Urban, sub-urban or rural: Where is the best place for electric vehicles?

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Abstract

This paper critiques the assumption that an urban setting is the most appropriate for electric vehicles. In so doing, it questions the implementation of transitions theory and socio-technical experiments in the quest to establish electric vehicles as an alternative to the existing automobility regime. For vehicle owners and infrastructure providers alike, as with society generally, the benefits of electric vehicles are maximised when usage is most intense; a difficult situation to achieve in urban areas aside from light commercial delivery and service applications. Using case study information from electric vehicle trials under the ENEVATE research programme into users of such vehicles in North West Europe, it is concluded that more policy and research attention should be given to sub-urban and rural electric vehicle applications as promising niches from which wider socio-technical change may develop.

Keywords

Electric vehicles; transitions theory; socio-technical experiments; urban; rural; transport policy; infrastructures.

Introduction

Considerable hope and enthusiasm, along with significant financial and political capital, has been invested in the urban mobility renaissance promised by the electric vehicle. Academics too have seized upon the anecdotal and theoretical case for electric vehicles as part of the emergent sustainable mobility mosaic anticipated for our urban areas.

This paper, while recognising the inherent potential of electric vehicles, draws upon secondary evidence and pilot studies in North West Europe to argue that the urban niche is not necessarily the most appropriate for such vehicles. Moreover, as protagonists for change, it is argued that many participants in the nascent electric vehicle ecosystem have allowed optimism to displace objectivity. As has been argued elsewhere, the automotive industry and prevailing concepts of automobility have proven remarkably obdurate (Wells and Nieuwenhuis, 2012; Bakker and Budde, 2012). It is, then, important to investigate why electric vehicle take-up to date has been so disappointing.

First, we situate electric vehicles as socio-technical experiments in the sense conveyed by transitions theory (Geels, 2002; 2005). The plethora of such socio-technical experiments is presented in stark contrast to the progress made in electric vehicle sales. A second key issue is that the focus on the urban may be misplaced, depending upon what problems are being addressed and what benefits are desired. Further, we argue that socio-technical experiments as reported must be considered an inadequate guide to future actions. In the final section, we explore why electric vehicles may not be the perfect match for urban

contexts. Thus we consider electric vehicles as an instance of transition failure, as the focus on urban applications may be misplaced in promoting usage.

As evidence, we offer indicative findings from our research in the European Network of Electric Vehicles and Transferring Expertise ENEVATE project to propose that electric vehicles may find a more 'natural' context in sub-urban or even rural environments when both vehicle and infrastructure efficiency are considered together. In particular, we draw upon a rural Welsh pilot – Carmarthenshire. We conclude that to suggest a regime shift to electric vehicles is clearly premature. More profoundly, however, we argue that the electric vehicle experience asks some uncomfortable questions of the value of socio-technical experiments and the broader concept of strategic niche management. If these experiments and concepts are to be of value, then the lesson to be learned must be that the electric vehicle project needs a radical re-think, not least in terms of its urban deployment.

Socio-technical experiments and electric vehicle policy

The theoretical and empirical basis for the promotion of electric vehicles in urban areas arises from the attempted combination of industrial, transport and environmental policy (Wells, 2012). This promotion may thus be considered an instance of socio-technical experimentation with a view to achieving a transition to sustainable mobility. Transitions theory builds on the idea that technological and social changes are intrinsically linked by complex mechanisms as innovations diffuse in an economic and a spatial sense. In so doing, enduring and dynamically-stable socio-technical regimes are established. Thereafter, niche applications may act as incubators from which eventually new socio-technical regimes are formed, displacing the existing regime.

Rather, an extended moment of historical and spatial serendipity appears to be crucial in allowing technological innovations, entrepreneurial guile and consumer bravery to create the basis of a new socio-technical regime. The typology from Berkhout et al (2004) offers a framework in which there are four potential transition pathways depending upon the degree of planned coordination involved and the extent to which external or internal resources are deployed. Spontaneous emergence in their typology is uncoordinated as opposed to a vision-driven centrally planned transition that is purposive in character. A more nuanced interpretation of transitions pathways is offered by Geels and Schot (2007), with outcomes not assumed to be either planned or unplanned but, rather, an emergent mixture of the two.

It is equally interesting that, in past transitions, the nascent technology was not necessarily superior to the incumbent regime of itself but, rather, provided a specific advantage that could be exploited. Perhaps more pertinently, the emergent technology offered a development pathway along which further quantum gains in performance, cost reduction and applications were possible, thereby forming the basis of profitable market growth. As such, one of the reasons why socio-technical management is failing to create the basis for lasting transition might concern the perception (and, reality) that the desired sustainable alternative is not necessarily better than the prevailing regime in a profound sense. Whether at the empirical level, using tools such as life-cycle analysis, or at the consumer level, with regard to framing of alternative sustainable technologies, there is a less than compelling case that the intended transition is substantive enough to warrant the loss of functionality and utility, or increased cost, that the transition is expected to entail (Hawkins et al, 2012).

A further issue that arises concerns strategic niche management and socio-technical experiments. In terms of electric vehicles and sustainable mobility, there has been a plethora of such niche projects developed (see RMI, 2012), but they appear to come and go like flowers in the desert – remaining marginal to the point of vanishing. Again, this is suggestive of a need for a more critical appraisal of transitions theory; less in terms of its explanatory power, more as a means of formulating policy to achieve future change. Indeed, it is a relatively common finding that users in such electric vehicle trials are largely content with the experience, do not succumb so readily to range anxiety and view electric vehicles more positively than before. Despite the encouraging appraisal, progress – with regards to share of new car sales or total vehicle distances travelled – is minimal.

Electric vehicles and transition failure

For Scott and Axhausen (2006), there is a fundamental interconnection between residential location and car ownership. As a result, their research modeling household-level decision-making processes has highlighted that mobility choice, such as whether to invest in public transport options like a travel pass or to purchase and fuel a car, is premised upon the socio-spatial geography in which actors find themselves. As such, the rational and/or emotional option that might be selected in a well-connected urban area may differ markedly from that in a more isolated rural one. It is recognized that definitions of 'rural' and 'urban' are not absolute, and vary from one country to another. However, this distinction is especially prominent in European cities, characterised by their relatively low automobile dependence and a heightened role for public transport, cycling and walking (Newman, 1999). In such circumstances, density and efficient land use is vital – with the close proximity of residential, employment and leisure areas militating against the need for car use. As a result, there will tend to be lower levels of car ownership and usage in more densely populated areas.

This situation is visible in the United Kingdom, where 87% of rural dwellers (aged 17 and over) hold driving licenses, compared with 62% for, the capital, London and 65% for other built up metropolitan areas (RAC Foundation, 2013). Even more pronounced is that 91% of rural households own at least one car, as opposed to 57% in London and 68% in other metropolitan areas (RAC Foundation, 2013). The latest census figures for England and Wales suggest that the car is in decline for urban areas, such as inner city London (Office for National Statistics, 2012). While there was a national increase in cars in the UK, from 23.9 million in 2001 to 27.5 million in 2011 (with an average 12 cars per 10 households, rather than 11 per 10 households), London showed consistent increases in the amount of households without a car on the previous figures. This applied both within the boundary of the Congestion Zone charge area (for example, Lambeth rising from 51% to 58% of households with no car), and outside (for example, Wandsworth, rising from 41% to 45%). The same trend can be witnessed in a deprived area such as Hackney, from 56% to 65%, as in an affluent area, such as Kensington and Chelsea, from 51% to 56%. Similar stories are true even in an area such as Westminster, with free weekend parking; there has been an increase from 57% to 63%. Car-free households are on the rise in the UK's major metropolitan area, and London was the only region where the numbers of cars was lower than the number of households.

Cars are used considerably more outside of the urban context. The average rural dweller drives 8,450 miles per year, compared to the average of 5,551 miles per year (RAC

Foundation, 2013). In terms of commuting, the UK Department of Transport data gives an average length of a trip as 8.6 miles. People living in rural areas travelled furthest to work (11.7 miles), while those in urban areas outside London travelled the shortest distance (6.9 miles). London residents travelled 7.5 miles (UKDoT, 2011). Rural householders are more likely to find themselves rendered dependent upon car usage, as has been highlighted by Dargay (2002) in considering the impact of economics on automobile ownership and usage. When car costs rise, urban drivers are far more likely to give up their car or restrict their usage, while rural drivers will persist with their cars for longer. Indeed, for purchase costs, the elasticity of car ownership is twice as high in urban areas, while fuels costs exert no significant influence in rural areas yet they do for urban drivers. Indeed, for drivers in a rural area, 72% rely upon a car for shopping and 69% require one for work, in contrast with figures of 39% and 69% respectively for urban areas (RAC Foundation, 2011). It is for these reasons that the availability of and attitudes to public transport are of significance with regard to electric vehicle ownership and use, as explored in the case study of rural Wales.

Fundamentally, urban areas have a greater degree of infrastructure to allow residents to go about their daily lives free from the car. Buses, trains, metros, cycle paths and pavements, ensure that sustainable alternatives to the internal combustion engine car can be pursued in many cases. As such, it appears somewhat perverse that such a concerted effort is being made to promote electric vehicles as a sustainable urban mobility node. In circumstances where cars are not strictly necessary, it seems somewhat strange that an environmental argument is being made to introduce them.

All the same, electric vehicles are actively promoted by the state in urban areas and concomitantly discouraged in rural areas (Yan and Wills, 2012).

Given this, it might reasonably be asked: what problems are electric vehicles supposed to solve? Put another way, how far do electric vehicles contribute to a future of sustainable mobility? There is a palpable sense that, as of mid-2013, governments and companies are increasingly worried that the attempt to create a transition to electric vehicles has failed despite subsidies both for industry and for consumers. Several vehicle manufacturers have scrapped or curtailed their electric vehicle plans as key milestones in market penetration are missed. As such, some important aspects of transitions theory when put into operation come to be highlighted – posing several key questions that must be addressed in future dialogue. For example, how are learning processes transferred from one niche to the next? What measures should be enacted if the transition process is deemed to be too slow? Should there be an equal focus on dismantling the existing regime in order to create the space for regime transition? At what point is it accepted that the desired regime transition will not happen, or not happen fast enough? The relative lack of distinctive advantage for electric vehicles when compared with traditional cars gives pause for thought: just why is there such a strong policy support for this sort of mobility? It is hard to escape the conclusion that it is precisely because electric vehicles as currently conceived and deployed offer the least disruptive alternative to the existing mobility regime, and that other choices such as the radical re-design of lifestyles, urban structures, and mobility expectations are just too unpalatable to contemplate as a viable political alternative.

In similar manner, it is sobering to consider the advances made by the myriad forms of electric bicycle over recent years, most notably in China (Weinert et al, 2007; Wells and Lin, 2013). This is a sector almost totally neglected by the major mobility providers, the establishment of automobility, policy-makers in transport, government funded R&D

programmes or the academic communities concerned with sustainable mobility. Yet, without visible support or incentives, electric two-wheel vehicles have ushered in a silent revolution in sustainable mobility in markets that also include the Netherlands and Germany. It can only be concluded that these vehicles constitute an appropriate application of technology, at an acceptable level of cost, to deliver increased functionality for consumers. Similarly, there appears a stronger 'natural' market for urban light commercial delivery and service vehicles where the duty cycle is clear, where 'back to base' recharging obviates the need for a wider infrastructure, and where large distances travelled per annum mean that the high initial purchase cost is able to be offset by lower running costs (Chocteau et al., 2010; Van Duin et al., 2013; Zhang and Zhang, 2013; Silvester et al., 2013; Davis and Figliozzi, 2013). The contrast with privately owned and used four-wheeled electric passenger vehicles is stark. At the least, this suggests that the initial applications of electric vehicles need to match capability against user needs with considerably more care if viable niches are to be created and form the basis of a more enduring socio-technical transition.

As discussed above, transitions in the contemporary era arguably have to occur in more complex environments than the historical examples often cited in the literature. In particular, in the case of electric vehicles there needs to be a consideration of multiple regime transition. That is to say, there is an important boundary question here when seeking to define both the existing regime and, more importantly, the alternative regime. It could be argued that, in the case of electric vehicles, the transition process is made more complicated by the need to integrate regime shifts in mobility alongside those in telecommunications and power generation and distribution. Transition failure in this sense is multi-dimensional with regard to electric vehicles and appears to arise, at least in part, from the enormous co-ordination challenges posed in an arena as complex as that of mobility.

Urbanism and electric vehicles

Precision is needed when evaluating the scope for electric vehicles in urban areas, and the extent to which their introduction constitutes progress to sustainable mobility. Prevailing opinion on electric vehicles suggests that they are primarily cars for the city (Bakker and Trip, 2013). Academic analysis and policy goals alike converge in conceiving of a somewhat circular relationship, whereby electric vehicles and the urban environment provide a neat and mutually beneficial fit. Electric vehicles support urban environmental considerations while the urban environment is most practical to the running of electric vehicles. Similar circularity applies to arguments for car-sharing schemes involving electric vehicles (Costain et al, 2012).

Electric vehicles are said to be suited to urban applications because they have zero emissions at point of use, are relatively quiet in operation, do not require power when stationary (i.e. due to traffic congestion) and have reasonable acceleration. Conversely, they are held to be unsuited outside (or between) urban areas because of limited range and top speed. Urban passenger trips are deemed suitable for electric vehicles because they are short in distance and duration (hence not imperilled by range issues), in often congested conditions with frequent stop-start driving. In addition, urban areas offer the population density to make infrastructure investments in recharging equipment more worthwhile – a classic economies of agglomeration argument.

As a result there has become a working presumption of the inherent connection between electric vehicles and the urban context. For Aultman-Hall et al (2012: 27), this situation epitomises the state of academic research, where 'except for a few … studies assume that EVs may be an urban, not rural, transportation energy solution' meaning that studies 'do not consider the spatial distribution of travel demand'. With this concentration upon the urban application of electric vehicles, there is a growing literature on electric vehicle use. This includes papers reporting surveys conducted with electric vehicle trial users (Everett et al, 2011), participants in electric vehicle test-drives (Skippon and Garwood, 2011; Campbell et al, 2012; Graham-Rowe et al, 2012) and ethnography into families with electric vehicles (Heffner et al, 2007). There are also studies into the perceptions and perspectives of car owners in general (Moons and de Pelsmacker, 2012; Peters et al, 2011; Pol and Brunsting, 2012). From a policy perspective publications such as the EV City Casebook (RMI, 2012) are relevant as a source of examples of socio-technical experimentation. What comes out of these studies is often taken as positive for electric vehicle uptake. For example, it typically emerges that users experienced no particular problem with range limitations for the vast majority of trips and that recharging of vehicles provided no major obstacles. Yet on deeper inspection these results provide more of a concern, because it also appears that users over-compensate by recharging the vehicle as soon as possible once a 50% charge level is reached thereby adopting a strategy of little and often. While logical enough for consumers, this is potentially disastrous for infrastructure providers hoping to generate revenues from the already low-priced electricity consumed at their recharge points. Capacity utilisation is thus likely to be the biggest single challenge for infrastructure providers seeking to generate revenues: electric vehicles could block recharge points for an eight-hour working day, but perhaps only be recharging for 120 minutes.

With low car ownership levels, established public transport infrastructures, growing use of walking and cycling (including e-bikes), and short distances travelled it could indeed be argued that both the potential of densely populated areas and the degree to which electric vehicle use improve the situation are limited (van Wee et al, 2012). These problems are exacerbated by the lack of (domestic) space within which to park and recharge electric vehicles for many potential owners. Moreover, because the trips tend to be of short length in which vehicles are often stationary in traffic the vehicles are being used well below their theoretical capacity. The breakeven distance per annum for an electric vehicle with low running costs to achieve a lower total cost of ownership than a traditional vehicle with low purchase costs could easily be 80,000 km so it is imperative that the vehicles are used intensively. While the importance of the contribution to improved air quality is certainly substantial, as a means of de-carbonising transport it is expensive and of marginal benefit.

There is perhaps one important caveat here, which is the example offered by the Autolib scheme in Paris.[1] The structure of this scheme, with a large number of vehicles provided by a single source and integrated into a city-wide (and sub-urban!) network of recharging facilities may be sufficient to underwrite the economic case for electric vehicles in urban areas. In addition, Paris is a hugely important tourist destination and such vehicles may thereby find additional applications with visitors. Underlying this point is the significant advantage afforded by densely populated urban areas: they make large fleet operations (whether public, private or some form of intermediate structure) more viable than would be the case for dispersed rural populations.

[1] See https://www.autolib.eu.

The sub-urban, the rural, and electric vehicles

An equal if not more compelling case can be made for electric vehicles in non-urban contexts. Sub-urban commuter ranges are typically those that are ideally suited to the capacity of the typical electric vehicle with perhaps 30-80km round trips and, hence, come much closer to fitting the discharge-recharge cycle more effectively. Additionally, higher distances travelled mean that the operational cost advantages of electric vehicles are greater relative to the purchase cost than would be the case in the urban setting, thereby making the total cost of ownership a more attractive proposition. Sub-urban (including small-scale urban) and rural households are more likely to have gardens and garages where domestic recharging could be achieved, and are more likely to support multi-car households where long-range (i.e. petrol and / or diesel) vehicles are already owned. In rural locations, the dispersed nature of residences relative to services such as shopping or schools results in longer trips, meaning that recharge points at supermarkets and elsewhere become more useful. Moreover, with less congestion, trip times can be more reliable – important in ensuring drivers are not left stranded away from recharging points. Most sub-urban and rural roads (other than motorways) are adequately suited to electric vehicles in terms of the typical road speeds attained. Often ignored, this application needs to be given proper consideration. The potential of rural and sub-urban locations is echoed by Dütschke et al., (2013: 13) who conclude from their surveys of the German market that:

"It could be assumed that early purchasers will be individuals who are or feel more dependent on their car. This dependency might be due to where people live as daily trips are usually longer for those living in more rural areas and public transport in these areas is often less developed."

As such, we move on to outline that the pilot surveys from the ENEVATE project suggest new patterns of demand may be compelling in such locations.

ENEVATE was a European Union-funded, three year programme designed to support and accelerate the uptake of e-mobility in North West Europe. The project was premised upon the need for structured transnational cooperation between academic institutions, public authorities and business representatives to best tackle the role that road transportation plays in CO_2 emissions. As part of this scheme, a work package was set up to examine market drivers and e-mobility concepts throughout the regions. By taking a transnational approach to consumer attitudes, it was hoped that solutions could be arrived at that would allow cross border participation in making policy recommendations. It was also envisaged that learning from previous e-mobility pilots could be used to enhance future pilots and projects to further understanding of the technology.

The study conducted for ENEVATE involved respondents using an electric vehicle for the first time across nine countries (Table 1).[2] It surveyed the participants of electric vehicle pilot in Belgium, England, France, Germany, the Netherlands, Northern Ireland, Republic of Ireland, Scotland and Wales. The research encompassed a range of different experiments; electric vehicles introduced into work fleets, electric vehicle car sharing schemes, short-term electric vehicle leases, electric vehicle test-drives and electric vehicle information events. This variety allowed the study to compliment previous research, which tended to restrict themselves by location or application. Most significantly, we did not just focus on urban pilots, but addressed car usage in sub-urban and rural contexts. Such variety had not been captured in electric vehicle consumer research ensuring our project presents a distinctive set of results, with findings that have the potential to genuinely advance knowledge. Despite the differences in our pilots, all were united in providing individuals who did not own an electric vehicle with hands-on experience of using such automobiles.

Table 1: ENEVATE Pilots

In order to satisfy the methodological desire for data triangulation, there were two main parts to our survey – an initial questionnaire with a follow-up consultation (also, an additional third component of stakeholder workshops to gain expert feedback on the results). The initial survey involved a basic questionnaire conducted with 234 participants. This was largely quantitative in nature, tasked with finding out what incentives would motivate consumers to purchase electric vehicles in the future. This approach was chosen as it would be quick and easy to complete and could be easily translatable. Whilst this perspective was suitable for the initial survey, it was felt that something more in-depth and qualitative in nature would be required for the follow-up consultation in order to capture a greater depth of opinions. Rather than tick boxes, respondents were given the time and space to provide more detailed responses. This meant that the survey followed a semi-structured approach as it questioned 97 self-selected participants who had completed the initial questionnaire.

Following the OECD urban-rural typology, with urban areas constituted as those demonstrating a minimum population density of 300 inhabitants per km^2 aligned to a minimum population of 5,000 the ENEVATE pilots can be regarded as split between the urban, sub-urban and the rural. There were large urban areas, such as the cities of Dublin and Newcastle-upon-Tyne alongside rural areas, comprised of varying levels of smaller settlements interspersed with significant less developed elements of countryside, including Cornwall and the Scottish Borders – and plentiful sub-urban in-between.

An example of one of these rural areas is Carmarthenshire, a county in West Wales – the third largest geographically, fourth highest population in Wales. Carmarthenshire is officially categorised as a rural area by the Office for National Statistics, with 183,800 residents at a density of 75/km2 – ranked 18th out of Wales' 22 counties for population density (the Welsh average is 147/km2). Carmarthenshire has two larger towns that meet the aforementioned urban definition in Carmarthen and Llanelli, located 16-24 miles apart depending upon the route taken. In addition, there are 11 smaller towns located across the

[2] A fuller discussion of results is provided in Davies et al (2012).

county. As a westerly county, there is only a very small section of the M4 motorway, but most settlements must be reached by A Class roads and connected country lanes – with a total road network of 3,474 km.

The specific pilot involved two electric vehicles introduced into the works fleet of Carmarthenshire County Council, used for professionals such as social workers to carry out their duties around the region – moving between council sites and out to residents homes and workplaces. The only charging points in the county are those provided at the council offices in Carmarthen. Welsh Government funding was obtained to render the area a 'sustainable travel centre' under the Welsh Transport Strategy. This pot of money was targeted at: CO_2 reduction; modal shift; reduced congestion; local air quality; higher quality public transport; improved access to key services, and; healthier lifestyles. The aim was to build on the lessons learned in each centre to identify the most effective measures for potential adoption elsewhere.

These specific cars were used to move between the council base in Carmarthen and surrounding towns, as well as the majority of the population living in smaller, more isolated settlements, dispersed across the county. The daily usage of these two vehicles taken between April 2011 and December 2012 is provided (Figure 1).

Figure 1: Carmarthenshire County Council Electric Vehicle Daily Usage

First and foremost, the greatest number of trips was in the 0-10 mile category. These were mainly within the county town of Carmarthen itself. At first glance, this result appears to fit neatly with the conventional view of electric vehicles, which considers them suited to travelling the short distances required in urban areas. At the same time, though, it must be recognised that the ubiquity of this lesser distance tallies with the low level of average trip length in the UK, at seven miles (Department for Transport, 2011). As such, the figures do not necessarily suggest that electric vehicles are best suited to urban environments, but more surely indicate that they fit wider travel patterns generally. Perhaps the most interesting aspect of this data, though, is that there is not a standard decrease from lower to higher distances. Rather, the second highest number of trips was in the 30-40 miles bracket, reflective of travelling across the length and breadth of the county. This longer distance does not simply cover travel between the two main urban areas, Carmarthen and Llanelli but, also, trips to and from them to numerous more remote, isolated areas – connecting often disparate and fragmented communities, spread out across this rural region. There was even one recorded daytrip of over 100 miles, showing that the cars were pushed to their limits in traversing the countryside of Carmarthenshire. As such, the dominant message emerging from this driver data is that electric vehicles can have a use in rural areas – they served the needs of users with travel needs more diverse and unpredictable than a short, simple urban commute.

The manner in which electric vehicles can fit within rural areas was reflected in the surveys users completed for ENEVATE. Following their experience driving an electric vehicle, the initial questionnaire asked participants how the pilot had affected their future intentions with regards to purchasing such a car of their own (Figure 2).

Figure 2: Future Electric Vehicle Intentions

In total, 82.1% of respondents (190 out of 234) claimed they were more likely to buy an electric vehicle, having actually tried one. Similar trends appear for Carmarthenshire.

Looking at council staff in particular, 12 out of 20 stated they were more likely to buy an electric vehicle following their pilot experience. Although this figure represents a smaller proportion of the subsample (in part, reflecting the lower absolute numbers used), 60% support shows majority backing for electric vehicles in this rural location. As such, there appears consensus among trial participants in both urban and rural areas that electric vehicles might have a future.

The initial surveys, then, highlight that there is potential for electric vehicles in rural areas. In Carmarthenshire as in the wider sample, they had a strong overall level of support. This suggests that it is entirely appropriate to consider electric vehicles in the rural context. Probing these issues, the follow-up consultation highlighted that electric vehicles might be particularly pertinent in the rural context, for the manner in which they could help to traverse a deficient public transport infrastructure. On discussing public transport with the 97 respondents in the overall sample, perhaps the key issue that emerged from thematic analysis focused upon the essential debate between whether or not public transport was suitable in that area (Table 2).

Table 2: Attitudes to public transport

There was some significant support for public transport, though this came from respondents in urban areas. For those in rural areas, public transport was considered a problem – buses, trains and trams were deemed irrelevant out of the town or city. Such transport nodes were inflexible, inconvenient or entirely absent from these rural locations. With walking or cycling unfeasible for the longer distances covered, respondents felt the need to own a car. The inadequacy of public transport was certainly a prominent topic amongst the nine respondents in Carmarthenshire, all of whom were frustrated by the limitations of current provision in their rural county.

For some, there was not enough public transport:

> "Due to the rural area where I work, the public transport options are limited. Buses from my village to the nearest town are only on Tuesdays, Thursdays and Fridays. From there, there are trains and buses that go to the town where I work, but the times do not tie in with when I could get a lift."

> "Living in a rural area poorly supplied by public transport means that it would be impossible to get to work let alone take part in social activities."

For others, public transport was too expensive or time-consuming:

> "Although it would be possible to get where I wanted to go eventually using public transport (my village is served by bus and train) the running times are such, that it would take a disproportionate amount of time travelling."

> "Trains are too expensive for commuting to work. Bus service takes too long to get to work."

The respondents in Carmarthenshire fundamentally felt that the present system of public transport would leave them unconnected and sequestered in their various small communities, were it not for their private car ownership:

> "There are a number of factors that make it essential for me to have my own car: I live in a rural area where the alternatives to a car are limited; I live over 35 miles from my place of work, and; I have two small children and my wife also works so I need flexibility to be able to arrive/leave when required."

> "Car ownership is vital for me. Because of poor transport links, without my own car I would not be able to get to work and would not be able to take part in social activities."

Unlike relatively well-served urban areas then, the deficiency of public transport infrastructure in more remote rural areas may have created a valuable niche in which electric vehicles could represent a more sustainable form of transportation than currently exists. To some degree, cars are more necessary out of the towns and cities; as an environmental concern, electric vehicles may be at their most viable and desirable in such locales.

While our rural pilots focused largely upon work car pools such as this, other UK schemes have highlighted further contributions that electric vehicles can make in the rural context, such as co-operative ownership, tourism or car clubs.[3] In the former case, a demonstration project in Scotland's Cairngorm National Park has seen an electric vehicle adopted as a community owned car available for residents to use. The second application can be seen with Welsh Road Trips, a company offering electric vehicle rental and charging for holidaymakers across three mid-Wales locations. The latter usage is apparent from ventures like E-Car, a wholly electric pay-per-use car club, serving areas across the English shires. These projects present electric vehicles working well outside urban locales; providing a useful communities service. The foregoing examples, though, all operate outside of conventional private ownership – still the dominant paradigm of car use.

Despite their promise then, it is important to understand that electric vehicle ownership also poses a potential problem in rural areas – these cars are expensive and this will exclude many. While there is a worthy focus on fuel poverty in the UK, the RAC Foundation (2012) has raised a little-considered parallel with regard to transport poverty. Fuel poverty applies to the 4 million households that spend more than 10% of their income on powering their homes – this figure is dwarfed by the 21 million households that spend over 10% on transportation. For the average household, transport is the single biggest

[3] See http://cllimatechangeadaptation.info, http://welshroadtrips.com and http://nef.org.uk.

outgoing. According to the Joseph Rowntree Foundation (2000), this issue is particularly heightened in rural areas, with transport acting as a major barrier to accessing services. So, any attempt to promote a move toward electric vehicles must be sympathetic to the specific needs of such communities. At the present time, relatively expensive electric vehicles are the preserve of privileged elites. Less affluent citizens in rural areas must use internal combustion engine private cars or else face social exclusion. Policy that would penalise traditional car usage patterns without offering an adequate replacement would harm many poorer rural residents.

Analysis and conclusions

Overall, the focus on urbanism may ultimately fail to match electric vehicle characteristics with functional user trips and behavioural preferences. This means much of the potential advantage that electric vehicles may have over more traditional petrol and diesel versions is potentially lost. Whether for corporate or retail owners, electric vehicles need to be used intensively so that the high initial purchase cost can be offset by lower running costs, and so that the wider advantages such as improved air quality can be maximised. Inserting such vehicles into congested urban areas replete with multiple transport alternatives offers scant prospect for realising such gains.

In turn, this raises questions over the value of transition theory for policy formulation. The identification of suitable niches as the setting for socio-technical experimentation is perhaps a combination of idealisation and pragmatism, to some extent reflecting the character of transportation research generally (Schwanen et al., 2012). The idealisation is evident in the logic used to justify placing electric vehicles in urban settings: this is where mobility problems are at their most acute and where electric vehicles can therefore make the greatest contribution. The pragmatism is evident in that urban settings are typically most able to achieve the political momentum and resource investment needed to make the socio-technical experiments a reality. Transitions theory has a quasi-market character embedded in the evolutionary perspective adopted as multiple niches may emerge initially but, eventually, only one displaces the embedded regime: survival of the fittest. Yet the most successful electric vehicle scheme to date is decidedly non-market in character, being that of the (city) state supported Parisian Autolib scheme. Free-market capitalism may be rather inadequate at developing nascent markets where risks are high and rewards uncertain, where investments are huge and where co-ordination with multiple other parties is imperative (Newman, 2013). This is not just a matter of the state protecting niches on a temporary basis, until they are fit to compete on equal terms with the established regime. Rather, in the case of electric vehicles, this may be an indivisible feature of the technology and its application. Only the state can come close to internalising some of the external benefits arising from electric vehicle use (for example, in reduced healthcare costs from lower air pollution). Only the state can orchestrate the integration of multiple diverse interests to bring electric vehicles into everyday use, thereby providing sufficient security to enable large investments to be made. On current financial cost projections, electric vehicles may never be competitive with petrol or diesel cars; in which case, the electric vehicle fleet and infrastructure would probably best remain in public ownership. These are issues rarely addressed in transitions theory analysis, but they are becoming all the more pressing in view of the transition failure that appears to be unfolding around electric vehicles. As a final thought, it is notable that, in the Paris scheme,

the mainstream automotive industry was largely bypassed, which leaves the question; is the existing industry is part of the problem or the solution?

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Table 1: ENEVATE pilots

Pilot	Region	Pilot Type
Angus	Scotland	Electric car in work car pool
Armagh	Northern Ireland	Electric car test drive
Carmarthenshire	Wales	Electric car in work car pool
Cornwall	England	Electric car in work car pool
Dijon	France	Electric car demonstration event
Dublin	Ireland	Electric car test drive
Dumfries and Galloway	Scotland	Electric car in work car pool
Dundee	Scotland	Electric car in work car pool
Helmond	Netherlands	Electric car lease
Kassel	Germany	Electric car test drive
Montbéliard	France	Electric car hire scheme
Newcastle	England	Electric car lease
Rhondda Cynon Taff	Wales	Electric van in works fleet
Scottish Borders	Scotland	Electric car in work car pool
Strathclyde	Scotland	Electric van in works fleet
Venlo	Netherlands	Electric car demonstration event
Wallonia	Belgium	Electric car demonstration event
Wrexham	Wales	Electric car in work car pool

Figure 1: Carmarthenshire County Council Electric Vehicle Daily Usage

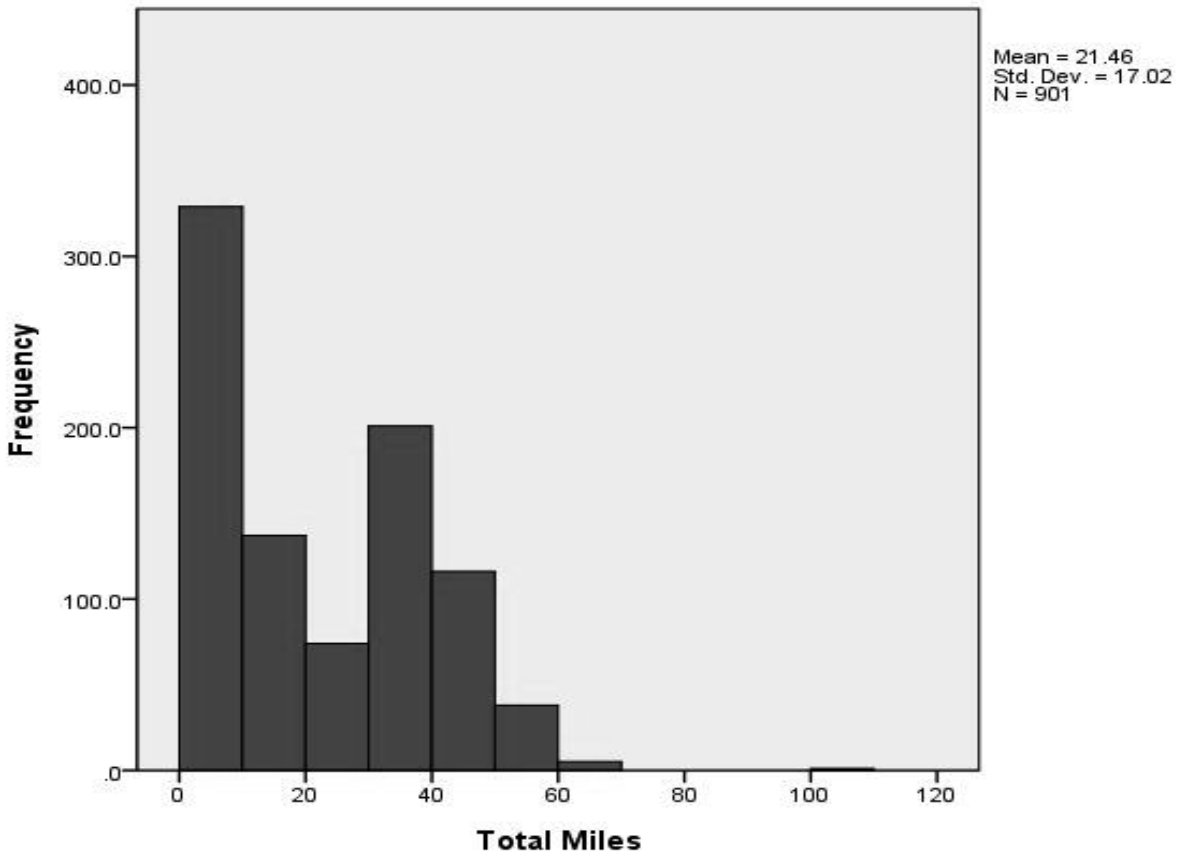

Figure 2: Future Electric Vehicle Intentions

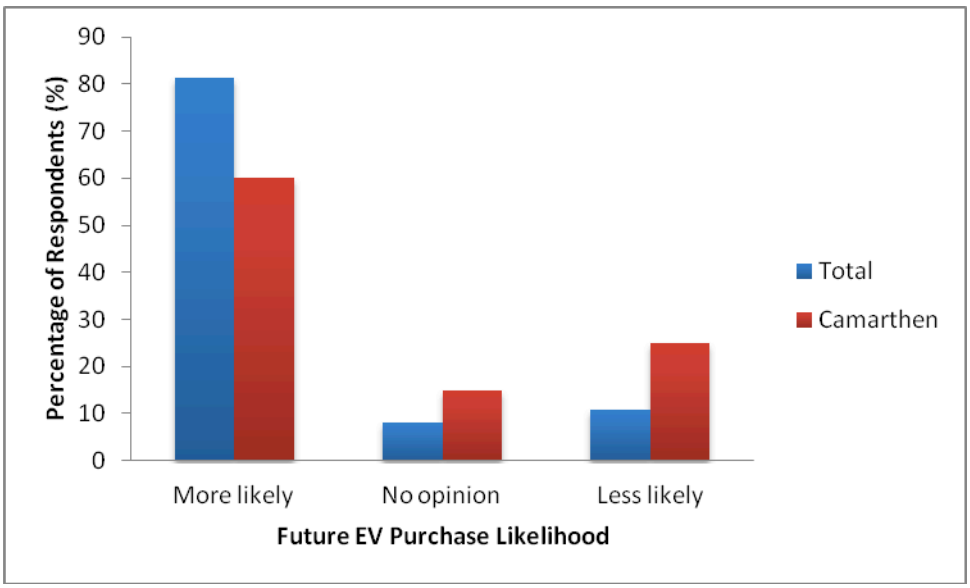

Table 2: Attitudes to public transport

Theme	Count
3.1 Public transport takes too long	8
3.2 Public transport is not convenient	16
3.3 There is a lack of flexibility with public transport	9
3.4 Public Transport is suitable some or all of the time	32
3.5 Public Transport is not suitable	30
3.6 Public transport in the city or locally is good	13
3.7 Public transport in the countryside or long distance is not good	16