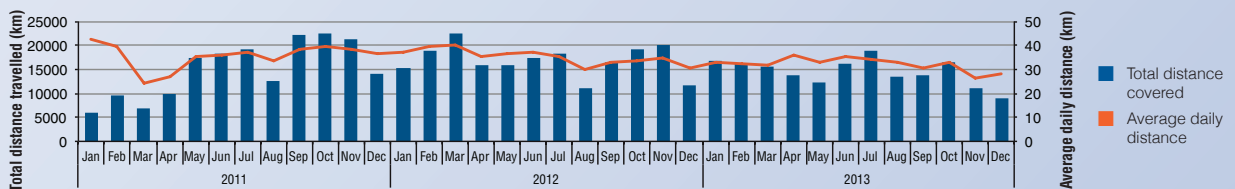
Graph 4 below shows the energy efficiency and the UK's average temperature per month per year. It compares the real-world average monthly energy consumption to that measured over the NEDC and Artemis Urban Drive Cycles during laboratory testing. As mentioned earlier, the NEDC drive cycle is the accepted cycle used across Europe for emissions tests, whereas, the Artemis Urban Drive Cycle is an industry-standard cycle considered representative of city driving.

The 12 month real-world energy consumption across all fleets (corrected for charging efficiency) was 2.0km/kWh. The real-world energy efficiency was marginally lower than that measured over the NEDC under test conditions (2.07km/kWh), but significantly greater than that measured over the Artemis Urban Drive Cycle (1.48km/kWh).

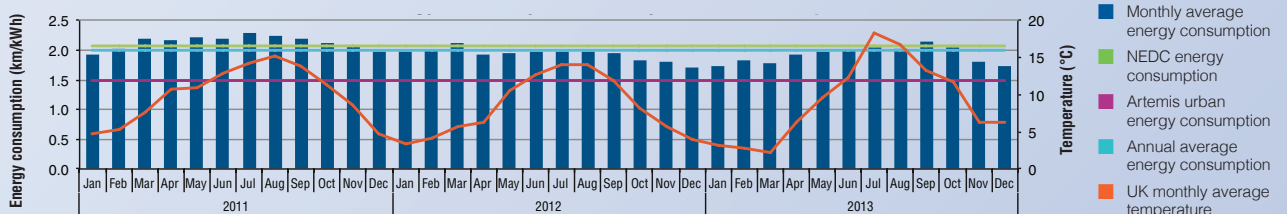
The real-world efficiency showed a clear seasonal variation. The efficiency energy decreased broadly inline with falling mean national temperature during winter months. Generally, temperature had a negative correlation with energy consumption due to the increased rolling and wind resistance, greater use of on-board cabin heating during the winter and temperature-related reductions in battery and regeneration efficiency.

Between 2011 and 2013, the average energy efficiency (km/kWh) decreased by 10%; which may partly be due to battery degradation. This theory is supported by data from charging events, which also showed a 10% decrease in the battery capacity over time.

GRAPH 3: Total distance and average daily distance by month – Smith Electric vehicle



GRAPH 4: Energy efficiency variation by month and temperature – Smith Electric vehicle



Detailed analysis of fleet electric van recharging patterns over three years

Smith vehicle charging patterns

Graph 5 below shows the frequency of charge events per month and the average energy transferred per charge event per month.

This graph agrees with the journeys per month data, as the frequency of charge events and the energy transferred (corrected for efficiency losses) is significantly lower in 2011 compared to 2013. The average energy transferred per charge event is 30% lower in 2011 compared to 2013, which could be due to the drivers' improved confidence in the range of the vehicle. Coinciding with the Ashwoods and the drive data, the frequency of charge events during the holiday periods (August and December months) is generally lower than the other months.

The average energy transferred per charge event across the three years was 22kWh, which is less than 50% of the rated battery capacity (50kWh); emphasising that the vehicles range was generally not exhausted. The total energy transferred was approximately 285,000kWh which achieved a total distance of 527,979km. The average cost of electricity in the UK in 2014 was 10.1p per kWh;⁸ giving an average energy cost of £5.05 per 100km. Furthermore, the average cost per charge event is £2.22.

Smith vehicles – start time of charge events

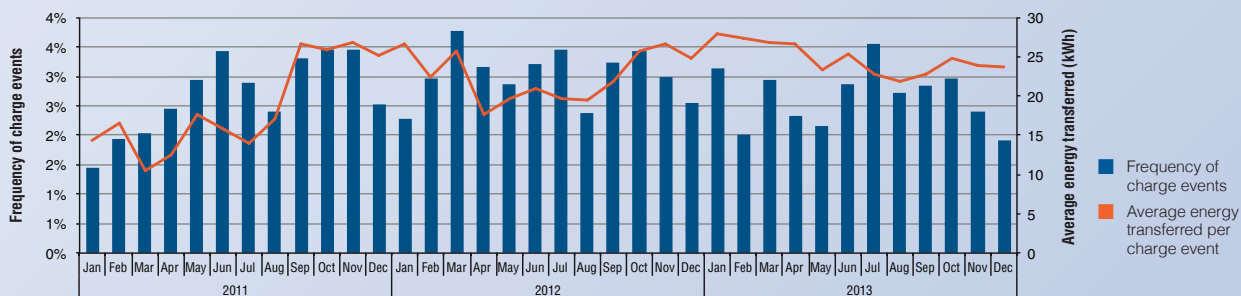
Graph 6 below shows the frequency of charge events per hour during working hours.

The graph shows that a large proportion (27%) of the charge events commenced between 2pm and 4pm; this is likely to be due to the fleets' day-to-day operational schedule whereby the vans are put on charge at the end of their daily operational duties.

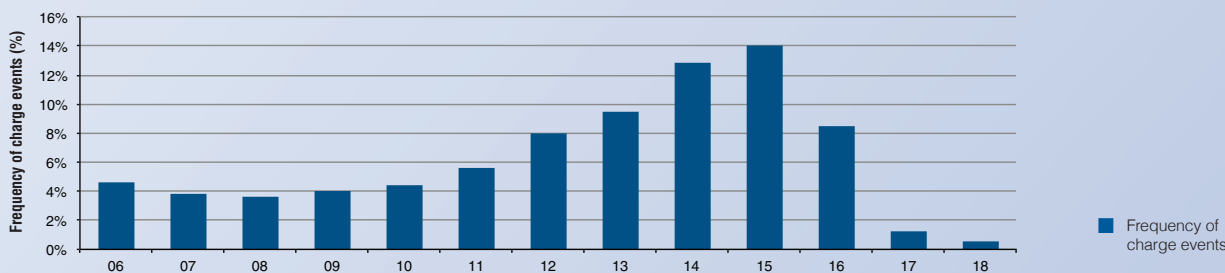
The average State of Charge at charge commencement was 51.5%. This further emphasises the fact that drivers were either reluctant to exhaust the range of the vehicles or the fleets' operations mainly consisted of short distance journeys.

⁸ Cost of Electricity taken from the 'Business Electricity Prices' website, published 2014.

GRAPH 5: Frequency of charge events and energy transferred per month



GRAPH 6: Frequency of charge events



Life cycle assessment of a hybrid van

Introduction to LCA

A Life Cycle Assessment (LCA) of a vehicle refers to the total carbon emissions of manufacturing, utilising and disposing of a vehicle. The illustration right outlines a typical LCA for a vehicle.



Production

Assessment of environmental impact of producing the vehicle from raw materials to complete product



"In-Use"

Tailpipe CO₂ from driving
Impact from maintenance and servicing



Disposal

Assessment of environmental impact of "end of life" scenario, including re-use of components, recycle of materials and landfill

Ashwoods 2nd Generation Hybrid Vehicle

Due to the success of the 1st Generation Ashwoods Hybrid System, Ashwoods introduced a 2nd Generation of its Hybrid System. As a result, Cenex were asked to carry out an LCA on the 2nd Generation system.

To gain a better understanding of the LCA regarding the outcomes, the lifetime carbon emissions of the Ashwoods Hybrid van was compared to that of an equivalent Ford Transit. The verification process, the total emissions of the hybrid system and its individual components are described below.

Ashwoods and Ford Transit van comparison

In order to understand the lifetime carbon emissions of the hybrid system, the entire lifetime emissions of the Ashwoods van was compared to that of a Ford Transit. The following two assumptions were made when carrying out the comparison:

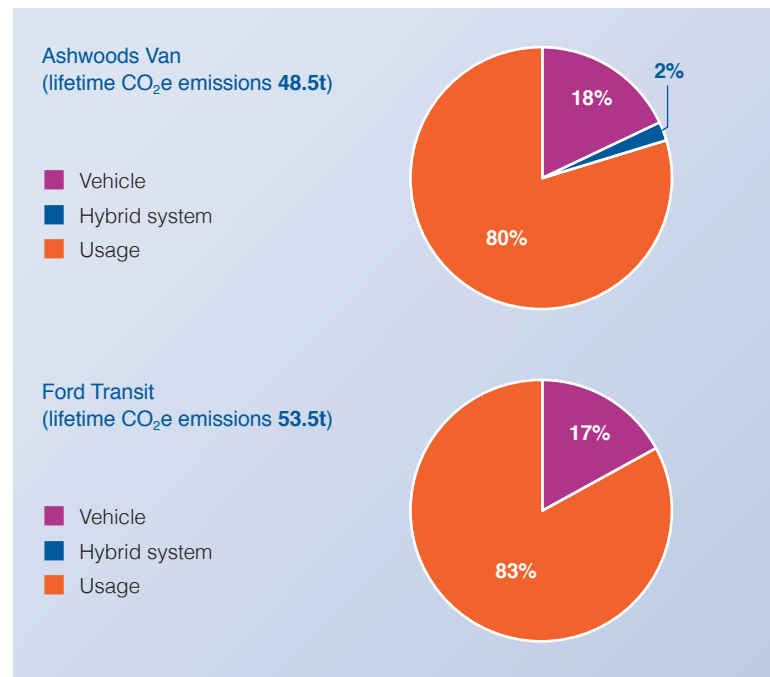
- The lifetime carbon emissions of producing and disposing the Ashwoods van (excluding the hybrid system) was equivalent to that of producing a Ford Transit van, i.e. 9,000kg.⁹
- Both vans will carry out 200,000km over the lifetime of the vehicle.

The University of Bath conducted emissions tests (NEDC) on the 2nd generation Ashwoods van and a Ford Transit.¹⁰ Using the results of tests and the assumed lifetime mileage, the total usage emissions were calculated. The following table shows the lifetime carbon emissions of the Ashwoods and Ford Transit vans.

Lifetime CO₂e emissions (tonnes)

	Vehicle	Hybrid system	Usage	Total
Ashwoods Van	9.0	0.8	38.7	48.5
Ford Transit	9.0	0.0	44.5	53.5

The total lifetime carbon emissions of the Ashwoods van were 9% lower compared to a Ford Transit. However, as the lifetime emissions of the hybrid system only constitutes 1.7% of the total lifetime emissions of the Ashwoods van, the fuel savings from the system clearly have a significant effect in reducing the total lifetime carbon emissions. The charts below give a clearer representation of the lifetime carbon emissions of the Ashwoods vehicle and the Ford Transit.



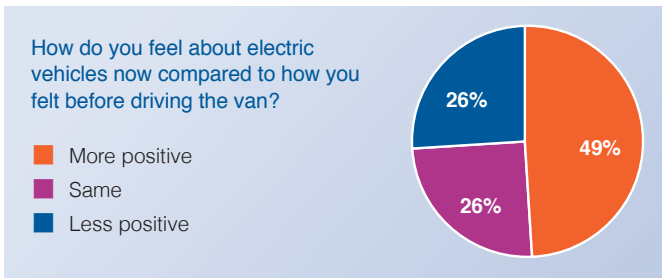
⁹ The Life Time Carbon Emissions of the Ford Transit was taken from the Life Cycle Assessment of Vehicle Fuels and Technologies Final Report published by Clear Zones in 2006.

¹⁰ Emission tests carried out at the University of Bath, Department of Mechanical Engineering

Users' responses to the LCVPPP vehicles

Electric vans

- 44 drivers of electric vans returned questionnaires.
- Around 50% of drivers felt more positive about the electric vans after the trial than they had before, compared with 25% feeling less positive.
- EVs elicited stronger opinions and more noteworthy results than the hybrids, reflecting the relative novelty of the technology.



The full range of responses shown below reveals a more varied picture. Drivers believe the vehicles have environmental benefits; many saw it as a positive status symbol; and 81% told their family and friends about it. Over half found the vehicles fun to drive, and 51% would recommend them compared to just 21% who wouldn't.

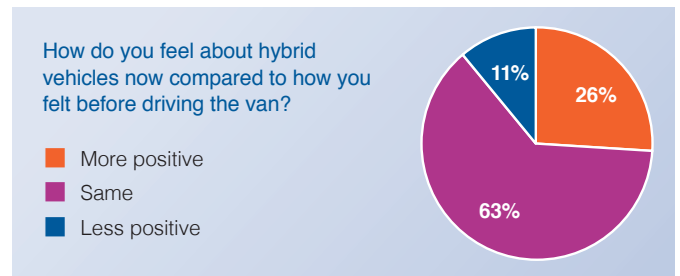
Only 20% felt the vehicle performed better than a 'normal' van, and only 26% preferred it to a diesel. The reasons for this are not clear cut – 30% found the payload insufficient, 20% found

they often had insufficient charge for their journeys and 45% found it inconvenient to have to consider how far they could drive on each trip.

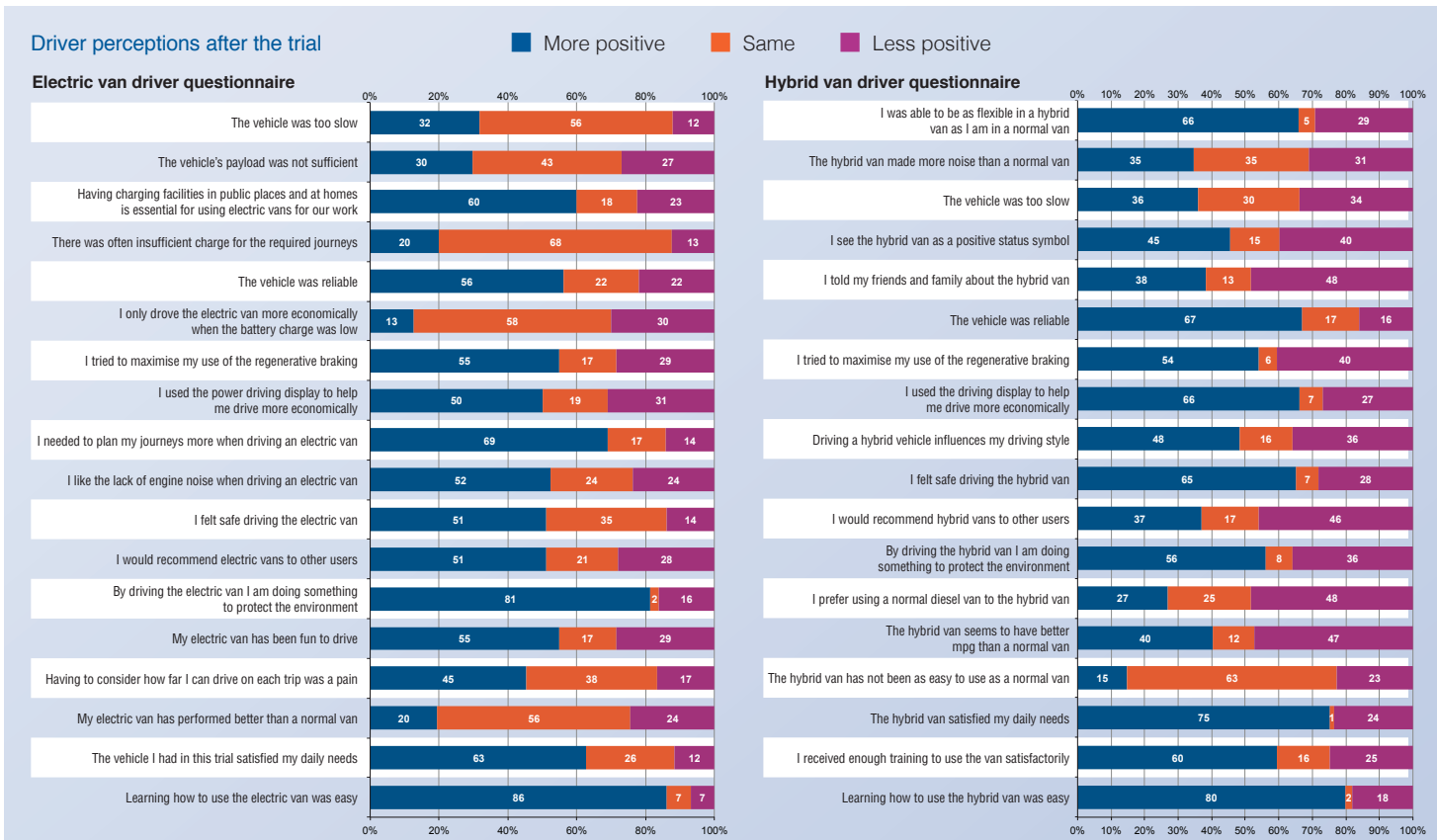
Hybrid vans

- 76 drivers of hybrid vans returned questionnaires.
- The responses suggest that they generally found the vehicles to be very similar to a diesel van. Nearly two-thirds of drivers showed no change in their opinion of the vehicles after the trial.

The majority of drivers returning surveys felt they were able to do their job as flexibly in the hybrid van as in a conventional van.



However, hybrids elicited less strong responses than the electric vehicles. 56% of drivers felt the hybrid had environmental benefits, compared to 81% of electric van drivers.



Innovation Orientated Procurement

Management

The LCVPPP applied Innovation Orientated Procurement (IOP) in an exemplar project. The idea for LCVPPP was developed by the Department for Transport in response to the recommendations of the 2007 Low Carbon Transport Innovation Strategy (LCTIS).

The LCVPPP was launched in 2008 following extensive Stakeholder consultation. The Programme's first phase ran between 2008 and 2012, with Cenex as Programme Manager. The DfT aimed to use the LCVPPP as a means of encouraging innovation with public sector fleet procurement targeting increased uptake of low carbon vehicles.

The central feature of the LCVPPP was a vehicle procurement exercise targeting the deployment of low carbon vans across public sector fleets combined with a grant to cover the differential cost of the technology. The Programme was designed to use procurement to help pull forward innovative technology. A Competitive Dialogue procurement procedure was used to explore technology solutions with motor manufacturers with the procurement exercise creating a supporting framework agreement from which a range of public bodies would be able to buy a number of low carbon vans.

The Programme design included risk mitigation for the participating public sector fleets deploying the innovative low carbon vans. This reflected consultation feedback regarding risk aversion among fleet managers being a key barrier to low carbon vehicle uptake. Risk mitigation measures included:

- Financial support – via full recovery of incremental investment costs.
- Technical support – during the procurement process adopted for supplier selection and project management oversight.
- Operational support – DfT managed the procurement on behalf of public sector Stakeholders and developed contractual terms protecting fleet operations from the possible adverse impacts of deploying new technology (ensuring replacement vehicles in the event of in-field operational issues).

The implementation of the Programme involved a series of steps commencing with procurement process and proceeding to the supply of vehicles for deployment across a range of public sector fleets. The first deployment phase included external monitoring and evaluation to create an independent assessment of real world performance of the vans to aid with public (and private sector) fleet decision making. Suppliers successfully delivering against the aims of the Programme during the first deployment phase would be rewarded with a second phase of grant-assisted procurement.

Four key programme outputs were:

1. A successful procurement exercise culminating in a framework including four approved low carbon van

suppliers; three supplying battery electric panel vans and one supplying a hybrid van.

2. The placement of 200 vans into operation across 21 fleets via vehicle orders from the framework.
3. A field trial phase involving the performance monitoring of all 200 vans for a minimum of one year's worth of real-world operation.
4. The selection of one supplier to proceed to the second phase of funded procurement.

Lessons learnt

Five features of programme design were successful:

1. The DfT sought to be innovative in what was being procured (van performance specification) and how the procurement was managed (via the use of the Competitive Dialogue procurement procedure) achieving vehicle performance aims and running a successful procurement.
2. The LCVPPP was implemented in a stepwise, controlled fashion, and outputs were delivered in all key areas meeting targets for deliverables, albeit not within the initial timescales envisaged.
3. The LCVPPP helped stimulate supply chain innovation via a two-stage process. Initial orders provided an immediate reward for suppliers with the potential for larger Phase 2 (follow on) orders. This helped qualify four suppliers.
4. The Programme successfully fostered the formation of a Stakeholder fleet group who supported the Programme through its full duration and were keen to participate in other low carbon vehicle demonstration projects.
5. The choice to combine the programme management and technical support roles positioned the Programme Manager (Cenex) to provide the DfT with independent evaluation of the performance of the low carbon vehicles deployed during Phase 1 trials, thereby helping DfT decide which of the suppliers (only one in this case – Ashwoods) met the success criteria for Phase 2 grant-assisted procurement. The success criteria were a combination of vehicle performance and cost reduction.

Five aspects of implementation proved problematic.

1. The Programme wasn't able to catalyse innovative product offerings from mainstream vehicle manufacturers.
2. The gap between the recruitment of the Phase 1 and 2 public sector fleets was too long. Also, the first entrants had a long wait until the Programme got up-to-speed, whilst the second wave didn't have the time to realign vehicle replacement cycles to LCVPPP timescales resulting in delays in vehicle orders being placed. Ideally a larger procurement group would have formed earlier during the Programme's set-up phase.

3. The risk mitigation placed required detailed contractual terms which slowed implementation. Contracts progressed better when based on broad principles not rather than specifics (e.g. not dependent on vehicle details and numbers, etc.). For programmes such as these generous time allocation is needed for contractual matters.
4. The innovative nature of the vans combined with the immaturity of the SME's supply chains resulted in delays in delivery and gave DfT and Cenex limited options for supply chain management (e.g. ensuring on-time delivery). IOP project design needs to make allowances for the lower Technology Readiness Level (TRL) and Manufacturing Readiness Level (MRL) of technology being deployed when compared with the procurement of mature technologies.
5. The diversity of needs among the procurement group led to a lot of vehicle customisation with associated complexity which worked against economies-of-scale for the suppliers and added considerably to the complexity of grant administration for Cenex and the DfT.

Evaluation and recommendations

The LCVPPP resulted in a completed IOP case study of interest both in terms of its supply chain stimulus when compared with conventional procurement procedures and its stimulus for innovation when compared with R&D support and grants.

Presently, the relative novelty of IOP makes it a harder project type to implement than potential alternatives. Its main advantage is that it seeks to leverage a sustainable customer demand to stimulate suppliers to invest to elevate technology from lower to higher Technology Readiness Level (TRL) and Manufacturing Readiness Level (MRL). IOP can complement R&D funding leveraged by vehicle manufacturers for supply chain capability development. Alternative policies that leverage customer-demand include demonstration-based R&D projects (TRL6-8) and grants to aid market uptake for validated TRL 9 technologies.

Based on the experience of the LCVPPP the following recommendations would be made for those considering implementing this form of project:

- Invest in the pre-competitive dialogue planning and preparation phase. Conduct supplier workshops to help ascertain supply chain capabilities and intent ahead of the formal commencement of a procurement process (e.g. before a PQQ is issued) and build in clear success criteria at the outset as a spur to technology providers. The LCVPPP offered future higher volumes based on independently validated vehicle performance with the higher volumes linked to price reduction targets.
- Focus on forming a large procurement group at the outset. Work with that group to help define requirements (needs, and socialising those needs with potential technology providers during the market sounding phase) and build a commitment for collective action and the associated process steps including sign-off on contractual arrangements.
- Where possible, the procurement group needs should be normalised into as few requirements as possible to avoid the complexity of customisation for individual Stakeholders.
- Use the Stakeholder group for both IOP and green public procurement initiatives. For example, conducting both more and less adventurous vehicle procurement exercises through the same group would help enable the Stakeholder fleets to remain engaged in low carbon vehicle uptake for an extended period of time, opting in or out of new procurement exercises depending on the applicability of a particular vehicle or fuel type to their operations.
- Accept that grant funding will be needed to facilitate projects where the innovation may not offer a compelling short term operational benefit versus incumbent technologies.

Stakeholder liaison and assistance is crucial for project success: consideration should be given to there being funding available for buyer consortia to engage innovation intermediaries to assist the consortia to manage projects from inception through to procurement, deployment, evaluation and dissemination.

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Holywell Park, Loughborough University,
Ashby Road, Loughborough LE11 3TU

01509 635750

www.cenex.co.uk