EVALUATION OF THE WARWICKSHIRE RURAL ELECTRIC VEHICLES (WREV) TRIAL

Key Findings Report
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Greenwatt
sustainable transport solutions

Centre for Business in Society

Coventry University

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WARWICKSHIRE RURAL GROWTH NETWORK

Government Equalities Office

Department for Environment Food & Rural Affairs

The European Agricultural Fund for Rural Development: Europe investing in rural areas

CWLEP Coventry & Warwickshire Local Enterprise Partnership

Warwickshire County Council

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1: Introduction and Trial Overview

The 'Warwickshire Rural Electric Vehicle' (WREV) trial was designed to support small and medium enterprises (SMEs) in rural Warwickshire in examining their options for switching to electric vehicles (EVs[1]). Through switching to EV technology it was hoped that these businesses would be able to counter increasing fossil fuel costs, improve their carbon footprint and stimulate business development. The trial included:

- A feasibility study to assess the practicality and viability of a business switching to EV technology
- £2,000 in grant funding towards the lease of an electric vehicle for up to a two-year period
- Installation of a free charging unit at a location suitable for the business
- Monthly Reports on cost savings, usage, and emissions
- Free EV eco-driving session
- Technical and project management support for business

WREV was funded by the Department for Environment Food and Rural Affairs (DEFRA) and led by Warwickshire County Council on behalf of the Coventry and Warwickshire Local Enterprise Partnership (CWLEP). The project was managed by Greenwatt Sustainable Solutions, a sustainable technology consultancy based in South Warwickshire, with support from Coventry University.

As a partner in the project the Centre for Business in Society (CBiS), on behalf of Coventry University, was responsible for evaluating the performance of the vehicles in the trial. The data on vehicle performance was provided by Quartix, a company specialising in tracking devices, and was analysed by CBiS and sent to project participants in the form of a monthly report. Additionally, CBiS also monitored feedback from the drivers and businesses at different points in the trial. This included a questionnaire at the start of the trial and an in-depth interview towards the end of the project period which evaluated the performance and benefits of using an EV in the business.

[1] The term EVs refers to a wide range of technologies including; battery electric vehicles (BEV), extended range electric vehicles (EREV), plug-in hybrid electric vehicles (PHEV) and fuel cell electric vehicles (FCEV). Hybrid electric vehicles (HEV) that use an e-motor as their secondary rather than primary means of propulsion are not classified as EVs in this paper.

2: Terms of Reference

The purpose of this report is to analyse the results from the WREV trial which took place between autumn 2013 and summer 2016. Specifically, the study will investigate the period of May 2014 to June 2016, where vehicle performance was monitored by CBiS.

In order to understand firm behaviour, the report will firstly assess the motivations held by users for joining WREV before assessing vehicle usage patterns. To assess the usage and performance of the vehicles, the report will take data collected between May 2014 and June 2016. This period has been selected as the bulk of the monitoring took place during this timeframe. The report will analyse:

- Number of trips undertaken by the fleet
- Travel time (in minutes) for the fleet
- Distance travelled (in miles) for the fleet
- Energy consumed by the fleet (kWh)
- Fuel Savings (£)
- CO_2 Emissions saved (g/mile)

The report will also assess the types of journeys made by the users during the trial, whilst investigating some of the advantages and drawbacks of involvement in the WREV trial. Additionally, the findings also draw attention to the future plans held by trial participants. While the report may draw attention to certain issues (such as range or charging), it does not outline how these aspects could be improved.

3: Electric Vehicles:

3.1: The need for the de-carbonisation of the vehicle fleet

By 2016, the total number of registered vehicles in the UK had reached over 35 million, with 30 million passenger cars, 3.7m light goods vehicles, with over 1 million other vehicles including heavy goods lorries and coaches. Since the mid 1990's, the vehicle fleet in the UK has risen by around 10 million vehicles (DFT, 2016). As a result of the increased number of vehicles on UK roads, policymakers have faced challenges in terms of traffic congestion and rising CO_2 emissions. In an attempt to address these issues there have been several legislative solutions including; investment in public transport, the adoption of low emission zones and support for the development, supply, and use of ultra-low emission vehicles. There are a variety of alternative vehicle technologies which have been promoted as transportation solutions, including electric, liquid petroleum gas (LPG) hydrogen and biofuels. For the purpose of this report, it is electric vehicles which are of the greatest interest.

EVs produce zero 'tailpipe' emissions, and battery powered vehicles are 'pure' as they operate solely on an electric charge. Hybrid vehicles have been more popular with consumers as these vehicles have a petrol powered internal combustion engine alongside an electric battery and as such they are not solely dependent on electrical power for driving range. For 'pure' EVs which are powered solely through an electric drivetrain there are widely expressed concerns surrounding recharging and driving range (Public attitudes towards electric vehicles survey, 2016). Moreover, as an emerging technology, EVs have typically been more expensive than a conventionally powered comparable car. In response to these issues, the UK government has offered incentives for motorists to switch to EV technology. This has included grants and tax breaks, with all EVs exempted from fuel and road taxation. Despite these incentives, adoption rates have proven to be sluggish, possibly as consumers wait for improvements in the technology before making a decision to switch from a conventional car or van.

Another factor influencing the slow rate of EV adoption has been the relative scarcity of models on sale. Mainstream manufacturers, whilst investing in EV technology, have been somewhat reluctant to fully commit to developing electric alternatives. Indeed, many have focused on 'downsizing' conventional engines and improving efficiency in their attempt to lower emissions. For many Original Equipment Manufacturers (OEMs) this is seen as being a more effective solution in the short-term as their sunk costs are primarily related to the design and manufacture of conventionally powered vehicles. This has however left room for new players such as Tesla to enter the EV market.

In a further attempt to encourage consumers and businesses to switch to EVs, both private and public sector bodies have utilised a range of initiatives to promote and inform users of the benefits of EV technology. This has included establishing a number of trials which enable drivers to experience an EV over an extended period of time. These trials include examples such as CABLED in the West Midlands and SWITCH-EV in the North East of England. The focus of most of the usage in these trials has been on urban driving, but the experiences of rural motorists also deserve consideration.

3.2: Rural Motoring and Electric Vehicles

Patterns of travel in rural areas are somewhat different to those found in urban locations where there is a greater supply of public transport routes and wider availability of petrol stations or charge points. Rural transport is principally influenced by five key factors:

- Demographics
- Travel costs
- Loss of local services
- Availability of public transport
- Urban-to-rural migration

In general, the rural population tends to be older and poorer than urban areas, and more dependent on a car for transportation. Despite some attempts to increase the provision of public transport in rural areas, the availability of such services tends to be low. Indeed, those in the most isolated communities may find it extremely difficult to find a public transport alternative that is suitable for their requirements. Furthermore, public transport routes in rural areas are under further pressure due to cutbacks in services, creating additional challenges for those living in isolated rural locations.

This greater dependency on vehicle usage is reflected in the access to cars/vans in rural communities. Evidence from the most recent census in 2011 illustrates that vehicle access is greater in rural locations than in urban areas. The regional breakdown is shown in Table 1:

Table 1: Percentage of English households with at least one resident with access to a car/van, 2011

	Percentage	
	Urban	Rural
North East	66.3	78.0
North West	70.2	87.8
Yorkshire and The Humber	69.4	86.7
East Midlands	74.2	88.2
West Midlands	72.7	89.8
East	78.3	89.3
London	58.4	84.9
South East	79.2	90.2
South West	77.7	88.5

Source: Census of Population (2011) Office for National Statistics, HMSO, London.

For the poorest rural households, the shortage in public transport and the isolation of communities suggests that they have to make sacrifices in order to maintain vehicle ownership. For example, 49% of the poorest urban households in 2014 had no access to a car or van, compared to 28% in rural communities. The breakdown is shown in Table 2:

Table 2: Car availability by English household income quintile (percentage)

		No Car/Van	One car/Van	Two Cars/Vans	Three or more Cars/Vans
All urban		28	45	22	5
	Lowest real income level	49	41	9	1
	Second Level	36	46	15	2
	Third Level	23	48	22	7
	Fourth Level	15	45	33	6
	Highest real income Level	14	42	35	8
All rural		11	42	38	10
	Lowest real income Level	28	53	16	4
	Second Level	18	53	22	8
	Third Level	10	42	38	10
	Fourth Level	2	40	46	12
	Highest real income Level	3	29	55	13

Source: Department for Transport, 2014; National Travel Survey 2014.

Additionally, these vehicle owners also face higher running costs and longer distance travel when compared to urban drivers. The lower number of petrol stations in rural areas has the effect of pushing up prices, creating an economic challenge for motorists and business alike. Irrespective of advances in existing ICE technology, these users will still face challenges with being 'rural' which cannot be overcome in petrol or diesel vehicles.

This is where EVs could be adopted as a mobility solution for rural motorists. Rather than depending on expensive fossil fuel sources, users can charge at home, work, or where possible through renewable sources such as solar power. The installation of renewable technology is more feasible in some rural locations due to the additional space available. Regardless of charging behaviour, the running costs for the EV are lower than a petrol or diesel equivalent, but as stated these vehicles are currently sold at a premium price. While the effects of this pricing strategy are partly alleviated through subsidies, there is no guarantee that such policies will be retained in the longer-term. As said, car-share schemes or trials such as WREV enable potential users to sample EVs and assess their practicality before adopting them as a transport solution for their business or personal transport requirements.

4: Trial Participants

Over the duration of the WREV trial, a total of seventeen electric vehicles were operated by seventeen different businesses. These businesses were required to meet specific eligibility criteria before engaging in WREV. These were:

- The business must be in a rural postcode on the Regional Growth Network (RGN) post code checker
- The business must be an SME (Less than 250 employees)
- A proportion of the selected firms must be led by women
- The businesses must come from different sectors
- The business must have the potential to create jobs or safe guard jobs as a result of 'added value' provided by the project
- The businesses must provide evidence of belonging to local networks to which the benefits of EVs could be promoted to add value to WREV
- The businesses must participate in the project until its end in September 2016

The SMEs who engaged in the project had to take a minimum 24 month contract hire for a new electric vehicle, which had to meet the practical requirements of the business. For the interested businesses Greenwatt conducted a feasibility study which included the evaluation of existing vehicles costs, electric vehicle costs, and the installation of a charging point. On the basis of these findings, the decision was then taken by the SMEs as to whether they wanted to be involved in WREV. The bulk of the interested parties who secured involvement in the trial elected to take a Nissan vehicle, with nine Nissan Leaf's running alongside six Nissan electric vans (e-NV200) which entered the trial at a later stage. The remaining two users elected to trial the BMW i3[2] without the petrol range extender. A full breakdown of technical specifications of the vehicles is provided in the performance indicator report. The trial participants are shown in Table 3:

Selection of WREV Participants

[2] There are two versions of the BMW i3 available. There is the 'pure' EV with an all-electric drivetrain plus a range-extended version which uses a 2-cylinder petrol engine to feed the batteries meaning that the car never solely operates on electric power

Table 3: WREV Trial Participants

Business	Start Date	End Date	Sector (SIC)*	Vehicle
Royland Farms	February 2014	March 2015	Mixed Farming	Nissan Leaf
Arden Business Solutions/Occupational Health	February 2014	September 2016	Environmental consulting services	BMW i3
MJ Tech Ltd	March 2014	March 2016	Maintenance and repair of motor vehicles	Nissan Leaf
CG Corbett & Son	March 2014	March 2016	Mixed Farming	Nissan Leaf
Act on Energy	March 2014	March 2016	Environmental consulting activities	Nissan Leaf
Pinnacle Care	March 2014	March 2016	Other human health activities	Nissan Leaf
Taste of the Country	March 2014	March 2016	Other retail sale of food. Manufacture of bread/ prepared meals and dishes	Nissan Leaf
Alderminster Electrics	May 2014	March 2016	Electrical Installation	Nissan Leaf
GNF and GA Browning	July 2014	September 2016	Mixed Farming	BMW i3
Haystoun Construction	April 2015	September 2016	Construction of other civil engineering projects	Nissan Leaf
Longden Events	July 2015	September 2016	Other business support service activities	Nissan e-NV200
Atherstone Pharmacy	July 2015	September 2016	Other human health	Nissan e-NV200
Revel Pharmacy	July 2015	September 2016	Other human health	Nissan e-NV200
Farmers Fayre	July 2015	September 2016	Other retail sale	Nissan e-NV200
Synium	November 2015	September 2016	IT consulting activities	Nissan Leaf
Trustees of the Cygnet Fund (Alscot)	December 2015	September 2016	Other service activities	Nissan e-NV200
Trees of the Stag Estate Trust (Alscot)	January 2016	September 2016	Other service activities	Nissan e-NV200

***Standard Industrial Classification (SIC) Code is used to classify business establishments by the type of economic activity that they are engaged in.**

During the first year of WREV which ran from May 2014 to April 2015, there were a total of nine vehicles in circulation. The remaining eight EVs joined the project in the second year (from May 2015 onwards). At the trials peak in early 2016, there were a total of sixteen vehicles being monitored, although six of these firms were no longer monitored after February 2016. As part of the eligibility criteria, the businesses participating in WREV were drawn from a variety of different sectors. There were examples of traditional rural businesses, with three organisations involved in farming activities. In contrast there were three businesses involved with renewable technologies, either through consultancy or installation. There were also three businesses drawn from the healthcare sector, with two pharmacies using an electric vehicle to offer a delivery service to patients. Two businesses were involved in food retailing, with the remaining users including a vehicle repair garage, events businesses, IT consultancy, and a construction company.

5: Data Collection

5.1 Vehicle Monitoring

Each of the Nissan vehicles involved in WREV was fitted with a data logger from Quartix. These loggers monitored various aspects of vehicle usage, with the data sent to CBiS on a weekly basis. The data included:

- Number of trips
- Total travel time
- Total distance (miles)
- Energy consumed (kwh)
- $C0_2$ emissions (KG)

The two BMW i3s involved in the trial did not record this data as they could not be fitted with a data logger for practical reasons. Instead the users of these vehicles recorded mileage which was sent through to CBiS on a monthly basis. From the mileage data, fuel and emissions savings were calculated.

Data collected from each of the vehicles in WREV were analysed and returned to trial participants in the form of a monthly report. These reports not only provided details of the data returned from the Quartix loggers, but also provided information concerning savings in terms of fuel costs and emissions. These data were calculated by benchmarking each of the EVs against an existing diesel vehicle within an organisations fleet, or a comparable car or van choice.

5.2 Participant Insights

In addition to the data collected from the vehicles in WREV, project participants were asked to complete a questionnaire and interview during the course of the trial. The questionnaire was distributed via an online system (Bristol Online Surveys) and was sent to participants shortly after they had joined WREV. The questionnaire asked respondents to consider their motivations for joining the trial, and their early experiences of using an EV (i.e. adaptation, charging habits, and number of drivers). Of the firms involved in WREV, twelve participants returned the survey, a 75% response rate.

The in-depth interview took place during the second year of WREV and requests were sent to all organisations involved in the trial. Principally, these requests were targeted towards the key decision maker within the trial organisation. In most cases, these individuals also had experience of driving the EV even where they were not considered as the most frequent user. The questions asked during the interviews focused on adding detail to the company's motivations for EV adoption, and how their usage and experience of the EV had changed over time.

Trial participants were also asked to reflect on whether they had formulated any future plans with regard to continued EV use, and whether utilising an EV has benefitted their business. Responses were received from all organisations involved in WREV, although due to business circumstances two firms could not undertake an interview. The remaining organisations all provided some feedback via a face-to-face discussion or telephone appointment.

Eco-driving winner

6: Motivations for joining WREV

Both the survey and interviews addressed the key motivations for joining WREV. Broadly, the three main factors influencing businesses to join the project were:

- Technological
- Environmental
- Financial

This is reflected in the survey, where 87% of the respondents highlighted that 'keeping up with latest vehicle technology' was a motivator for their engagement in WREV, 93% stated that environmental considerations were important, and 87% noted the availability of the grant support as being influential. These responses were explored further in the interviews with project participants.

When addressing motivations concerning technology, four respondents reflected that they held an interest in solar panels or other renewable technologies. As said, their interest in EVs was part of a wider consideration of sustainable or environmentally friendly innovations:

> ***"I was looking at electric vehicles before this [trial] came along….I have already got solar panels, we are organic farmers, we are trying to do the environmental things. I have been interested in that sort of thing for quite a long-time"***
> ***(Respondent F)***

> ***"I wanted to find out more about [EVs]. Prior to having the car, we put 90kw PV cells in, so we're trying to make best use of the electric regeneration"***
> ***(Respondent D)***

> ***"It's nice to look to be green to the public, and to try and encourage it. One of the Doctor's has quite a high interest in it….We looked at things like solar panelling when we had some extension work done four years ago"***
> ***(Respondent K)***

> ***"If planning goes ahead we're having solar [panels] in the bottom field here. Hopefully, my car will be powered off solar. Solar [power] is being tapped into my building, so I am hoping that my car will be even cheaper"***
> ***(Respondent I)***

In contrast to the survey responses, these participants did not openly discuss a desire to 'keep up' with the latest technology, but instead suggested that they had a desire to utilise environmentally friendly solutions. In addition to these participants, there were three businesses in the trial which had renewable technologies as a core part of their message or operation. Therefore, using an EV was advantageous for their business as this gave them a platform for promotion:

> ***"I do a fair bit of sustainable development work and helping SMEs, not on a particular technology, but doing assessments to see what technologies might be appropriate for them. Therefore, turning up in an electric vehicle reinforced my message. I was living it, not just telling someone else to do it"***
> ***(Respondent C)***

> ***"Particularly on our renewables side you've got to practice what you preach. It's pretty important to us"***
> ***(Respondent B)***

The respondents felt that using EV technology was beneficial in promoting their message about using sustainable technologies. Along side these technological factors, project participants also argued that concern for the environment was a key motivation:

> ***"I think we need to take care of our environment and think about the way that we live and look forward to what our children and grandchildren [will have] to protect things for them when they are older"***
> ***(Respondent J)***

However, one respondent was explicit in arguing that environmental considerations were not a key motivation. Instead his desires were financial, suggesting that the availability of the grant was of greater importance than any 'eco' concerns:

"The financial terms were favourable. It suited our purposes and fitted into our company way of life… There is only gain because we get a £2,000 grant and it's cheap to run. I can confirm it's a financial benefit ….I have had a grant for £2,000 so I did it and took it. The environment, I am not an eco-warrior. I do believe there is too much wrong with the world to try and get it right with the environment. The reason I went for it was the financial advantage"
(Respondent G)

Other respondents were also explicit in stating how the grant was a crucial element in their decision making process:

"Money speaks. If it is viable, if it stacks up financially with a grant that is the reason we went in with it…We are a small organisation, we don't have a massive surplus of cash, and we did it because we could see it could possibly break even if we did enough miles in it"
(Respondent A)

"The grant was really the cherry on top. That's got to be it really for any business looking at it. It helps. I would defy anyone to say that it doesn't"
(Respondent N)

The financial support offered through the WREV scheme was a critical factor for many organisations that otherwise would not have been able to afford an electric vehicle. So whilst many organisations noted that they were interested in the technology, they would not have been able to engage with it due to financial barriers. Therefore, the grant support offered by WREV was of high importance to these organisations as it allowed them to subsidise some of the upfront costs of the vehicle. It is possible to surmise therefore, that in the longer-term the high purchase price or lease costs of these vehicles may inhibit other adopters from switching from conventional vehicles.

The comments from the discussions with trial participants highlighted that the vast majority had some form of interest in electric vehicles before joining WREV. However, this interest was often realised because of the grant support on offer, and the ability to lower fuel costs from utilising an EV.

7. Data Analysis: Usage

Having addressed the factors which encouraged businesses to join the trial, the next section of this report will evaluate data collected from the vehicles used during WREV. The form of data collected from the vehicles is outlined in Section 5, and for the purpose of this report, information on trips, time, and distances will be analysed in order to ascertain the journey patterns of users. Once these patterns have been established, the next phase of the report will identify the likely energy usage and savings (both cost and emissions) resulting from EV use during this trial.

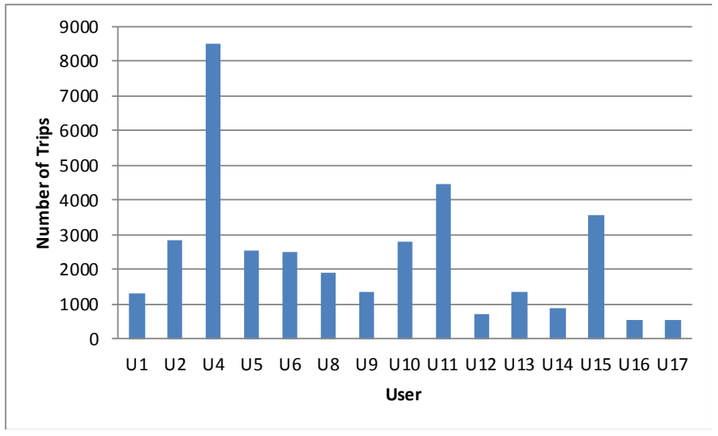
The data to complete this analysis are drawn from the monthly reports sent to each business involved in the trial. The monthly reports were based on a spread sheet designed by Quartix and contained data on number of trips, driving time, miles driven, energy use, cost savings, and emissions. The key information drawn from the data loggers was the mileage, time driven, and number of trips. These data were used to calculate the cost savings, energy usage, and emissions through information on the performance of the EV, and the vehicle used for comparison being built into the spread sheet. The cost of electricity was taken as the average between the on and off peak rate charged to the user. However, for those using solar power or public infrastructure, the estimated cost of charging in the spread sheet could be somewhat different to the actual cost. These costs assume that the user is plugging the vehicle into the grid supply. To calculate fuel savings, diesel costs were taken from three postcode regions, as will be explained later in the report.

7.1 Travel Patterns

In analysing the travel patterns of users, the first aspect to be covered will be to evaluate the number of trips made by users involved in WREV. During the period of May 2014 to June 2016, the Nissan fleet made a total of 35,814 trips spread across fifteen different vehicles. Of these journeys, 10,090 took place during the first year of the trial (May 2014-April 2015) with 25,724 occurring from May 2015 to June 2016. The significant increase in the number of trips between the two periods was driven by two factors. Firstly, the number of vehicles being monitored grew from seven between May 2014 and June 2015 to fifteen in early 2016. Secondly, each of the users who were involved in the trial in both the first and second year recorded a higher average number of trips in their second year of using the EV. For example, one SME had an average number of trips per month of 175 in year one, but this increased to 235 in year two.

Overall the highest number of trips made by a single user was 8,518. Somewhat surprisingly, this user was only involved in WREV for the second year of the trial, and the total number of trips was over 4,000 greater than the second highest user. This user also recorded the highest number of trips per month with 774. In contrast, the smallest number of trips made by a single Nissan user in the trial was 528, although the SME recording this result was only involved in the final few months of WREV. The smallest number of trips on average was made by another user who recorded 66 journeys per month, and they were also only involved during the second year of WREV. The number of trips across the trial is summarised in Figure 1:

Figure 1: Number of Trips by each Nissan user May 2014-June 2016



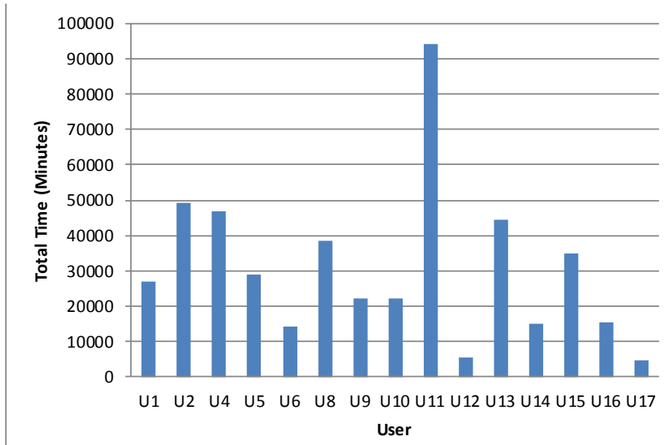
The highest number of trips made by the fleet in a single month was 2,937 in November 2015, with each user making an average of 245 trips. The lowest total number of trips made by the Nissan users in a single month was 661 at an average of 94 for each EV. Overall, the average number of trips made each month was 1,377. In the first year of WREV, the average number of trips made each month was 841, and this increased to 1,837 in year two. In a single month, the highest number of trips recorded by a user was 1,145 with the lowest being 4. The lowest number is explained by the

SME using the vehicle sparingly during their first month in the trial[3] .The volume of trips undertaken in WREV, indicates that these businesses were extremely active in using their vehicles throughout the trial.

7.2 Time Travelled

Each of the Nissan vehicles involved in WREV also recorded the total driving time. For each of these vehicles, the total driving time in minutes is shown in Figure 2:

Figure 2: Total Time Driven by each Nissan user (May 2014-June 2016)



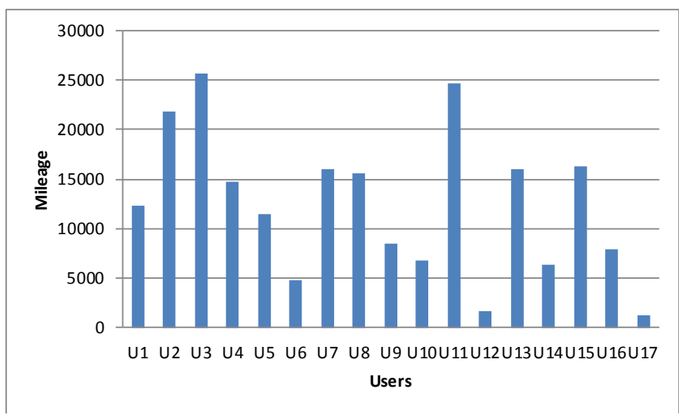
A total of 463,751 minutes (equivalent to 322 days and 1 hour) was spent by participants driving their electric vehicle. As with the number of trips, there was a significant increase in the total time driven in the second year. In year one, a total of 163,682 minutes was driven, compared to 300,069 minutes in the second year. The highest driving time recorded by a single user was 94,259 with this SME involved in both the first and second year of WREV. This was significantly higher than the second highest figure of 49,378 minutes, whilst the lowest recorded driving time for a single user was 4,615 minutes by an SME involved in the second year of WREV only. The highest monthly driving time for the fleet was 33,029 minutes in November 2015, with each user averaging 2,752 minutes. The lowest time driven by the Nissan fleet was 10,340 minutes in August 2014, with each user averaging 1,477 minutes driving time. The highest amount of time spent driving by a single user in a month was 7,343 minutes, whilst the lowest was 11 minutes as a vehicle was used sparingly after an SME joined the trial.

On average, the fleet of Nissan vehicles drove 17,837 minutes in each month of the trial. However, in the first year of WREV, the fleet drove an average of 13,640 minutes each month compared to 21,434 in year two. In contrast to the number of trips, two users involved in both years of WREV recorded a lower average driving time per month in the second year of the trial when compared to May 2014 to April 2015. Those users who recorded higher average monthly driving times did so by a significant margin. For instance, one SME recorded an average driving per month of over 2,071 minutes higher in the second year when compared to year one.

7.3 Distance Travelled

In measuring distanced travelled, data was taken from all vehicles involved in WREV. Despite operating without a data loggers, the BMW drivers kept a record of miles driven. The miles driven by all users is shown in Figure 3:

Figure 3: Total Miles Driven by all users: May 2014-June 2016



[3] The SME used two vehicles and did not increase usage until the second van was delivered.

The total mileage for all vehicles involved in the trial was 211,934, with 78,783 miles driven in year one compared to 133,151 from May 2015 onwards. Once again, this is to be expected as the number of vehicles in the trial increased during the second year. However, the majority of users who were involved in both the first and second year of WREV reported higher average monthly mileages in the second year. In one case, an SME recorded an average monthly mileage in year two which was 667 miles greater than in the first year. Conversely, two firms did record a lower average mileage in the second year, but for one of these firms this was partly explained through acquiring a second EV.

The increased average mileage is demonstrated by a comparison of the means across the two years of the trial. Between May 2014 and April 2015, the fleet had an average mileage of 6,565 each month. In the second year with an increased number of vehicles and more user confidence, the average monthly mileage for the fleet increased to 9,511, giving an overall mean score of 8,151 for the entire project. In a single month, the highest mileage recorded by the entire fleet was 14,180 in November 2015, with each user averaging 1,013 miles driven. The lowest mileage driven by the entire fleet in a single month was 4,087 in January 2015, with each user averaging 534 miles during this month. The highest monthly mileage of any user was 2,345 with the lowest being a single mile due to an EV not being utilised shortly after delivery.

In a single year, the highest recorded mileage by a user was 15,966. This was completed by a firm in the first year of the trial which suggests that this business was able to adapt to the technology quickly. From May 2015 to June 2016, the highest mileage recorded by a single user was 14,771. Interestingly, the user who recorded this figure only joined WREV in the summer of 2015, providing further evidence to suggest that some businesses were 'up to speed' and confident in the technology almost immediately. Other businesses took time to adjust to the technology due to multiple drivers and lower trust in the EV.

7.4 Journey types

Data on travel patterns was supplemented by asking the trial participants to describe the typical journeys undertaken by the vehicle. From the survey data, 93% of respondents stated that the EV was well suited to their 'short journey' requirements. A similar narrative emerged from the discussions with participants, as five users highlighted that the vehicle was used for short trips which followed a similar route. These businesses reflected how the vehicle was used for basic 'shuttle work':

> ***"We've literally been using it because [the kitchen] was ten minutes away and it was fine to transport the team in that way"***
> ***(Respondent M)***

> ***"From here [the business], the journey's that we do are quite short, and we do a lot of them….We bring staff in from Rugby that's a 6 mile journey, so that happens three times a day. Then the Lodge…we use it for that in between. So it's had quite a lot of use but mainly [for] short journeys"***
> ***(Respondent J)***

Additionally, a further seven users highlighted that the vehicle was used for short distance travel, but with slightly more variation in the routes followed. These examples included businesses using an EV for delivery purposes:

> ***"The electric van mainly comes into use with buffet deliveries. A lot of them are on site or just in the local area….For us it's just an ideal bit of kit, it very rarely goes below 30 miles left [of range] but that's just what we need"***
> ***(Respondent E)***

The feedback from the users indicated that the EVs were ideally suited to the short journey requirements held by most businesses. This pattern of travel was reinforced by the average mileage per journey being calculated at six miles for businesses with Nissan vehicles. While the EVs were effective in completing these shorter distances, some drivers expressed 'range anxiety' even with small journeys:

> ***"One staff member jumped in it the other day and it's got 19 miles [of range left]. I said [to him] you've only got to go to Welford and back which is 6 miles. Once it starts dropping its range off, everybody gets the old 'oh my god I can't go anywhere' [feeling]"***
> ***(Respondent I)***

Range anxiety is a phenomenon well covered in EV literature, and the experiences of users in WREV are no different. Although the driver in question completed the trip, a lack of confidence in the vehicle, allied to a shortage of available charge points, strongly contributed to these anxieties. For many WREV users this resulted in limiting their travel distances:

> ***"We're talking up to about 50 miles [for journeys]. Therefore, from talking with a number of the other participants [in the trial], the range anxiety with the [Nissan] Leaf's that they have got means they would typically go no more than 30 miles in one direction unless they could charge up"***
> ***(Respondent C)***

Although the vehicles were effective in completing short trips, when users required longer distance travel there was some uncertainty in using the EV. This uncertainty was primarily caused by confidence in the vehicle and a shortage of charging stations. For longer journeys, two users expressed their concerns with the EV:

> ***"I did have visions of doing an experiment going down to the South West, but after the hassle I had just running out electric once, a mile from home, I thought better of that….I can't do that [with] having seventy or eighty mile range to the next station or anything like that"***
> ***(Respondent M)***

> ***"I take my son to school and its 74 miles from my house to the school [and then] to the office…. Although I start off with 93 miles on the clock and I am all happy I daren't put the heater on. I have the lights on and if it rains I've got to put the windscreen wipers on, but it just gets to the office. It's literally one or two miles left [of range]"***
> ***(Respondent G)***

For these users, travel routes did not have sufficient public infrastructure to make them more comfortable about undertaking such trips. A recent review of journey time statistics undertaken by the DFT enables an assessment of how far people have to travel in order to access certain services. As part of this review, charge point accessibility was evaluated, with the findings indicating that parts of rural Warwickshire have over 10 miles between charge points (DFT, 2016). This compares to the average distance across England of 3.8 miles (BBC, 2016) suggesting that the current level of provision is not sufficient. Meanwhile, on average, there is a petrol station every mile in the UK and although this distance increases in rural areas, more confidence in the technology means that there is not the same 'anxiety' over driving distances. One of the businesses in the trial suggested that the location of their customers did not coincide with a good availability of public charging stations:

Eco-driving winners

New charge point being fitted for Taste of the Country, Jim Cherry

> ***"Our engineers can go between five or six jobs a day in the Cotswolds where the infrastructure for charging is non-existent"***
> ***(Respondent B)***

The comments from participants indicated that they felt the supply of charge points within rural Warwickshire and the surrounding non-urban areas was not sufficient. This shortage of charging provision negatively affected some users' experiences as they did not take the vehicle on longer trips due to a concern surrounding charge point availability. Another factor influencing the use of public infrastructure and driving range was the reliability of charging stations. This was a further deterrent for users taking longer trips as there was a concern that they would embark on such journeys and then be unable to charge:

> ***"Yes I do [charge at home]. The reason that I am not confident in going further with charging is I have had a couple of examples where I have not been able to charge up"***
> ***(Respondent H)***

> ***"I went to Shropshire the other day, I could have gone in this [EV] because they have got a CCS charger at Corley and they have got a CCS charger at Telford Services. If the chargers all worked it was perfectly possible to do it. We stopped at Corley anyway and there were two Mitsubishi hybrids…They'll plug-in leave or they do not even plug-in, they just park at the electric car charging space. Basically they are blocking a charging point"***
> ***(Respondent F)***

For the participants the behaviour of some hybrid drivers was effectively misuse of the system, and this provided a further deterrent for relying on public infrastructure. Another user highlighted a situation where he was incorrectly given a parking ticket:

> ***"One of the chargers wasn't working so I parked and didn't plug in….Anyway I came back and had a car parking ticket…. So I challenged it and I got off as it didn't say I wasn't charging at the time. So there was a clear lack of understanding about it. Now they have put a little tickertape strip across the bottom of the signs saying you must be charging! Even with something like that there is not the understanding"***
> ***(Respondent C)***

Not only were there instances of unreliability or misuse, but also a general lack of education according to some participants. This not only relates to drivers, as the above quote explains how parking attendants were also unaware of how to deal with EVs. As a result of these problems, the majority of trial participants suggested that they had either abandoned the idea of using public charging stations or they had not even tried these services. One participant stated that he was unaware of how to use public infrastructure:

> ***"I have never looked how to. I have seen all these charge points in service stations and in town but I don't know how to do it"***
> ***(Respondent G)***

Not only was there a lack of research by some users, but those who had intended to make use of public infrastructure soon found it to be unattractive and disengaged from using it:

> ***"I don't now rely on public charge points, so I have completely killed off the Chargemaster subscription based on their charging structure which was a bit odd. From my calculations, if you had a diesel car that did 75mpg you might as well use that instead of an EV. Forget emissions, but cost wise that's where you're at" (Respondent C)***

Essentially, charging at home or work was seen as more attractive than paying a subscription for public infrastructure which may not be in working order. The issue of charging illustrates that the home-charging advantages enjoyed by businesses in WREV suggests that EVs are a practical mobility solution for these organisations. In particular, the agri-businesses who have the space to install solar panels were able to enhance the sustainability of the vehicle, but also lower costs even further. Additionally, some users were also creative in securing charging points outside of public infrastructure if required:

> ***"I've introduced one of my clients to a Nissan [Leaf] and they've had a charge point installed. They're over in Kenilworth, so I know if I am going to them first thing in the morning, I will not necessarily charge overnight. I'll limit the charge, so I get to them, plug in and charge, because I know their Nissan is out during the day"***
> ***(Respondent C)***

While such a strategy makes sense for shorter journeys it is more difficult to execute when travelling longer distances. Until the infrastructure supporting charging is more widely available and reliable, users will continue to harbour range anxieties. Although there was universal agreement that increasing the number and reliability of charging stations would be beneficial, there were concerns about the practicality of such decisions:

> ***"I have noticed personally that in towns there are lots more [charging points] available, and they are usually next door to disabled parking spaces…. I wonder if they will convert disabled spaces to put the charging points up though"***
> ***(Respondent J)***

Should policymakers install additional charging points, but at the same time disadvantage other groups of motorists, then this could be seen as unfairly favouring EV drivers which could create conflict. In addition to providing this infrastructure fairly, there needs to be greater education of drivers. Some range anxiety was caused by drivers not adapting to an EV or continuing to use the vehicle as if it were a petrol or diesel equivalent. Participants stated that they used techniques such as slipstreaming and coasting as methods of increasing vehicle range. The most confident drivers took great pleasure in using these techniques to overcome any issues with driving distance:

> ***"I see a lot of my motivation now is to try and aim to beat the maximum range quoted for the vehicle. Now for the i3 its 93 miles. Last summer I got 114 miles out of it and still had 3 miles left….So that's been useful to demonstrate these technologies, but also hand on heart to say to these businesses 'forget what you hear, if you've got the right education to drive the vehicle properly you can get these ranges'. You've just got to think slightly differently"***
> ***(Respondent C)***

Other drivers found that trying some of these advanced techniques to boost range was dangerous and raised questions about their effectiveness:

> ***"I don't like doing it because sitting behind a lorry for example you've got to get pretty close to get in their slipstream, and I don't like to be that close to anything driving at 50mph or 60mph. It scares me"***
> ***(Respondent A)***

In chasing range there could be unanticipated safety issues, and despite some of these techniques being successful in adding driving distance, the concern for some users is that it adds unnecessary risk to travel.

The final aspect of the journal types was the distinction between business and private mileage. Although the majority of firms, particularly those with the e-NV200 mostly used the EV for business purposes, some users also found that the vehicle was well suited to their personal mobility requirements. On the survey, one user highlighted how 80% of their journeys with the vehicle were through private trips. Although this was somewhat of an outlier, this reflects how different participants had diverse purposes and requirements for using their vehicle. The type of private mileage undertaken by users was described by one participant:

> ***"It was business based money but the lion's share of the mileage was private….We didn't hang around we used it properly. Other than that I have got a child who is at a school in Warwick which we've been doing every day, so we put some miles on"***
> ***(Respondent L)***

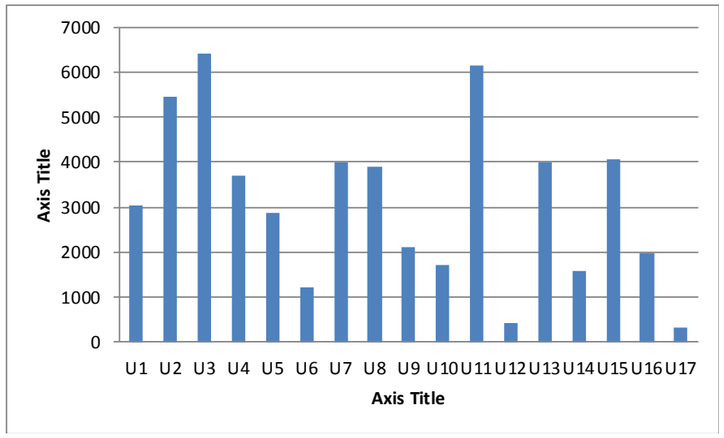
Using the vehicle for private purposes has an additional benefit for users of EVs. Through gaining more experience of driving an EV, confidence in the technology increases whilst the business also see a greater value from the vehicle as it is being used more frequently.

8. Energy Use and Estimated Cost Savings

8.1 Energy Consumed (kWh)

Energy consumption was measured for each vehicle in the fleet. In total, vehicles involved in WREV consumed 52,940 kilowatts per hour during the period of May 2014 to June 2016. In the first year of the trial, the fleet consumed 19,653 kWh of energy compared to 33,288 kWh from May 2015 to June 2016. This is shown in Figure 4:

Figure 4: Energy Consumption of all vehicles: May 2014 to June 2016



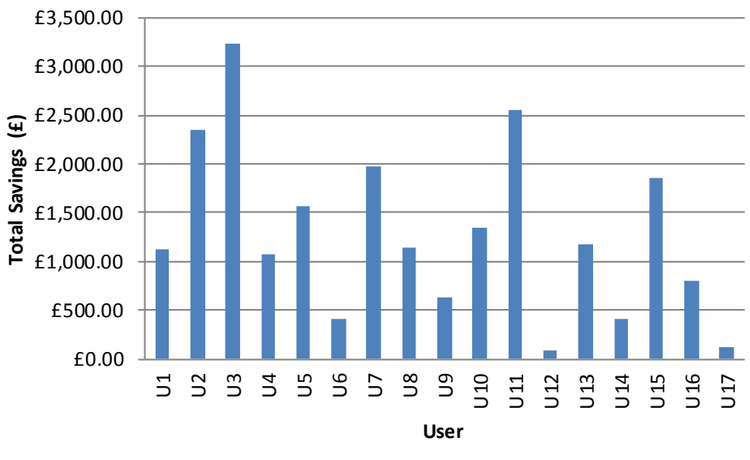
On average, the vehicle fleet consumed 2,306 kWh of energy each month during the trial. There was a noticeable difference between the first and second year, as the fleet, on average, used 1,638 kWh of energy per month in the first year and 2,378 kWh of energy per month in the second. The highest total energy consumption by the fleet in a single month was 3,543 kWh in November 2015, with each user averaging 253 kWh of energy. Conversely, the lowest energy consumption by the fleet was in January 2015 with a total of 1,202 kWh used at an average of 134 kWh per vehicle.

8.2 Fuel Savings

To estimate the fuel savings from users switching to an EV, a figure for the cost of diesel was calculated from a monthly snapshot of fuel prices at nearby filling stations. The stations were taken from three postcode areas which were CV37 7RF, CV8 1NE, and CV35 0BJ. These data were then used to calculate the cost of running a diesel vehicle based on the actual mileage data recorded from the EV. The expenditure for vehicle charging was then deducted from the diesel costs in order to estimate the cost savings. The total savings for the fleet are shown in Figure 5.

Across the two years of WREV, the seventeen participants saved an estimated combined figure of £21,828 on fuel costs. In the first year of the trial, the fleet of nine users saved an estimated £9,480 on fuel expenditure, compared to £12,348 across the expanded number of vehicles involved in the trial from May 2015 to June 2016. Overall, the fleet made estimated average savings of £839 per month, with the mean saving on fuel costs slightly higher in year two compared to year one.

Figure 5: Total Savings by all users May 2014-June 2016



In the first year, the average monthly saving for the fleet was £790, which increased to £882 in the second year. This was due to the higher number of vehicles in the fleet and the higher average mileage recorded. In terms of the estimated savings for each user across the duration of WREV, the aveage fuel cost saved per vehicle was £1,284.

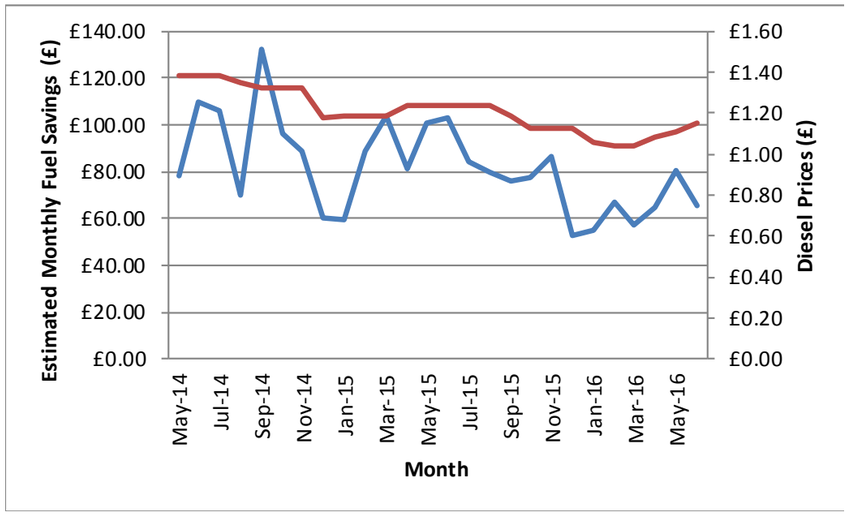
The largest amount of money saved by the fleet in a single month occurred in November 2015, with savings of £1,214. For each user this equated to an average saving of £86. However, during the first year of the trial it was evident that the average savings per user were higher than from May 2015 to June 2016. In the first year the average monthly saving for each vehicle was £90, but in the second year of the trial this dropped to £75. Moreover, the highest average monthly saving for users came in September 2014 where each SME saved an estimated average of £132. These average monthly savings for the fleet are shown in Figure 6 (blue line)against the average cost of diesel (red line).

The fluctuations in average monthly savings were driven by two principle factors, which were usage and the cost of diesel. There was a general downward trend in diesel prices across the duration on WREV, particular from the summer of 2015 onwards. From May 2014 to January 2015, there were only two months (August and December 2014) where the estimated fuel savings fell below £70. As both months were peak holiday periods, the smaller savings were caused by lower mileage. In contrast during the final eight months of monitoring there were only two months (November 2015 and April 2016) where the fleet was able to save an estimated average over £70. In both months usage was particularly high due to business requirements, hence the users were able to generate greater savings.

In turning to the individual users, the highest estimated fuel cost saving for a single user was £3,226. Indeed, as expected the businesses recording the highest estimated savings were involved in WREV for the majority of the May 2014 to June 2016 period. In a single year, the highest amount of money saved on fuel by a single user was £1,798, with the figure recorded by an SME during the first year of WREV. In the second year, the same user also made the highest saving at an estimated £1,428. In contrast, the lowest amount of money saved by an SME was £93. Meanwhile, in a single month the highest amount of money saved by a single user was £253 with the lowest recorded saving £1.54.

There are some caveats to the figures presented in this report. The data presented refers to an estimation of fuel costs only. When acquiring EVs, there are additional financial benefits such as a grant worth up to 35% of the list price, and zero road or fuel taxes. However, even with these additional benefits, the purchase price of EVs is still prohibitive for many motorists who are not willing to invest in the technology due to its high cost. Furthermore, experience in the UK with hybrid vehicles suggests that in the longer-term incentives for EV adoption could well be scaled back, particularly as the number on the road increases at the expense of conventional cars and vans. Therefore, financial support when acquiring an EV is unlikely to remain constant in the future. Indeed withdrawal of this support will make it more challenging for businesses without access to large cash reserves or borrowing facilities to purchase EVs.

Figure 6: Estimated Average Monthly Fuel Savings May 2014-June 2016

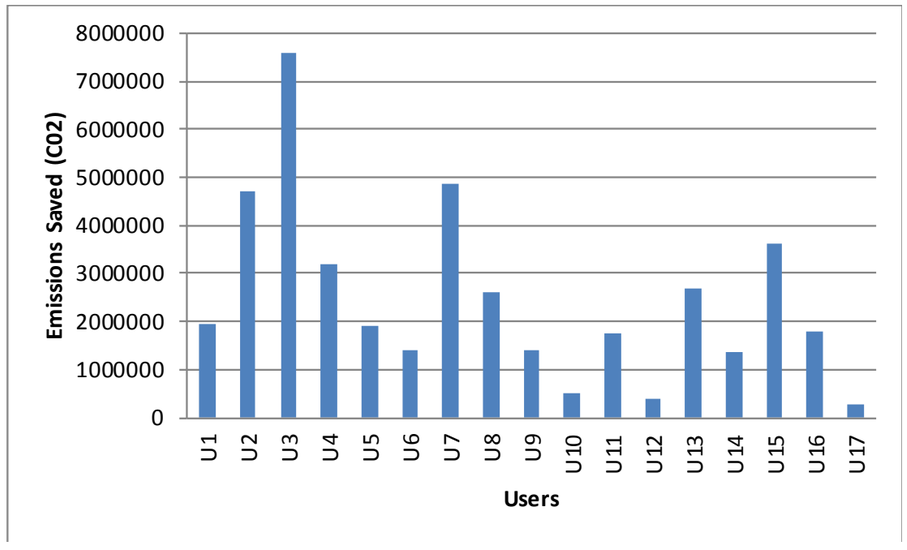


8.3 CO_2 Emissions Saved (g/mile)

Alongside fuel expenditure savings, data collected during WREV also illustrates the estimated CO_2 emissions saved by the adoption of EV technology by these businesses. Emissions saved for each EV are estimated in grams per mile of carbon dioxide (CO_2) which would have been released as tailpipe emissions by a comparable diesel powered vehicle[4] over the same distance covered as the participant. Initially, data analysis included the well-to-wheel[5] emissions but this process was dropped due to concerns surrounding the reliability of these measurements. The advantage of this approach is that the emissions for the entire process of driving and charging an EV are considered, but instead for this report the emissions reported related to driving the vehicle only. The total estimated CO_2 emissions saved by the fleet was 41,994,051 g/mile for the period of May 2014 to June 2016. In the first year, the total CO_2 emissions saved was 14,985,626 g/ mile, and in the second year this increased to 27,008, 425 g/mile. The total emissions saved by each user are shown in Figure 7: Across the duration of the trial, the estimated average monthly saving by the fleet of vehicles was 1,615,156 g/ mile. As the number of vehicles in the fleet increased, this saving grew from 1,248,802 g/mile as the average monthly saving in year one to 1,929,173 g/mile as the average monthly saving for the fleet in the second year. In a single month the most emissions saved by the fleet was 2,669,619 g/mile which was recorded in November 2015. On average each user saved 190,087 g/mile of CO_2 during this month. The highest average saving for each SME was recorded in May 2016, as each user saved 215,392 g/mile of CO_2 in this month.

The highest amount of CO_2 saved by a single user during the course of WREV was 7,594,832 g/ mile, with the lowest figure being 278,099 g/mile by a business who joined during the later stages of the trial. Between May 2014 and April 2015, the highest amount of CO_2 saved by a business was 3,899,712 g/mile, with the highest figure from May 2015 to June 2016 recorded at 3,695,120 g/mile. However, in the second half of the trial three users saved over 3m g/per mile of CO_2 compared to just a single business in the first year.

Figure 7: CO_2 Emissions saved by each user May 2014-June 2016



[4] Emissions for diesel vehicle based on OEM stated g/mile of CO2
[5] Well-to-Wheel emissions take into account the production and distribution of the fuel supply for an EV.

9. WREV Advantages and Drawbacks

9.1 Using an Electric Vehicle

As part of the in-depth interviews conducted with project participants, the respondents were asked to consider how utilising an EV had benefitted their business or personal circumstances. In considering the vehicle itself, aside from any business impacts, the unanimous view from the participants was that the vehicle was enjoyable to drive. In cases, where there were multiple drivers, three respondents stated that gaining experience with the vehicle was crucial in shaping attitudes. In one case, a respondent reflected how this changed people's perceptions:

> ***"I haven't found one person [in the company], and you've got to bear in mind most of us are 'petrol heads', I haven't found one person that doesn't like it yet. Everybody loves it. I haven't had one adverse comment about it. There are lots of adverse comments before they get in [the electric vehicle] but it's a bit different when they get out!"***
> ***(Respondent I)***

For the other businesses, particularly those where there was a single driver, one participant spoke emotively about their vehicle:

> ***"I suppose it hasn't fundamentally changed over the course of the trial. I love it [my car]. It's wonderful"***
> ***(Respondent F)***

Despite concerns over range (see Section 7.4) charging and the availability and reliability of public networks, the trial participants were extremely positive towards EVs and the driving experience. Indeed, where range proved to be a critically limiting factor, participants still acknowledged other benefits of the vehicle:

> "The only downside is the range. I drive it in eco[6] ; if you don't drive it in eco it's very nippy. It's a great round-the-town car. It's great if you've got to do 5, 10, 20 miles a day no problem at all, fantastic. If you go on the motor way that eats it up [range] terribly…. The idea of the car is fantastic it's just the range. It's nice to drive there's no problem with it. It's quiet. It's a good idea, it's a great idea"
> (Respondent G)

9.2 The Trial

Alongside the advantages of the vehicle itself, participants also discussed some of the features of the trial and their importance. Some respondents were explicit in stating how the grant was beneficial:

> ***"If the government keeps offering £2,000 I will probably keep buying one or using one"***
> ***(Respondent G)***

> ***"I worked out that the break-even point was probably about 7,500 miles a year. We're just under that we are doing 7,000 miles a year, so it is not a massive cost to us. Of course there is a £1,000 grant each year towards the cost "***
> ***(Respondent A)***

However, the value of the grant was not sufficient for some firms to 'break even' from adopting an EV. The high leasing costs, when compared to a conventional vehicle, were challenging for some businesses even with the grant support factored into the costings:

> ***"Financially where are we with it? I think it's possibly more [cost] on the lease. We are paying more than you would pay for a similar Nissan vehicle which uses conventional fuel"***
> ***(Respondent B)***

> ***"I have lost money on that vehicle, that's going to cost me, but I've learnt a lot from it….I'll try next time to make money or break even on that project"***
> ***(Respondent I)***

Simply increasing the grant on offer may not be affordable or practical, but more financial support from manufacturers for EV leasing schemes could be a short-term solution to this challenge. Until the technology becomes more mature and widely available, it is unlikely that prices will decline.

[6] Eco is a driving mode which enables a slightly higher range to be achieved
[7]This user based the calculations on previous paying 45p per mile for staff to use their own vehicles. However, he also encountered higher than expected insurance costs due to never having previously used a company car.

Aside from the grant offered through WREV, other users made reference to the support and guidance offered by Greenwatt as being important:

> ***"We were approached and Greenwatt went through the benefits of an electric vehicle. They went through how it would meet our business needs"***
> ***(Respondent N)***

> ***"Then we went from a meeting at WREV and they explained it [EV technology] which was really helpful. It's something new"***
> ***(Respondent J)***

> ***"Speaking to the team from Greenwatt, including the person who did the feasibility study, who has gone out and spent £60,000 on his car now [Tesla] [was beneficial]. You've got to have some form of belief if you've bought that haven't you?"***
> ***(Respondent E)***

As the vast majority of businesses involved in WREV were making their first steps into electric vehicle technology, the advice and information provided by Greenwatt was important in influencing their decisions and choices. As part of this process, the feasibility study enabled users to identify the potential costs or savings from switching to an EV. Not in all cases was a direct comparison of a previous vehicle to an EV straightforward to achieve. In one instance, a participant noted that his business van had run on LPG, making a fuel cost comparison difficult: In other cases, the EV was not replacing an existing car or van but was instead the first vehicle in a fleet. Therefore, the comparison made to another vehicle was not one which should be viewed as being a replacement for an existing car or van. So to some extent the cost savings should be treated with care. Indeed, where solar power has been used to fuel EVs, the costs saved are likely to be larger than what has been calculated.

> ***"It was difficult to do a comparison with the van, because he said you're better off to keep the van. It has depreciated as much as it is going to depreciate and its worth next to nothing anyway"***
> ***(Respondent F)***

ECO driving day with Longden Events

Another advantage noted by some users was the ability to test the EV before the business joined WREV:

> ***"We had a couple of days use [before the trial started] and the feedback was practically the van met the needs [of the users]"***
> ***(Respondent N)***

> ***"Having it for a test was good, but again like I said it was a bit scary [without the charge point]. It nearly put me off because of the charging"***
> ***(Respondent E)***

Crucially, more experience in driving an EV was important in changing attitudes towards the technology. So for some firms, the ability to sample a vehicle for a short-period before joining the trial was of value:

> ***"What I've found with people [from] small businesses and large businesses, it's all about getting them to drive the vehicle. Until you've got them into the vehicle they will be negative"***
> ***(Respondent C)***

The concern with this 'pre-trial' phase was that the users were unable to install charging points due to practical reasons. This can be a deterrent as there were concerns about the charging process:

> ***"That 13A[8] thing nearly put us off having it [electric vehicle].When they came [before the trial] you didn't have a charge point and that puts a massive worry in your head that it will take that long to charge and it's not going to work. Whereas since we've had the main power supply [charger] put in"***
> ***(Respondent E)***

Other users noted the use of a 13A plug after initially receiving a vehicle, but they did not express the same concerns:

> ***"Originally we were given a 13A charge plug that was only because our one at the business hadn't been installed"***
> ***(Respondent M)***

[8] 13amp charger was used as an interim solution whilst participants waited for installation of the charge point

SME's sign up to WREV

Furthermore, an advantage of WREV for some businesses was the assessment that took place prior to the installation of a charge point:

> ***"I think the assessment of whether you can have a charging point and if it's in the right place [is positive]….Just having someone to come out and do the assessment, and going we will install it next week was great for us because you haven't got the time to do all of the donkey work beforehand"***
> ***(Respondent K)***

The installation of a charge point was crucial for many SMEs involved in the trial as the vast majority of charging was done either on-site at the business or at home. Users were generally confident in charging the vehicle at home on a three phase charger:

> ***"Absolutely, we couldn't get hold of the phase three charger to start with, so I had a free one fitted by British Gas to just get us going and then they came out and fitted it. That was good it is still working fine now. Being three phase it will be slightly faster at charging as well"***
> ***(Respondent L)***

Alongside the financial support and charge point installation there were other elements of WREV commented on by respondents. In terms of the data recording there was a mixed reaction. For some participants, the ability to have a monthly report detailing usage and savings was a positive as this enabled them to understand how the vehicle had been utilised:

> ***"With the University sending out the data that's a positive because it makes you look at what you're actually doing. Sometimes you think you do more than you do"***
> ***(Respondent E)***

> ***"[As] the driver…I was doing a direct comparison against what a manufacturer would have done with another vehicle"***
> ***(Respondent M)***

In contrast other users were not as positive. One participant believed that the tracking of travel was uncomfortable:

> ***"We got rid of the tracker after 12 months. That's just me, I don't like the modern world, I don't like how technology can track everything you do"***
> ***(Respondent L)***

Another participant, whilst not been unhappy with being 'tracked' remarked that the monthly reports and data logging were not important, the key aspect was simply financial:

> ***"The fact that it was going to be monitored was of no consequence to us. It was a completely financially justified decision that we thought it was a break-even situation"***
> ***(Respondent A)***

With the other support offered by the trial including an 'eco driving day' there was also a mixed reaction. Whilst some users were able to share their experiences at these driving day events, not all of the trial participants were open to them:

> ***"At the start of the trial, we were invited to go on an eco-driving day and I said to Greenwatt even with the best will in the world I am not interested…I am not going to be trying to break some kind of record for using less electric"***
> ***(Respondent L)***

Selection of WREV Participants

This does to some extent highlight the varying perceptions of participants. Some users noted how they sought to improve their driving through making better use of slipstreaming or the vehicle's braking system. Other drivers were not as keen to share experiences. In light of the concerns surrounding 'range anxiety' making more use of shared driving experiences may have been of benefit to those involved in WREV who were encountering such problems. One participant noted how one of the drivers within his organisation benefited from the driving day prior to joining the trial:

> ***"The day at Stoneleigh helped to put more detail behind the trial. It meant that they went into with their eyes opened. If I had driven up to them one day in the electric van and said here you go this is your new van, I think there would have been more scepticism about what is going on here"***
> ***(Respondent N)***

Although a forum was available on-line, more interaction may have helped to overcome some early adaption issues with the EV, particularly when the second group of firms joined the trial in the summer of 2015. In this instance the first group of drivers were now experienced using the EVs and could offer advice to new users.

Finally, one respondent highlighted how simply being able to trial the vehicle for a period of time on a lease basis was effective:

> ***"That's the thing with any new set-up, [being able to] trial something rather than having a massive cost and then it not working out, [plus] being able to hand something back after six months and saying this isn't working for me"***
> ***(Respondent K)***

That 93% of firms who completed the questionnaire asserted that they were participating to assess whether or not EVs could be used as a potential mobility solution highlights how the availability of trials such as WREV is beneficial. These businesses may not have the capital to commit fully to EVs without having trialled the technology in order to assess whether it will be positive for them.

9.3 Other Benefits from WREV Involvement

Aside from the financial benefits already identified in the report, the users engaged in WREV also noted that there was a range of other unexpected advantages from using an EV. For one business, utilising an EV provided 'hidden savings' as they were able to reduce reliance on agency staff by offering a cost effective travel solution:

> ***"In actual fact there may have been a cost saving as well. We were using a lot of agency staff, because for staff from Rugby, even though its only 6 miles [away], there are no buses. You can see we are out of the way. That means that we don't need to use as many agency staff who are more expensive than our own staff. We have saved some money in that way"***
> ***(Respondent J)***

Rather than direct cost savings, other participants noted that using the EV had become part of their marketing strategy as they felt it was beneficial to promote a 'green' image:

> ***"We used that [EV] in our business ethically ourselves, we were interested as part of our image and marketing leaflet to talk about using the electric vehicle to go to-and-from the kitchen. There is a lot more than just cost [savings]"***
> ***(Respondent M)***

> ***"We will certainly do it online and with the media and with our website. We have also got to see if the local newspaper will want to run a story, and we will generally mention it where we can"***
> ***(Respondent N)***

In addition to marketing activity, three participants reflected how the vehicle had been used as a 'talking point' to help their business:

> ***"Because of what we do, we are out with different people; they all see the van and so having it sign written that's quite good. So from our point of view it gets people talking, so we can use that as a 'talking point'"***
> ***(Respondent H)***

"It's a talking point. We've got an element of our business which is renewables and it's pretty important to us"
(Respondent B)

"An i3 without the range extender petrol engine in is brave in a lot of people's eyes…So it did create a talking point and that's part of what got me into the airport. I just got a phone call out of the blue to say 'we're looking at vehicles airside, we've done some solar PV and your name came up in conversation, could you come in and speak to us about what we can do and where we could take it and link in with it in with what we've already got'. That was all based around low emission vehicles"
(Respondent C)

In the last case, the use of an EV was influential in a user gaining additional business. To some extent this reinforces the impression that is held by some users in terms of being able to 'practice what they preach'. Another user identified how using the EV was beneficial for them at exhibitions which were important to their business activities:

"Having anything with our name splattered all over it is promotion. The fact that it is an electric car does let us into key locations within exhibitions which is a useful thing….In Bewdley on Saturday I was actually allowed to park right outside the front door…. It suits them [exhibition hosts] because it promotes the technology the fact that people are using them, it promotes us as our name is all over it"
(Respondent A)

"Our typical model is that we buy our vehicles on HP every two or three years or we buy them outright. Then they work for us, there workhorses. The [Peugeot] Experts we have just changed were 8 years old. They owed us absolutely nothing and we got a little bit of money back for them. This type of lease contract is not the norm for us"
(Respondent B)

"My philosophy with vehicles is I don't lease them, I don't buy something and want to swap it five months later when you're fed up with it"
(Respondent F)

"We had always had BMW or more premium vehicles. We were in the situation where we were always used to paying £25-30,000 for a car, not necessarily a new one or even leased, but a second hand one of that order"
(Respondent C)

Another impact of these businesses being involved in WREV was the alteration of vehicle purchase habits for some of the SMEs. For several of the businesses involved in WREV, vehicle leasing was not a concept which they had utilised with regularity before entering this trial. Some SMEs stated that they looked to keep vehicles on a longer-term basis:

Although it remains to be seen as to whether this behaviour is repeated in the longer-term, the trial was effective in opening-up new sources of finance to businesses that may have otherwise not been able to engage with EV technology.

10. Post WREV Plans

With the feedback on the vehicles being mostly positive, the majority of respondents suggested that they would be willing to continue with EV technology in the future. However, in the short-term there were two diametrically opposed scenarios. Firstly, two trial members have added a second EV to their fleet on the basis of their WREV experience. In these cases, the EV met the businesses immediate practical requirements, and the participants were sufficiently convinced by the technology to purchase rather than lease a vehicle. In other cases, the EV did not meet changing business circumstances so the SME elected to switch to other types of vehicle, whilst not completely abandoning the idea of electric in the future:

"I have just finished the lease, and we have bought a second-hand diesel van. The reason is I am now starting a local wholesale round, and that round is undefined in how big it is because we are growing it. I could be doing 250 miles just locally really, so the flexibility of needing it is greater…I think if we needed a vehicle to just go to-and-fro I would love to still have the electric vehicle, but the trouble is with the price of fuel coming down, and there are some exceptionally cheap deals out there…. It makes it less attractive financially than it was two years ago"
(Respondent M)

"We've got an [Audi S3] E-Tron now so I haven't totally lost the electric idea. It's purely the kids are getting a little bit older and they have spread themselves round at Universities across the country and the electric car, with the best will the world, I am not going to start stopping for half hour or two hour coffee breaks and worry about whether I am going to get there [to destination]"
(Respondent L)

Both of these cases highlighted the current difficulties in convincing motorists to switch to EV technology. For these businesses, practical concerns surrounding cost, range, and charging outweigh any other benefits which can be provided by adopting an EV. With rural areas not having an extensive infrastructure for charging, it is difficult for some firms to adopt an EV as a first vehicle if they are using it with a variable route for deliveries. Fundamentally, until these issues are addressed adoption will continue to be sluggish. In some respects this encapsulates the difficulty of convincing drivers to switch to EVs as the users positive experiences in this trial were still not enough to convince them that they should immediately adopt EVs as part of their fleet. In contrast other users were committed to electric:
In one case, a respondent reflected that whilst the EV had not benefitted their business, he was still keen to explore them in the future:

"To me the future is electric and I would be evangelical about telling anyone else the same thing. I am very enthusiastic about it, it's just so sensible as far as I am concerned. Basically this car has cost me a penny a mile in the time I have had it"
(Respondent F)

"I don't think I would necessarily continue with this vehicle. I spent the money on it initially to learn from it and to probably extend my business from it. The savings side I probably have done, but it's done nothing to my business. I do see the advantage of having that vehicle, and I would love another electric vehicle. More than likely what I will be looking for in the future is I will be looking to change this vehicle, but go for something that is a bit smaller"
(Respondent I)

A further possible future consideration for one user was the possibility of having a 'community' vehicle where the EV is used by several local businesses:

"We did also talk about sharing it [electric van]. We did talk to Greenwatt about looking into sharing a vehicle, so for rural places having a community vehicle, rather than just for the surgery. In the village there is the Post Office and they do their newspaper deliveries, and there is the Chinese which would be ideal to share with because they want it during the evenings and we want it during the day"
(Respondent K)

This potentially provides a benefit to those organisations that do not use the vehicle as extensively as others. The costs of the vehicle can be shared between different users, and through utilising the vehicle more often, greater environmental benefits can be accrued from the EV. The concern for policymakers should be that despite the positive feedback on the vehicles, there are still genuine concerns with charging and range which deter even those interested in EV technology.

11. Summary and Recommendations

The WREV trial was designed to encourage rural businesses to examine their transport and mobility choices. Specifically, WREV assisted the adoption of electric vehicles within rurally based SMEs in an attempt to counter increasing fuel costs, reduce carbon footprints, and stimulate business development. In total seventeen vehicles formed part of the trial, with a diverse range of businesses adopting the technology as part of their transport choices.

The evidence from this trial highlights some of the advantages and disadvantages of using EVs within a rural context. Although users were positive about the trial and their EV experience, significant issues in terms of range and charging facilities were highlighted when speaking to participants. To encourage more wide spread adoption of these vehicles, it is apparent that several issues must be addressed by policymakers at a local and national level.

On this basis, the report has five key recommendations:

Recommendation 1: Increase the level of public charging infrastructure in rural locations

One of the key concerns highlighted by many participants in the WREV trial was the shortage of public charging infrastructure in rural locations. To encourage adoption of EVs, policymakers have mainly directed investment towards stations in urban areas. Whilst this is welcome, it is critical that an increased level of charging infrastructure is provided in rural locations in order to ensure that the requirements of adopters in these areas are supported. However, simply increasing the number of charge points should not be the only focus of any future investment. Additionally, users in this trial noted that charge points were at times misused or not in working order. Therefore, more effective monitoring and maintenance of public infrastructure is also required. This should help to increase driver confidence and lessen range anxieties.

Recommendation 2: Consider EV car share schemes as an ownership model

The adoption of new vehicle technologies presents an opportunity to modify patterns of behaviour in relation to ownership and usage. Due to the current cost of purchasing or leasing an EV, financial support such as subsidies has been crucial in influencing the decision of motorists to adopt the technology. However, such incentives are a luxury which may not be available to drivers in the long-term; therefore to encourage EV adoption alternative models need to be considered. Car share schemes or car clubs are becoming increasingly common, and for new technologies these offer a potential opportunity for users to sample EVs without having the cost of using the vehicle on a full-time basis. Within WREV, one participant spoke of using their electric van as a form of 'community vehicle' where it is shared between different organisations. This is particularly useful for remote locations as the vehicle can be used to perform a range of different functions providing a multi-purpose tool.

Recommendation 3: Improve information availability on EVs and ensure technical support is offered to users.

The vast majority of WREV participants stated that they had some form of interest in sustainable technologies or electric vehicles prior to joining the trial. This is not necessarily reflective of the wider public or business community, and a lack of knowledge or experience in using these technologies can negatively impact upon consumption decisions. Thus, it is crucial to offer users the requisite level of information and support before making the decision to adopt an EV. Due to the 'new' nature of the technology, some of the trial participants found that having the support of Greenwatt was extremely helpful as they were provided with the information with which to make a decision. Feasibility studies were a crucial aspect of this process as they gave organisations the financial details of taking the decision to adopt an EV.

Recommendation 4: Ensure that any future trial comes with charge-point installation

Feedback from the respondents suggested that there were some initial concerns surrounding charging at home, particularly during the 'pre-trial' phase where the demonstration vehicle was charged through a 13A standard socket. Whilst the logistics of this 'pre trial' phase are difficult, it is imperative that the WREV experience of including a subsidised charge point installation for full-time users is adopted in future trials. Through being able to access an installed charge point at home or work, users have more confidence in the charging process as they have more faith in the technology being deployed to charge the vehicle.

Additionally, with the existing weaknesses in public infrastructure, users must have confidence that they can charge successfully at home or work. Also by providing some financial support for the charge point installation, there is less of a burden being placed on the shoulders of users who would otherwise have to invest in a charge point installation which they could remove at the end of the trial should EVs have not met their business requirements.

Recommendation 5: Target EVs at rural businesses/ motorists with consistent travel patterns

From this trial it became evident that the majority of businesses mostly undertook short journeys, but there was some difference in the types of routes which were followed. Some organisations had a regular route, whilst others had more flexibility in their travel patterns. In the latter case, the variance in routes can lead to challenges in charging the vehicle due to the shortage of rural infrastructure. If a user has a consistent travel pattern using similar routes then journeys can be pre-planned effectively. More flexible travel patterns are harder to plan, and with range and charging concerns this creates more difficulty for the user.

Until issues with range and charging are overcome, perhaps the greatest opportunity should be targeted EVs towards those companies with short and regular travel patterns.

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