A STUDY OF THE DECISION-MAKING BEHAVIOUR OF FLEET MANAGERS IN RELATION TO ELECTRIC VEHICLES

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1. INTRODUCTION

It is estimated that road transport is responsible for around 20 per cent of carbon dioxide (CO_2) emissions in Europe, with passenger cars alone responsible for 12 per cent (European Commission, 2010). A variety of national and EU-wide targets have been set which aim to reduce CO_2 emissions in general, and from road transport in particular. For example, one of the goals in the European white paper 'Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system' (European Commission, 2011a) is to halve the use of 'conventionally-fuelled' cars in urban transport by 2030, and phasing them out of cities by 2050, with the aim of achieving essentially CO_2-free city centres by 2050. In 1990, the UK Government set a target of reducing CO_2 emissions by 20 per cent by 2010; a target that was not achieved. Whilst emissions from sectors such as energy and business declined, CO_2 emissions from private cars increased by six per cent between 1990 and 2008 (DEFRA, 2010). Average exhaust CO_2 emission figures for new cars registered in the UK in 2011 were 138g/km (SMMT, 2012a) while among the 15 main EU countries the average new car emission figures in 2009 were 146g/km (the 2015 target is 130g/km) (European Commission, 2011b).

Electric vehicles[1] (EVs) and other low carbon vehicles are expected to have an important role to play in meeting CO_2 reduction targets as EVs have no exhaust CO_2 emissions. Taking into account the CO_2 emissions at power stations required to charge battery electric vehicles (BEVs), one recent report found that the average CO_2 emissions from a range of BEVs available to buy in the UK in 2011 and 2012[2] is 75g/km (Davis, 2011). This figure varies by country, for example in France CO_2 emissions would be 12g/km as most of the electric grid is fed by nuclear power. In Greece (where most of the power stations are coal-fired), the figure is 118g/km.

On the basis that their uptake could considerably reduce average CO_2 emissions, governments are investing a great deal of funding into EVs and associated infrastructure. However, an alternative view is that the manufacture of batteries is more harmful to the environment in the long term than efficient petrol or diesel vehicles. Since the EV market is still in its infancy there is currently limited understanding of whether consumers will purchase EVs and what their attitudes, perceptions and decision-making processes are towards EVs and the potential purchase of EVs. The Energy Technologies Institute commissioned the Plug-in Vehicle programme to investigate the business case for the mass market deployment of BEVs and PHEVs in the UK. As part of this they sought to develop a model of consumer attitudes to

purchasing plug-in vehicles[3]; one aspect of this was to conduct research into fleet purchase decisions.

1.1 EVs and Fleets

In 2010, just under 2 million new cars were registered in the UK; 52 per cent of these were registered to fleets (i.e. vehicles registered at a business address with 25 or more vehicles) and 5 per cent to businesses (fewer than 25 vehicles; henceforth 'business' vehicles will also be referred to as fleet vehicles) (SMMT, 2012b). Given that over half of new cars in the UK are fleet vehicles, it is important to understand the fleet perspective on vehicle adoption.

Despite the fleet market accounting for around half of new car registrations, there is a surprising lack of research exploring fleet managers' decision-making processes, and consequently a lack of understanding in this important area. Of the limited research that has been undertaken, most is US-based and concentrates on economic factors rather than fleet manager attitudes and the perceptions underpinning their decision-making.

1.2 Previous Research

In 2012, Stewart conducted a study which explored the total costs of ownership of low and ultra-low emission vans (including plug-in hybrids, range-extended and pure electric vehicles). One of the components of the study was a series of interviews with fleet managers to gain an understanding of their purchasing priorities, daily driving distances and the likely feasibility of incorporating these types of vehicles into their fleet (including considerations such as range constraints and the requirement to supply appropriate infrastructure). The results of this study suggest that fleet managers are prepared to pay for low emission vans, however, in order for companies to commit to deploying EVs across their fleet, they would need to offer a total cost of ownership comparable with an equivalent diesel van (Stewart, 2012).

Lane (2005) combined findings from Lex (2004) and Shell (2004) to identify the key economic factors affecting fleet managers' purchase decisions. These were: total cost of ownership; capital cost of the vehicle; running cost of the vehicle; fuel costs; residual vehicle values; taxation costs; and government incentives. Fleet managers' purchase decisions are likely to differ from private consumers by placing more importance on reliability and maintenance issues.

Nesbitt and Sperling (2001) attempted to categorise the decision-making processes used by fleet managers in the US using focus groups (59 fleet managers), interviews (39 fleet managers) and questionnaires (2,117 fleet managers). They distinguished fleets by the decision-making structures within the organisation, taking into account the degree of formalisation (the extent to which rules and procedures guide the fleet decision process) and centralisation (the number of people involved in fleet decisions, and their decision-making autonomy). This typology is illustrated in Table 1. The authors concluded that the typology could be used to formulate effective

marketing strategies aimed at introducing new innovations (for example EVs) into the market.

Table 1. Nesbitt and Sperling's (2001) typology of fleet decision-making

		Degree of formalisation	
		High	**Low**
Degree of centralisation	**High**	**Hierarchic** Highly centralised and formalised with decisions made by one or two higher-level managers, guided by standard policies and procedures. Detailed cost analysis and in-depth assessment of the alternatives often used, as is solicitation of bids. Decision process encompasses both non-quantitative factors and analytical evaluation. Prevalent in highly-departmentalised organisations with several semi-autonomous medium-large fleets affiliated with different departments.	**Autocratic** Informal, highly centralised decision behaviour. Decisions typically made by one or two individuals who have several non-fleet-related responsibilities. Fleet often considered a low priority. Intuition and personal judgment used more than rigid analysis for making decisions. Brand loyalty, vehicle reputation and personal tastes often as important as economic factors. Prevalent in small owner-managed businesses.
	Low	**Bureaucratic** Highly formalised and decentralised. Several people influence the decision outcome. Decisions based on objective formal evaluations carried out systematically though pre-established routes. Heavy reliance on precedent. Frequently involves solicitation of bids, and the decision process often includes technical evaluations, financial assessments and cost-benefit analyses. Prevalent in public and institutional organisations.	**Democratic** Highly decentralised and very informal. The decision-making process is 'diffuse', involving several individuals at different levels/departments as no individual is in a position to commit the organisation to a particular decision. Cost analysis seldom used. Final decision is usually a compromise that is satisfactory to all decision-makers but preferred by none. Most difficult structure to define due to dynamic, unstable nature. Prevalent in small, organically-structured organisations.

Chocteau et al (2011) studied the impact of collaboration of key stakeholders on the adoption of EVs into commercial fleets in France. They proposed that the key stakeholders in EV adoption are the fleet manager, the vehicle manufacturer and the electricity supplier. Using cooperative game theory, they determined the conditions under which EVs would become economically feasible for commercial fleets. Although the paper focused on developing models using game theory, Chocteau et al., (2011) proposed a number of

factors which make EVs attractive to fleet managers. For example EVs are ideal for many collection and delivery services, have reduced maintenance and running costs, have vastly lower emissions and may improve the organisation's reputation. However, EVs are also associated with some increased costs including higher purchase/leasing costs and battery replacement.

Nevertheless, there is a scarcity of literature relating to the decision-making processes when adopting EVs into fleets as noted by Lane (2005):

"Given that fleets are the most important early adopter segment, fleet managers' attitudes to low carbon and fuel-efficient cars should be investigated through structured interviews with key personnel."

The qualitative research presented here explored this novel area by using interviews to investigate the perceptions of fleet managers with respect to their current purchase behaviours and perceptions of EVs.

2. Method

2.1 Approach

Structured telephone interviews followed by qualitative analyses were used to map levels of understanding and expectations of EVs among fleet managers. In particular, the following areas were examined:

- The main factors that informed fleet managers' decision-making processes with regard to the purchase of fleet vehicles.
- Fleet managers' knowledge and understanding of EVs, which sources of information they used to find out about EVs and any direct experiences with them.
- Fleet managers' perceptions of the advantages and drawbacks of EVs.
- The potential for introducing EVs to fleets.

2.2 Participant Recruitment Procedure

Fleet managers tend to be difficult to recruit for research purposes as they are typically busy and need to see clear benefits before agreeing to participate in research. The following approaches were taken in order to reach as many fleet or transport managers as possible:

- Financial incentives for participation
- Adverts placed in relevant publications.
- Personal fleet contacts from TRL staff.
- A list of 1,000 fleet managers was purchased from Data HQ. Each fleet manager on the list was contacted via email. The email contact yielded two participants. Following on from this, a TRL researcher telephoned those participants who had opened the email, but not responded; this yielded a further six participants.

In total, 20 fleet managers took part in the interviews.

2.3 Sample

Across the sample of companies, the mean number of fleet vehicles was 1,732. The number of vehicles within a given fleet varied from 30 to 105,000.

Vehicle types were largely associated with the organisations' business activities; most fleets consisted predominantly of cars and vans, with some also using motorcycles, trucks and plant equipment. The focus of the research was on cars (as opposed to other vehicle types), and so all participating organisations had at least 15 cars on their fleet.

Some organisations reported having dedicated car parks with adequate parking for their staff. Others described having limited parking or no staff parking at all, meaning that staff were required to pay to park in local public car parks.

As expected, journey purposes varied between organisations. The purposes reported included:

- Meeting customers/sales
- Maintenance call-outs
- Transporting customers/goods

2.4 Organisation Types

The UK Standard Industrial Classification of Economic Activities (UK SIC) is used to classify business establishments by the type of economic activities they are engaged in. Organisations involved in the research were divided into their respective SIC categories as shown in Table 2.

Table 2. Industry sectors of interviewees

Participant	Industry Sector (SIC categories)	Company Activity	Vehicles in fleet
1	Transport and Communication	Taxi service	225
2	Transport and Communication	Courier and taxi service	125
3	Transport and Communication	Post and courier services	33,000
4	Transport and Communication	Delivery of goods and services	40
5	Transport and Communication	Car rental	105,000
6	Property and Construction	Construction	2,600
7	Property and Construction	Construction	200
8	Property and Construction	Construction	30
9	Property and Construction	Engineering	110
10	Property and Construction	Installation	120
11	Energy and Utilities	Energy supplier	11,000
12	Energy and Utilities	Energy supplier	10,200
13	Health and Education	University	160
14	Health and Education	Healthcare trust	90
15	Public Sector	Fire and rescue	200
16	Public Administration	Civil service	15,000
17	Financial Services	Accountancy firm	2,500
18	Real Estate Activities	Social landlords	2,000
19	Manufacturing	Manufacture and distribution	1,700
20	Recruitment and Human Resources	Recruitment consultants	225

While the organisations were not categorised according to Nesbitt and Sperling's (2001) typology of decision-making, it was found that the sample mapped onto the decision-making structures; please see the results section for details.

2.5 Information Letter and Interview Topic Guide

An information letter was provided to give participants as much relevant information as possible prior to the interviews. The purpose of the letter was to offer fleet managers:

- A high level overview of the main differences between conventional vehicles, PHEVs and BEVs.

- Specific information about the differences between PHEV and BEV technologies.
- Useful information about company car tax.

Participants were asked to read the letter before their telephone interview so that during the interview, the discussion could focus on how BEVs and PHEVs are perceived. All interviews followed a structured interview guide. This standardised approach ensured consistency.

2.6 Procedure

Twenty telephone interviews with fleet managers were conducted by three TRL researchers. The interviews were recorded using Digital Voice Recorders. They were transcribed by an external company before content analysis was conducted by TRL researchers.

2.7 Method of Analysis

The transcripts were analysed using content analysis (e.g. Neuendorff, 2002). The analysis was facilitated using XSight computer software which assisted the researchers in compiling and comparing the interview data. The researchers then explored the relationships between the comments and thoughts put forward by the interviewees.

Qualitative content analysis involves condensing raw data into categories and themes based on inference and interpretation. Following good practice guidelines to ensure that the qualitative data were explored exhaustively, two researchers coded the data, comparing themes and sub-themes on a regular basis to ensure that any new themes emerging from the data were captured. The following sections describe the data under the high level topic areas and themes that emerged from the analysis. Within each section, important sub-themes are also described where present.

3. Results

It should be noted that the sample of organisations interviewed in this study is not representative of all UK business types, therefore, all findings presented in this section should be seen as indicative, but not conclusive. The results presented here expand on the ideas identified in the data analysis undertaken by Hutchins and Delmonte (2012).

3.1 General information from the interview data

Across the sample, the mean number of people who drove for work within a given fleet was 1,732. The number of vehicles within a given fleet varied from a minimum of 30 to a maximum of 105,000.

Vehicle types were largely associated with the organisations' business activities; most fleets consisted predominantly of cars and vans, with some also using trucks and plant equipment. Motorcycles were also reported as being used in the courier industry. Some organisations reported having dedicated car parks with adequate parking for their staff. Others described a first come, first served arrangement or having no staff parking at all, meaning that staff were required to pay to park in local public car parks. As expected,

journey purposes varied between organisations. The purposes reported included:

- Meeting customers/sales
- Maintenance call-outs
- Transporting customers/goods

3.2 Current purchasing/leasing behaviour

In order to try and understand how fleet managers currently make purchase decisions, fleet managers were asked to describe their last fleet vehicle purchase in terms of:

- Vehicle types (including manufacturer and model, segment and fuel type)
- The process involved in buying/leasing/adopting new vehicles
- Information sources used
- Who was involved in the decision making
- Whether they part-exchanged
- Which manufacturers they considered and what influenced that decision

Fleet manager responses revealed a diverse and seemingly non-standardised approach to vehicle purchase decisions. The interview data suggest that vehicle types vary according to the intended journey purposes. The processes involved in buying, leasing or adopting new vehicles varied. Some reported an informal process using their experience in the fleet industry and subsequently having 'a feel' for which process to follow. Others followed a more formal, evaluative approach, whereby they invited manufacturers and dealers to respond to invitations to tender.

> *'The manufacturers normally come in to try and get business. They'll put forward what vehicles they have, ask us why we run the fleet we run, mainly down to size and price, so they try and compete.'*
>
> P9 (Engineering, 110 vehicles in fleet)

> *'We indentify which manufacturers' vehicles meet the user requirement and we go out to the marketplace, to all the manufacturers and give them usually about 48 hours' time to respond.'*
>
> P12 (Energy supplier, 10,200 vehicles in fleet)

Purchase decisions were often made by a range of different people including senior managers, transport managers, finance teams and procurement departments.

3.3 Vehicle choice

In order to ensure that vehicles in the fleet meet operational requirements, the following attributes were considered by fleet managers to be important when deciding on which new vehicles to introduce to their fleets:

- Fit for purpose (i.e. size/number of seats, boot space, interior)

- CO_2 Emissions
- Efficient fuel consumption/mpg
- Reputable brand/manufacturer – associated with image and reliability
- Comfort
- Safety
- Whole life cost
- Availability of vehicles (e.g. if a fleet required 200 new vehicles at short notice, would this be possible?)

The amount of choice available to drivers fell into one of three categories; full choice, choice from a predetermined list or no choice. Where full choice was given, drivers within an organisation were given a list of all manufacturers and models to select from based on their grade within the organisation.

> *'There are various rules within our policies, so dependent on grade you get a certain allowance and that allowance enables you to choose from a very wide range of cars.'*
>
> P12 (Energy supplier, 10,200 vehicles in fleet)

One fleet manager felt that this system gave drivers too much flexibility of choice:

> *'It is entirely up to the individuals. A bit too much freedom for my money, but that is a different thing.'*
>
> P9 (Engineering, 110 vehicles in fleet)

Where drivers had a pre-determined list to choose from, filtering by the fleet manager had taken place to ensure that certain criteria were met (which varied from organisation to organisation), examples of these include:

Number of seats/doors: *'They can virtually choose anything, as long as it's got four doors.'*

P7 (Construction, 200 vehicles in fleet)

Fit for purpose (e.g. storage space, appearance): *'Boot space, because of our service we need to make sure people can stick their luggage in.'*

P1 (Taxi service, 225 vehicles in fleet)

Brand: *'We stick to a manufacturer that's still quite highly respected, so the company wouldn't choose a [manufacturer] for example just because it has to be a car that people want to drive.'*

P20 (Recruitment consultants, 225 vehicles in fleet)

CO_2 emissions: *'We also have CO_2 band policies. CO_2 on Band A is 135 grams, Band B is 150 and Band C is 160 grams. Now, our policy is to drop two per cent each annum. So, when they come up to renew the vehicles, they would've had to drop their CO_2s for the next vehicle.'*

P9 (Engineering, 110 vehicles in fleet)

A small number of fleet mangers reported that there was very little choice or no choice at all about which vehicles employees could have (e.g. one construction company allowed their drivers to select between a car and a van; in another, vehicles were allocated by job role).

The current lack of choice of EV models compared to internal combustion engine (ICE) vehicles may restrict EV uptake by fleet managers, particularly where they have specific requirements to ensure the vehicle is fit for purpose. However as the choice of available vehicles increases year on year, fleet managers will be presented with a greater selection of EVs and may be more likely to consider incorporating EVs into their fleet.

3.4 Finance programmes

A range of finance programmes was reported, as shown in Table 3.

Table 3. Frequency of reported finance systems

Finance system	Frequency
Contract hire	8
Outright purchase	4
Lease	4
Mix of contract hire and operating lease	2
Mix of contract hire and outright purchase	1
Mix of lease and outright purchase	1
Total	20

The most frequently reported finance programme was contract hire, whereby organisations hire vehicles from a provider for a specified period and make regular monthly payments to rent them. The leasing company retains ownership of the vehicle and is responsible for the associated risks. Contract hire was considered to be the lowest maintenance solution for fleet managers. They described it as being particularly useful because it required minimum input from them. The reduced input in the day-to-day running and maintenance of their fleet vehicles meant that they could focus their time on core business activities.

> *'It's like one package and all I have to do is just to manage the cars, it's a one-stop solution.'*
>
> P20 (Recruitment consultants, 225 vehicles in fleet)

> *'We use contract hire rates to acquire the vehicles. It's best in terms of taxation for the company, that allows you to have knowledge of what your outgoings are going to be every month without any surprises.'*
>
> P17 (Accountancy firm, 2,500 vehicles in fleet)

Outright purchase (up-front purchase of vehicles by organisations) and the mixed finance programmes were described as being the most cost-effective options.

> *'By buying outright, we can move the cars around as we please…Our normal cycle used to be three years, 80,000 [miles], and with the recession we increased it to four years, 100,000. By buying outright we can have more control over it.'*
>
> P9 (Engineering, 110 vehicles in fleet)

A lack of viable or flexible finance options may discourage EV uptake among fleet managers. In order to encourage uptake of EVs, it is important to provide fleet managers with competitive finance options which are comparable or superior to ICE vehicles in terms of costs and day-to-day management required. This supports the findings from Stewart's 2012 study, in which 50% of fleet managers interviewed explained that ultra low emissions vans (ULEVs) had to offer a total cost of ownership comparable with diesel vans before they would consider introducing them to their fleets.

3.5 Knowledge of EVs

Prior to the telephone interviews, participants were provided with an information letter. It was not possible to determine precisely how much participants knew about EVs prior to the interview but by providing the letter it was more likely that feedback was based on at least a basic understanding of EVs. Depth of knowledge appeared to range from a basic overview to detailed, technical knowledge.

Participants generally did not have any difficulty in describing the differences between EVs and hybrid vehicles. There was some confusion about what a PHEV was, despite this being explained in the information letter.

Several fleet managers reported having experienced driving EVs, including one who already had EVs on his fleet. Most of those with direct experience regarded EVs positively.

> *'I love them! Fantastic acceleration, ever so quiet, and yes it's a different experience, but you get used to it fairly quickly.'*
>
> P18 (Social landlords, 2,000 vehicles in fleet)

One exception to the positive experiences was a courier company who had purchased an electric scooter. This fleet manager describes experiencing range challenges:

> *'As I say, they're great, but…they advertise a range of 63 miles I think it was and realistically you get about 28 or 29. So bearing in mind the average bike rider does 90, 100 miles a day, it doesn't really work.'*
>
> P1 (Taxi service, 225 vehicles in fleet)

The following quote is taken from a fleet manager who had run three electric vans on his fleet, and demonstrates buy-in of the technology despite some negative experiences.

> *'The three that we bought, the mega vans, they're really not fit for purpose and they're not very strong. But they were very low cost entry into electric vehicles.'*
>
> P13 (University, 160 vehicles in fleet)

Fleet managers reported using a variety of sources to gain their knowledge of EVs, including:

- Vehicle manufacturers
- Attendance at conferences/seminars
- Publications aimed at the fleet industry
- Press releases/media information

3.6 Knowledge of Charging

It seemed that (despite being provided with indicative charging times in the information letter) participants were largely driven by their own pre-conceptions of the time taken to recharge EVs. There was also a lack of knowledge about different charging systems and their capabilities. This is supported by the diverse range of suggested charging time periods in the following quotes.

> *'You get a quick charge and an overnight charge, I think. That's about it.'*
>
> P9 (Engineering, 110 vehicles in fleet)

> *'If we're looking at our home charge situation using domestic plugs, you're looking at about eight to ten hours, I believe. If you're going for a dedicated plug-in system...you reduce that quite considerably probably then to about four hours. But then it's getting dedicated plug-in points where you need them.'*
>
> P15 (Fire and rescue, 200 vehicles in fleet)

> *'If you have a rapid charging system you can probably charge your vehicle up from start to finish in the space of about an hour or so.'*
>
> P3 (Post and courier services, 33,000 vehicles in fleet)

These findings suggest that fleet managers need to be provided with more information about potential charging infrastructure and associated charging durations before they can make an informed decision about adopting EVs.

3.7 Perceived Benefits and Drawbacks Associated With Adoption of EVs into Fleets

Having established participants' knowledge of EVs, they were asked to describe the advantages and drawbacks of the vehicles from a fleet management perspective. Participants offered a range of different benefits

and drawbacks which they associated with adoption of EVs compared to petrol or diesel vehicles. Following content analysis these factors were categorised into one of three groups: environmental, financial and business. The benefits and drawbacks associated with each of these categories will be discussed in turn.

Environmental benefits The most frequently-cited benefits associated with EVs were a combination of lower emissions and reduced fossil fuel use. Participants tended to report an awareness of their organisation's responsibilities for carbon reduction which drove them to consider alternative fuel sources.

> *'Our corporate responsibility in terms of carbon reduction, low emission.'*
>
> P12 (Energy supplier, 10,200 vehicles in fleet)

> *'I think we've got to start looking at reusing fuel and being a bit more economical...There's not going to be any fossil fuels around, so it is important to have to look at the alternatives for all vehicles.'*
>
> P2 (Courier and taxi services, 125 vehicles in fleet)

Several participants reported already using alternative fuel sources such as LPG and bio fuel.

> *'We try to encourage our drivers to run their vehicles on bio fuel if they're diesel. We've got LPG vehicles as well, but basically, we try to incentivise them to use bio fuel.'*
>
> P2 (Courier and taxi services, 125 vehicles in fleet)

> *'We had a handful of LPG cars in the fleet at one stage.'*
>
> P19 (Manufacture and distribution, 1700 vehicles in fleet)

Others reported having already adopted 'eco' brands and hybrid vehicles into their fleets.

> *'They're all [hybrid vehicle]. Oh, there's a couple of [hybrid vehicles] as well, but only about half a dozen.'*
>
> P17 (Accountancy firm, 2,500 vehicles in fleet)

> *'We brought in 500 [low emission vehicles] which are 99g/km [of CO_2] and they're liveried cars.'*
>
> P12 (Energy supplier, 10,200 vehicles in fleet)

Environmental drawbacks The batteries used in EVs were frequently cited as a two-fold environmental concern; firstly, the materials used to produce the batteries, and secondly, how to dispose of the batteries at the end of their life.

> *'What would they do if all these vehicles all had batteries…there would be piles and piles of waste. Have they even thought of recycling, have they even thought of disposal for that?'*

P20 (Recruitment consultants, 225 vehicles in fleet)

'Where do you dispose of your battery and if you need new batteries, who pays for the batteries?'

P9 (Engineering, 110 vehicles in fleet)

Another question raised over EVs was related to the generation of electricity used to power them. Participants were concerned that EVs were not actually as 'green' as advertised.

'You could say that they are green, although I take a bit of an issue with that, to be honest with you at the moment. There's not really enough renewables…it's deceiving.'

P10 (Installation, 120 vehicles in fleet)

Even including electricity production, EVs (in the UK) demonstrate an emissions figure which is lower than the most economic petrol and diesel cars currently on the market in the UK. Nevertheless, the finding that some fleet managers are sceptical of how 'green' EVs are may indicate that attitudes and opinions are still being formed and could be influenced by media exposure and the experiences and views of others.

Financial benefits Lower running and maintenance costs were offered as financial benefits associated with EVs. Cost of fuel was considered to be a negative factor for ICE vehicles. Comparing the cost of recharging and the cost of refuelling, recharging was considered to have a far lower cost than refuelling.

'Fuel savings; we all know fuel's going through the roof.'

P1 (Taxi service, 225 vehicles in fleet)

'Benefits, obviously the big one is that the cost of the fuel is a lot less.'

P10 (Installation, 120 vehicles in fleet)

In terms of maintenance costs, the view was that electric motors would have fewer moving parts and would therefore cost less to maintain than an ICE, thus creating a financial benefit.

'I think vehicle maintenance is going to be a lot easier to manage on an electric drive vehicle and there will be cost benefits associated with that.'

P12 (Energy supplier, 10,200 vehicles in fleet)

'There's very little service, maintenance, repair.'

P18 (Social landlords, 2,000 vehicles in fleet)

Overall fleet managers were able to see the financial benefits offered by EVs but felt that these might be outweighed by the financial drawbacks.

Financial drawbacks The outright purchase cost and the costs associated with batteries were common financial drawbacks. In addition to these costs, fleet managers reported feeling uncertain about the resale value of EVs.

> *'One of the things that is hard for us at the moment is determining a really robust total cost of ownership model that will enable us to bring this technology into our fleet.'*
>
> P12 (Energy supplier, 10,200 vehicles in fleet)

Several fleet managers felt that the purchase cost of batteries was a financial drawback. In addition to the cost, concerns were raised over the likely lifespan and servicing costs of the batteries.

> *'Cost of batteries, huge costs…when the leasing companies look at it at the moment that's the biggest issue; that if you got to replace £8,000 worth of lithium ion batteries after five years…who in the second-hand market's going to buy a second-hand vehicle and then go and have to pay eight grand for a set of batteries? So that's something that's a real problem at the moment.'*
>
> P18 (Social landlords, 2,000 vehicles in fleet)

> *'Batteries, size of battery, using space, load space, and the cost of the battery.'*
>
> P9 (Engineering, 110 vehicles in fleet)

Business benefits In terms of staff wellbeing, respondents (largely those who had direct experience with EVs) reported that the advantages of EVs were related to the driving experience with regard to quietness, responsiveness and reduced demands as a result of the automatic transmission.

> *'They will relieve a lot of driving fatigue because they are fully automatic transmissions; they're very quiet, they're very responsive…the driving experience is actually enhanced I think for the driver.'*
>
> P12 (Energy supplier, 10,200 vehicles in fleet)

> *'They're easy to drive, they're comfortable to drive. So, from a driving experience they're perfectly acceptable.'*
>
> P11 (Energy supplier, 11,000 vehicles in fleet)

For businesses where short, localised journeys are required, it was felt that EVs would be a cost effective option as they would be fit for purpose and would reduce fuel costs. Another business benefit identified was the image projected to customers.

Business drawbacks Range was the most frequently cited drawback associated with EVs, and was almost always linked with available

infrastructure. This also became apparent when considering key attributes and vehicle choice.

> *'They have a limited mileage really, and the travel distance is limited.'*
>
> P10 (Installation, 120 vehicles in fleet)

> *'The range of electric vehicles is a major, major drawback; along with the time to...fully recharge the battery. That's the biggest single drawback.'*
>
> P15 (Fire and rescue, 200 vehicles in fleet)

> *'Once the vehicle is charged if it can cover 60 miles maximum but the way you are driving means 40, you might run out of fuel or you see the gauge is low and you've got to find a filling station quite quickly. And for electric, if the thing stops then it basically stops until it is charged again.'*
>
> P6 (Construction, 2,600 vehicles in fleet)

It was clear that limited range was seen as a major drawback. The average company car annual mileage in the UK is approximately 8,000 miles which equates to roughly 31 miles per working day suggesting that for some fleets range is perhaps not as much of a barrier as some fleet managers believe it to be. The option for travelling longer distances might influence fleet manager decision making where they feel constrained by the limited range of BEVs, even when BEVs are suitable for day to day work. PHEVs may be more attractive to fleet managers who are concerned about range.

In addition to the issues regarding range and infrastructure, the time investment associated with EVs was deemed to be another business drawback. Fleet managers reported concern over the amount of time required to charge EVs and the potential impact that charging could have on business. The comparison was made between the amount of time taken to refuel using petrol or diesel and the time taken to fully charge an EV.

> *'I can't afford to put any technology in the fleet that is going to in effect reduce the operational performance of the engineer.'*
>
> P12 (Energy supplier, 10,200 vehicles in fleet)

> *'As far as I know, it's a plug-in thing and it takes, you know, can take several hours to recharge. Again, it's time-consuming.'*
>
> P8 (Construction, 30 vehicles in fleet)

The actual physical availability of EVs on the market was a concern for some fleet managers, for whom lead times are important and delays in delivery can have operational impacts. Some other participants reported that they likened the EV market to the LPG market, which was considered to be a short lived technology lacking in longevity. As such, fleet managers felt that EVs would be a big financial investment for a technology that may not last.

3.8 Perceptions of EVs from Different Business Perspectives

Fleet managers had mixed perceptions of what senior management and staff within their organisation would feel about having EVs on their fleet. It was felt that some senior staff would consider it to be an advantageous and unique selling point when competing for business, as illustrated in the following quote.

> *'I think they would be quite keen. I think one thing we are quite keen to do is differentiate ourselves…we would embrace selecting something that is a bit different and better.'*
>
> P6 (Construction, 2,600 vehicles in fleet)

However, it was felt by other industry sectors that having EVs on their fleet would go against the image that they wanted to project. For example, a recruitment company viewed themselves to be a cool and trendy organisation in which image was everything, and this extended to their fleet.

> *'They [the staff] would laugh at it. I think it needs a lot more marketing…to make it popular, probably get someone cool out there to make it popular for young people maybe, or someone respectable in the corporate industry to make it, to get that image slightly better.'*
>
> P20 (Recruitment consultants, 225 vehicles in fleet)

Interviewees thought that the reaction of drivers would be mixed:

> *'Some of them are keen, some of them are actually, you know, would say they're a waste of time.'*
>
> P10 (Installation, 120 vehicles in fleet)

> *'Unfortunately they're the type of people that don't like a lot of change.'*
>
> P2 (Courier and taxi service, 125 vehicles in fleet)

> *'I think they would go for it. I think everyone's trying to be green. There is a lot of reason to go green. Sometimes drivers want to take the [hybrid vehicle], for example.'*
>
> P9 (Engineering, 110 vehicles in fleet)

Most interviewees thought that customers would have a positive or neutral reaction to the introduction of EVs to the organisation's fleet.

> *'I think they would see it as a good thing, we hope so…taking the lead and being involved…I think it would perhaps enhance our brand.'*
>
> P13 (University, 160 vehicles in fleet)

> *'Most companies aren't particularly worried what we run around in.'*
>
> P17 (Accountancy firm, 2,500 vehicles in fleet)

'I think some of them would think it's a fantastic idea. I think some of them would think it's green wash [trying to pretend you have green credentials when really you haven't]…I think some of them would think aren't electric vehicles an awful lot more expensive to conventional vehicles.'

P11 (Energy supplier, 11,000 vehicles in fleet)

3.9 Potential for EV Adoption in the Future

Participants were asked to estimate how likely their organisation would be to adopt EVs into their fleets in the future, and when they envisaged that happening. This section presents fleet managers' responses in terms of the likely impact on operations and the availability of infrastructure, and summarises participants' feelings about the likelihood of EV adoption.

Potential operational impacts When participants were asked to describe the potential for adopting EVs into their fleet, it was felt that there would be some benefits such as reduced CO_2 emissions and efficient fuel consumption. However, an area of concern with regard to operational requirements was whether the EVs would be fit for purpose.

'For me it's the interior, because obviously our passengers are looking for a high standard inside the vehicle, oh, and boot space, because of our service we need to make sure people can fit their luggage in.'

P1 (Taxi service, 225 vehicles in fleet)

There was a concern that the presence of the batteries required to power EVs would take up valuable boot space or space in other parts of the vehicle.

'The fact that you haven't got as much luggage space because...the batteries tend to take up quite a lot of room in the boot.'

P2 (Courier and taxi service, 125 vehicles in fleet)

Fitness for purpose was also an important factor for construction companies; those interviewed reported that cars were used to transport toolboxes and smaller pieces of equipment.

'[It is important that] all our engineers' tools can fit in the vehicle and the vehicle is comfortable to drive, because our engineers do spend most of the day in the vehicle, and then service and repair costs…It's pretty difficult when we get another car because none of the toolboxes fit.'

P9 (Engineering, 110 vehicles in fleet)

Other operational concerns were borne out of a cautiousness of new technology, as well as a lack of knowledge and experience. In terms of cautiousness, fleet managers reported that adopting EVs into their fleet would be taking a chance since they use such new technology:

'You're committing heavily to the current technology…we feel there is going to be quite significant advancements in technology around electric vehicles and, you know, we would be stuck with what we've got.'

P12 (Energy supplier, 10,200 vehicles in fleet)

'You might find that in two years time it is really old and slow technology and you don't want them for another three years. So, there is a nervousness around getting in very early and thinking it is going to cost us more money and perhaps might not be the right thing to do.'

P6 (Construction, 2,600 vehicles in fleet)

In contrast, one of the characteristics displayed by early adopters was a sense of pride when describing their own positive experiences of EVs. Quotes such as the following may be useful to assuage some of the doubts expressed:

'The university, I'm proud to say, is one of only two universities that have signed up to the low carbon vehicle procurement programme which is being managed by the Department for Transport. And we're actually awaiting delivery of five electric panel vans.'

P13 (University, 160 vehicles in fleet)

Operational impacts associated with EVs will clearly vary according to business types, with some being more likely to consider EVs than others, both in terms of the required range and interest in promoting the 'green' credentials of their organisation. For example local authorities, energy companies, taxi companies and local delivery firms may be early adopters of BEVs. EV uptake may be increased by identifying and targeting other suitable business types whose practical needs could be met by an EV.

Likely infrastructure availability Concerns over charging were raised in terms of organisations' potential for accommodation of charging infrastructure; this was particularly pertinent where there were inadequate parking arrangements or where the organisation did not own their business premises.

'Because we don't have the space [the staff] take their vans home, and we don't want to get into a system where we are assessing from a safety and practicality point of view whether the guys can charge vehicles at home.'

P6 (Construction, 2,600 vehicles in fleet)

'We're tenants on this site…it's going to be relatively complicated and expensive to get the recharging port installed in our underground car park.'

P19 (Manufacture and distribution, 1,700 vehicles in fleet)

The lack of adequate parking arrangements experienced by some participants posed a big challenge to organisations' abilities to introduce EVs into their fleets, if they were to be reliant on available infrastructure. In situations where

fleet vehicles were assigned to individual drivers, fleet managers were concerned that drivers would not be able to home-charge if they did not have appropriate off-road parking with electric supplies.

For most of the fleet managers interviewed, the specific details of how charging might work had not been considered, for example, whether they would charge employees to recharge their vehicles at work. EVs were already on the fleet at one of the participating organisations (a university), and charging facilities had been installed around the campus. Their strategy was to use their charging points as an incentive for other local EVs users and ultimately as a revenue source when EVs become more widely used.

> *'We would allow our charging points to be used by the general public or staff or visitors who use electric cars to drive to campus. And at the moment we're considering providing that free as an incentive…however, longer term as we probably acquire any and include more electric vehicles into a general fleet, then yes the recharging of those vehicles would be recharged back to the department.'*
>
> P13 (University, 160 vehicles in fleet)

Predicted future adoption Almost half of the sample reported feeling confident that EVs would be introduced into their fleet within the next five years. However, there was hesitancy over the adoption of fully electric vehicles. Participants suggested that hybrids were more appealing as they offered greater range.

> *'The hybrid vehicle; yes, I can see potential for that.'*
>
> P8 (Construction, 30 vehicles in fleet)

> *'Not all-electric, mainly because of the range issue.'*
>
> P13 (University, 160 vehicles in fleet)

> *'I would say over the next five years anyway, but whether they're actually purely electrical or hybrid vehicles, I couldn't actually say at the moment.'*
>
> P10 (Installation, 120 vehicles in fleet)

Participants also reported that, within the five-year time frame, they were realistic about what proportion of their fleet would be comprised of EVs given the availability of vehicles.

> *'Maybe 2 per cent or 3 per cent; maybe up to 5 per cent of the fleet may go electric over the next five years.'*
>
> P18 (Social landlords, 2,000 vehicles in fleet)

> *'Within the next five years I would like to think that there's at least one on the fleet.'*
>
> P7 (Construction, 200 vehicles in fleet)

For those who did not envisage their organisations adopting EVs, this was largely due to 'unanswered questions' and the novelty of EV technology.

> *'If we have a situation where we have a specific use that keeps it within a specific area and where the range is within the battery capacity and its down time is such that it allows recharging, then yes, we could probably make use of it.'*
>
> P15 (Fire and rescue, 200 vehicles in fleet)

Unanswered questions raised by fleet managers included:

- The actual purchase cost of EVs
- Whole life costs of EVs
- Residual and resale values
- (Contract) hire costs

4. Summary and Conclusions

As expected given the diverse range of organisations involved in the study, the results demonstrate that the fleet managers interviewed did not exhibit a standardised or consistent approach to purchasing or leasing fleet vehicles. Fleet managers reported using a range of approaches to the adoption of new fleet vehicles from very formal, evaluation-based arrangements to far more informal approaches. The degree of choice of fleet vehicles available to drivers ranged from a broad choice of vehicles dependent on grade to no choice about the vehicles that they drove for work.

Despite the diversity of organisations, it appears that the sample mapped on to Nesbitt and Sperling's (2001) categorisation of decision-making structures. Examples of autocratic, bureaucratic and hierarchic decision making processes could be identified from the sample. These are summarised in Table 4.

Table 4. Examples of different decision-making processes used in the interview sample, based on Nesbitt and Sperling's (2001) typology

Process	Supporting quote
Autocratic (low formalisation, high centralisation)	*'To be quite honest, the choice is normally the Managing Director himself. So you know, if we were to buy a new vehicle, he would tell me what vehicle he would like for me to get hold of for him.'* P2 (Transport and communication)
Bureaucratic (high formalisation, low centralisation)	*'Well, we have a cars policy which basically has a number of criteria and thresholds. The first one is it sets an allowance level for a choice of car depending on the individual's salary grade, okay. And then it sets out the criteria then to do with the choice of car, for example, we have a ceiling on CO2 emissions, which is 150g per kilometre. We have a minimum Euro NCAP safety rating of four stars for the choice of car. And then we have other factors sitting there which are to do with practicalities, that they must have four doors or five doors, you know, they must be suitable for carrying passengers. We have policies that exclude vehicle types such as 4x4's or sort of camper vans and those types of vehicles.'* P13 (Health and education)
Hierarchic (high formalisation, high centralisation)	*'I work with our HR team, who, if you like, own the policy. And I work with the procurement team as well because we work together to buy the vehicles efficiently, to lease the vehicles efficiently. But actually, I would say I'm the person that has the most input in terms of the models.'* P19 (Manufacture and distribution)

This suggests that EV marketing strategies will need to be targeted differently towards the different structures of decision making within different organisations.

A lack of understanding was apparent with regard to the different categories of EV. Participants were typically able to differentiate between a BEV and a standard hybrid, but in many cases were unable to describe the attributes of a PHEV. Similarly, there seemed to be an uncertainty about charging times and different types of charging. The fleet industry needs to be provided with clearer information on EV attributes and charging routines in order for them to evaluate the likely impact that EV adoption would have on their operational needs.

Another theme which linked with the lack of knowledge was the uncertainty and wariness relating to new technology which was cited as a barrier to introduction of EV technology. There was a tentativeness associated with being early adopters, participants expressed that they would rather base their decisions about whether to adopt on feedback and experiences of others. This

feedback from other users, potentially in the form of case studies, could be a useful marketing strategy.

While the approach to vehicle adoption varied greatly across the different organisations, fleet managers' perceptions of the advantages and drawbacks associated with EVs were more closely aligned. The EV attributes that fleet managers considered to be advantageous over ICEs included environmental, financial and business factors. The most frequently cited advantage was the potential that EVs had to assist fleet managers in meeting their corporate carbon reduction targets. CO_2 reduction was important to fleet managers across the sample, in some cases it was the most important vehicle attribute of all. From a financial perspective, the lower running and maintenance costs were considered to be advantageous. Finally, from the business perspective, interviewees felt that the benefits of EVs over ICEs were twofold. Firstly, they had the potential to differentiate organisations from their competitors by being a new and innovative technology. Secondly, the driving experience of EVs was thought to be preferable from a wellbeing perspective given that EVs offer quiet, responsive driving with automatic transmissions reducing driver workload.

In terms of barriers to introduction of EVs into fleets, the two most frequently cited were the available range and the availability of infrastructure. These drawbacks were often synonymous with one another, whereby even if range was less of a problem, the lack of available infrastructure would be the main barrier against adoption. The charging process was a further area of concern for the fleet managers within our sample. Many described inadequate parking facilities for the provision of charging infrastructure for their employees, as well as a paucity of publicly available charging points. There was a fear that should EVs need recharging during the working day, the time taken to charge would have a far greater impact on operational efficiency than refuelling at a petrol station would. Feasibility of home charging was also a concern for some fleet managers who felt that they would not be able to incorporate EVs into their fleet if their drivers did not have facilities (such as off-road parking with an electrical power supply) with which to charge.

Despite the apparent emphasis being placed on the drawbacks associated with the introduction of EVs, the organisations within the sample were, on the whole, keen to introduce EVs into their fleets, but fleet managers suggest that this will be a gradual process. The fleet managers interviewed in this study reported that they were likely to adopt a small number of EVs (with PHEVs possibly being more likely) into their fleet in the next five years and would be keen for others to 'test' the technology before they invested.

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Notes

[1]The term ‘EV’ can be used to refer to both battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). In this paper, we will denote where discussing BEVs or PHEVs specifically; the term ‘EV’ will be used where there is generic discussion of electric vehicles.

[2]Figures based on average of Nissan Leaf, Mitsubishi i-Miev and Renault Fluenz EV emissions.

[3]This paper reflects work undertaken as part of the wider Plug-in Vehicle programme, which was commissioned and funded by the Energy Technologies Institute. The ETI investment programme is investigating the business case for the mass market deployment of electric and plug-in hybrid electric vehicles in the UK and determining what energy infrastructure would be required.

[4]http://cdn.volkswagen.co.uk/assets/common/content/fleet/A-Fleet-Managers-Guide-Part-8-Grey-Fleet-Issues.pdf