

ENEVATE WP3

Scenarios for Sustainable e-Mobility

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Introduction

The main objectives of ENEVATE Work Package 3 – Market Drivers and e-Mobility Concepts - are as follows:

- Study the impacts of the introduction of electric vehicles (EVs) on user and market behaviour;
- Investigate the potential for new e-mobility concepts, and;
- Determine the market drivers that will influence the acceptance of the different EV mobility concepts and the conditions needed for realising this acceptance.

There have been two previous actions to this work package. The first defined a niche typology, which outlined nine different types of possible EV scheme (Nieuwenhuis, 2011). The second was the initial market drivers survey (Newman et al, 2012). This was a basic questionnaire, which was designed to determine consumers' views on various incentives that could be used to promote e-mobility. These included financial incentives, infrastructure development and organizational involvement.

Results for the initial market drivers survey clearly show costs to be a primary concern for potential EV drivers. Currently EVs are much more expensive than conventional internal combustion engine (ICE) cars. In order to mitigate the high initial purchase cost, new models of ownership could be used, so an additional, more detailed follow up survey was conducted in order to gauge how open consumers might be to suggested alternative models. To build on this, a series of stakeholder workshops were subsequently undertaken, where attendees were encouraged to discuss topics centred around financial inducements, infrastructure and range anxiety. The workshops offered a different perspective from both surveys and will be used to further develop the objectives stated above.

Methods

The initial survey was a basic questionnaire, with most responses being tick boxes on the *likert* scale (i.e. strongly agree, agree, no opinion, disagree and strongly disagree). This was chosen as it would be quick and easy to complete and could be easily translated into Dutch, French and German. Whilst this was a suitable for the initial survey, it was felt that something more in-depth would be required for the follow up survey in order to capture a wider range of responses and opinions. This second survey still needed to be relatively straightforward and quick to complete - in some cases the follow up survey was completed in the respondents' native language rather than English. However, rather than tick boxes, respondents were given free-text boxes in order to give a more detailed answer to the questions posed. This meant that the survey follows a semi-structured approach – the respondents are guided by the questions, but they are free to answer how they wish. The survey was also available to complete online using Survey Monkey in order to make distributing the survey and collecting responses quick and easy.

The first three questions were designed to gauge respondent attitudes to vehicles that they might own or share, and also to public transport. They were then asked to give their option on four potential alternative usage models as follows:

- Contract model (similar to mobile phone usage);
- Short term usage (similar to Boris Bikes or Paris Autolib’);
- Car sharing, and;
- Vehicle rental

In order to make vehicles suitable for shared use, they are sometimes more basic, without features such as heating and radio. How acceptable this would be to respondents was the focus of the next question. The last two questions asked the respondents for their opinions on the future of car ownership, and what might encourage them to drive an EV.

As the data from the responses was free-text, qualitative methods were required in order to analyse the data. The software package NVivo was used to do this. This allowed the responses to be analyzed for recurring themes, which were then highlighted using the software. Each theme (or node, to use the NVivo terminology) can then be analyzed to see how often it was highlighted, which shows those that are most prominent. The nodes can also be examined to see the individual responses, some of which have been quoted in this document. Each respondent has also been classified by attributes such as country and pilot type in order to make comparisons where appropriate to do so.

In addition to the follow up survey, a series of stakeholder workshops has been conducted throughout the ENEVATE region. This has allowed different perspectives to be sought. Again the sessions have followed a semi-structured approach, with presentations followed by facilitated discussions, centred on three topics as follows:

- Financial Inducements;
- Infrastructure, and;
- Range anxiety.

Follow up Survey Findings

Responses

There were a total of 97 responses to the follow up survey, with at least one response from each of the ENEVATE regions. The distribution of the responses is shown in Figure 1.

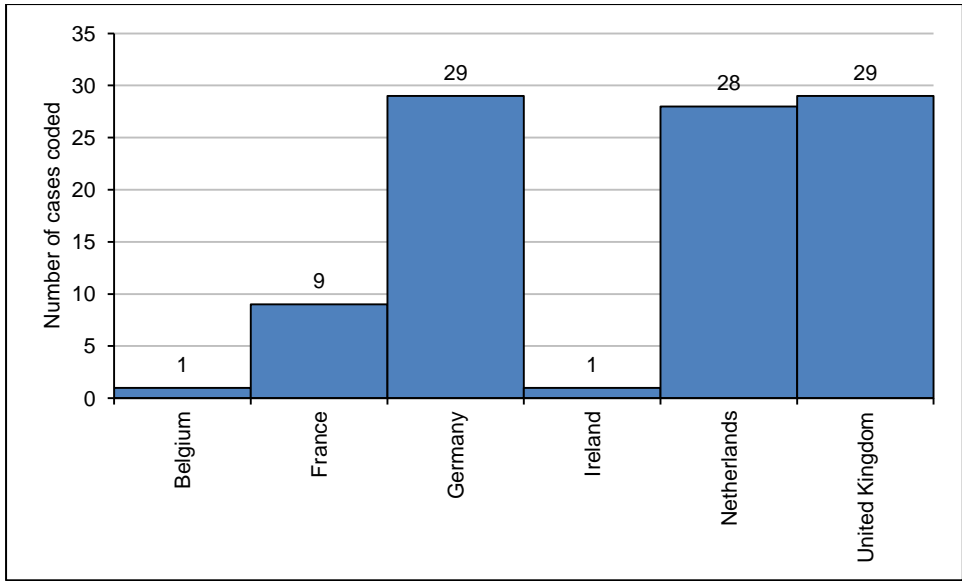


Figure 1 - Responses by Country

The majority of responses were split between Germany, the Netherlands and the UK. There were only nine from France and only one each from Belgium and Ireland. Due to the small number of responses, Belgium and Ireland cannot be examined individually.

The responses to each question posed in the follow up survey are described in the following sections.

1) How important is owning your own car – for you? Also, is it important for you to have a car that allows you your own space?

The first question was designed to gauge attitudes to personal vehicles in terms of usage, and also whether people see vehicles as their own personal space and how much they value this. The themes that emerged are shown in Table 1.

Table 1 - Attitudes to vehicle ownership

| Theme | Count |
|--|-------|
| 1.1 Public transport is not suitable | 8 |
| 1.2 Need a personal car for work or commute | 15 |
| 1.3 Need a personal car for family or social use | 15 |
| 1.4 Personal space is important | 22 |
| 1.5 Personal space is not important | 10 |
| 1.6 Personal vehicle means independence | 15 |
| 1.7 Personal vehicle ownership is important | 54 |
| 1.8 Personal vehicle ownership is not important | 23 |
| 1.9 Need vehicle to carry equipment or towing | 6 |

Interestingly, eight respondents mentioned that public transport was a not a suitable option for them, even though public transport was not mentioned in the question. The general feeling seemed

to be that owning or having access to a personal car was important because public transport didn't meet their needs:

"I live in a rural area where the alternatives to a car are limited"

The table also shows that over half of the respondents stated that personal vehicle ownership was important, although 23 said that it was not. Figure 2 shows the distribution of those who thought personal vehicle ownership was important by country.

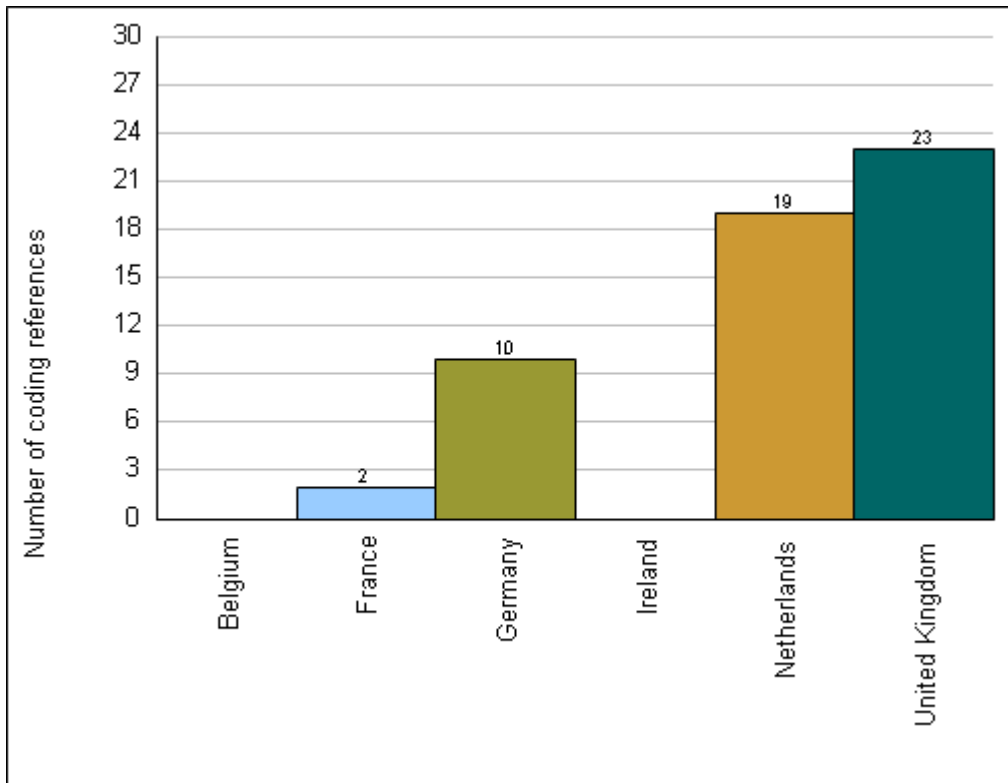


Figure 2 - Personal Vehicle ownership is important by country

When compared to the overall distribution of country responses shown in Figure 1, it is clear that the profiles are not the same – the majority of UK respondents thought personal vehicle ownership was important, whereas in Germany there were proportionally far less respondents who thought this was important.

Other common themes were that respondents needed vehicles for family use (particularly if they had children) or for work purposes, including commuting:

"You need a car for all sorts of reasons, such as transporting children around"

"[W]ithout my own car I would not be able to get to work"

Three of the responses that stated they needed a car for commuting gave the distance they drive to work as 20–30 miles, which would be well within the range of an EV, even if they couldn't recharge whilst they were at work.

2) Do you feel different about using the pool car than you do your own car? If you do, please explain why.

This question relates to how drivers feel about vehicles that they do not own. This was worded in relation to pool cars, but equally applies to car sharing clubs. The themes that were apparent in the responses are shown in Table 2.

Table 2 - Attitudes to shared vehicles

| Theme | Count |
|---|--------------|
| 2.1 Other drivers don't look after the vehicles | 8 |
| 2.2 Drivers are careful not to cause damage as they don't own the car | 12 |
| 2.3 It takes some time to get used to driving a pool car | 7 |
| 2.4 Feel the same about personal and pool cars | 15 |
| 2.5 Driving the pool car means not driving personal car | 1 |

There were two main themes that emerged. Firstly, some drivers stated that they were more careful with a shared or pool car as it did not belong to them. In addition, there was also a feeling that other drivers were less careful and did not look after the vehicles in an acceptable manner. Several drivers noted that it took some time to get used to driving the pool car:

"I'm not as familiar with the controls"

"[T]he first 10 minutes or so in the car is spent 'getting used to' the different controls"

This suggests that there could be some merit in introducing driver training or familiarisation sessions, so that drivers are more confident with the vehicles. This is particularly applicable to EVs, where drivers need to understand how to recharging, range etc.

3) What do you think about public transport? Does it, or could it, fulfil your personal mobility needs?

Next the respondents were asked their opinions on public transport and it's suitability to meet their transport needs. The opinions that were expressed are shown in Table 3.

Table 3 - 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 |

There appears to be a similar number who think public transport is good and those who do not. Again, this can be analyzed on a country level as shown in Figure 3.

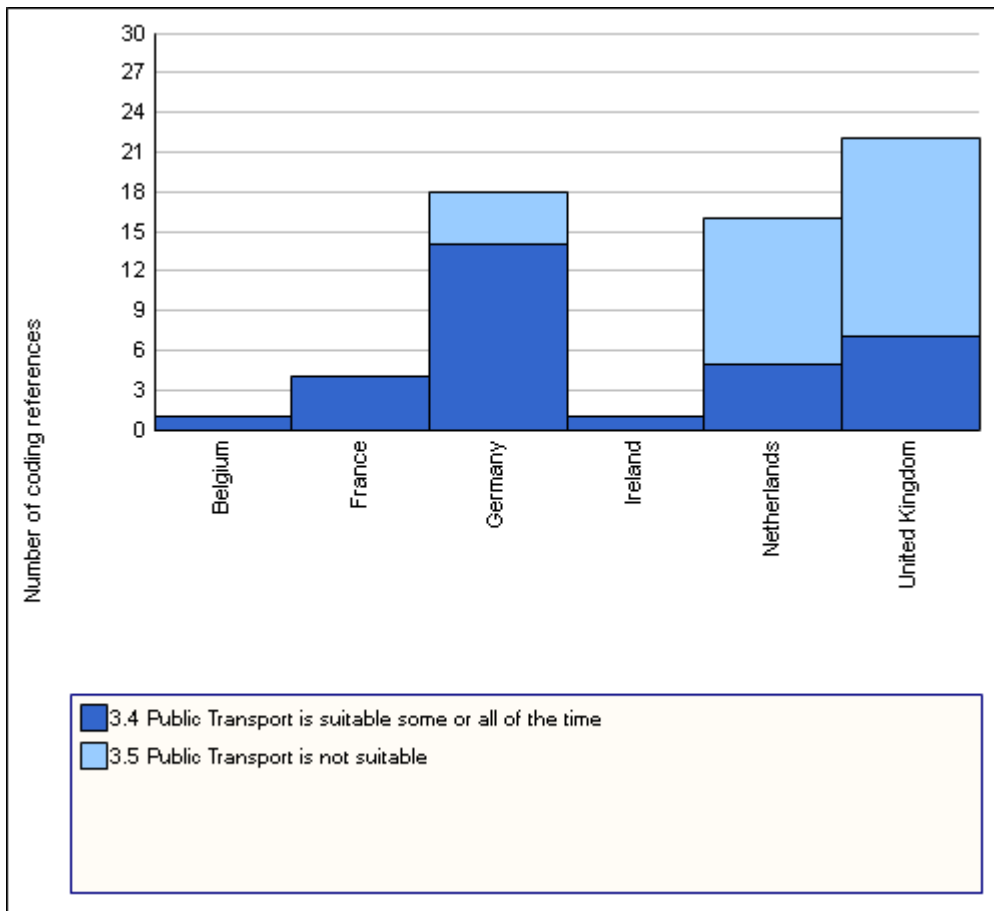


Figure 3 - Attitudes to public transport by country

As previously identified, there is some difference between nations – the British and the Dutch are less inclined to think of public transport as good in comparison to the Germans.

There were some comments relating to location – there were more positive comments on public transport in urban areas whereas those relating to rural or countryside were more likely to be negative:

“In the city, public transport meets my weekly mobility needs one hundred per cent”

“In the countryside, public transport does not work”

Another theme was that public transport does not meet the flexibility and convenience that personal transport can offer:

“Public transport is too complicated”

“[S]ome timetables aren’t always convenient”

4) Do you have or have you had a mobile phone contract? If so, how would you feel applying a similar model to your car? This is opposed to traditional ownership, where you are paying for usage of a car rather than owning the car outright?

The following four questions suggest various alternative models of vehicle ownership. Although the nodes were coded according to the themes that arose from the responses, for these four questions some common nodes were used in order to compare attitudes across the four models. These were:

- Good idea in principle;
- Would be suitable for others;
- Not a good idea, and;
- Unsure.

The first model outlined was a contract model similar to mobile phone type contracts where the user pays for usage rather than paying for the vehicle upfront. The responses to this are shown in Table 4.

Table 4 - Attitudes to contract model

| Theme | Count |
|---|-------|
| 4.1 Model would be appealing if it was financially advantageous to user | 18 |
| 4.2 Contract model - Good idea in principle | 51 |
| 4.3 Contract model - Would be suitable for others | 2 |
| 4.4 Contract model - Not a good idea | 17 |
| 4.5 Contract model - Unsure | 11 |

This model seemed to have a reasonable amount of support, with 51 responses being favourable. However, these positive responses were often accompanied with the caveat that the model would need to be financial advantageous:

“This would suit me well, as long as the price was right”

“Sounds good but it depends on what the payment model looks like”

It is also possible to look at the positive responses by country, as shown in Figure 4.

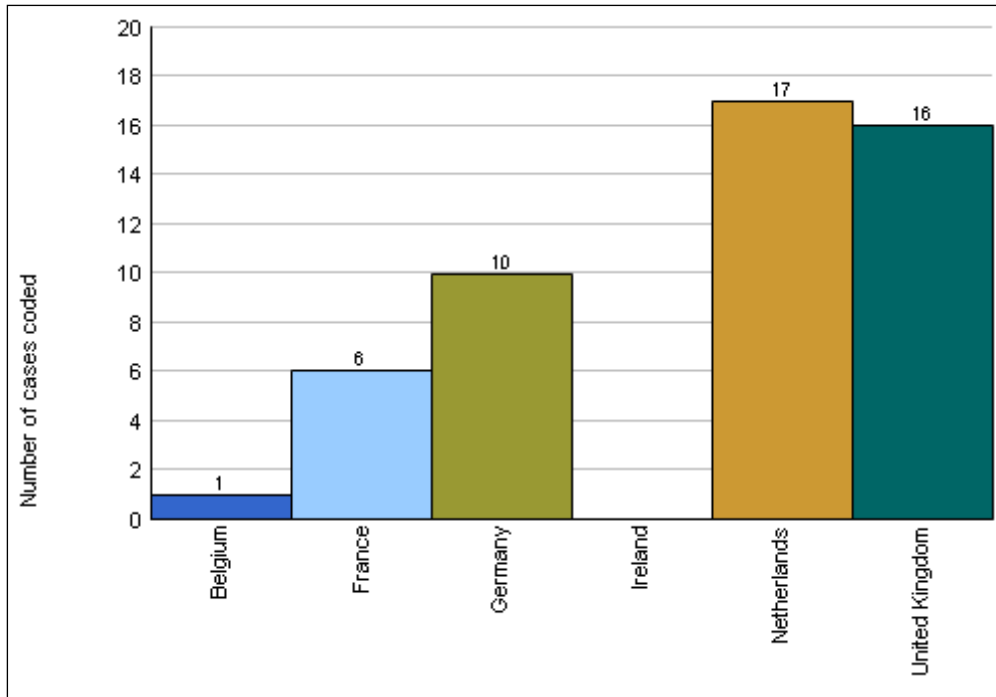


Figure 4 - Positive attitudes to contract model by country

It seems that this model is viewed most favourably the UK and the Netherlands. Although the number of responses from France is small, 6 out of 9 respondents also gave positive comments on this model.

5) For your personal mobility needs, how would you feel about using the ‘Boris-bike’ option with an online membership? Having paid a subscription, you could pick up a shared car from various points and pay a fee per mile as you use it.

The next model proposed a scheme similar to the “Boris Bike” scheme in London or the Paris Autolib’ scheme, which operates in Paris. This offers short-term vehicle loans from set points on a pay as you go membership model. The model is more suitable for ad hoc use over shorter distances between set points within a defined area, such as a city. Responses to this model are shown in Table 5.

Table 5 - Attitudes to short-term loan

| Theme | Count |
|---|-------|
| 5.1 Boris bike scheme isn’t suitable for a rural area | 12 |
| 5.2 Boris Bike model - Good idea in principle | 39 |
| 5.3 Boris Bike model - Would be suitable for others | 6 |
| 5.4 Boris Bike model - Not a good idea | 26 |
| 5.5 Boris Bike model - Unsure | 15 |

This model was seen as slightly less favourable overall. There were comments that suggested this model was only really suitable for urban areas:

“It may work in very urban areas, but cannot envisage it in a rural area”

“Not a good option for those outside the big city”

The profile of those who made favourable comments is shown in Figure 5.

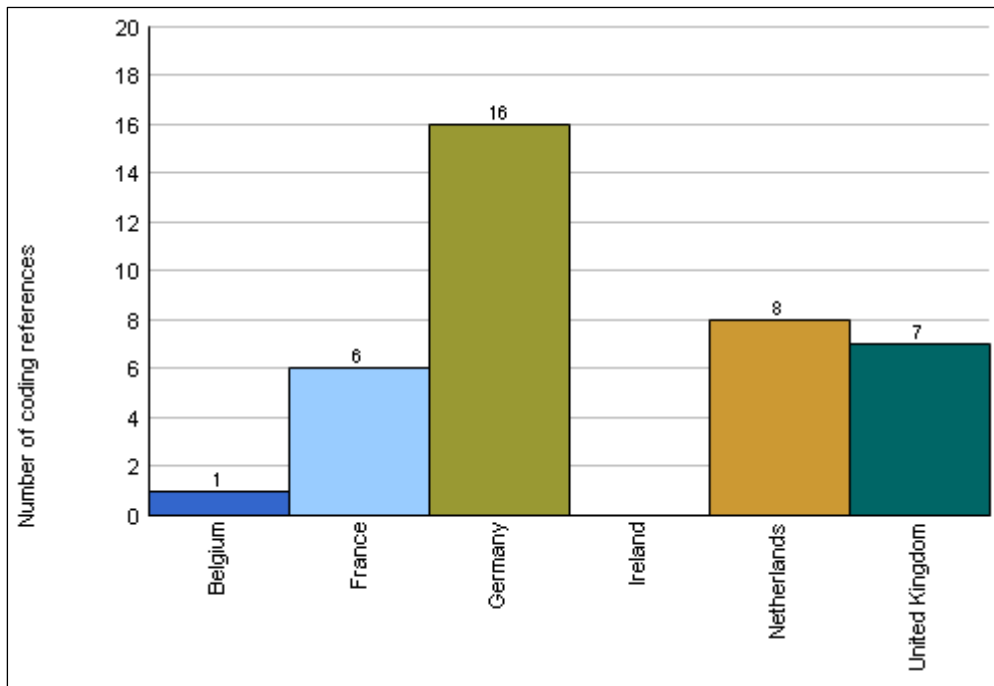


Figure 5 - Positive attitudes to short term loan by country

In this case it seems that there are more favourable comments from Germany. There are also a relatively high number of favourable comments from France – however, it should be noted that the French respondents came from Montbéliard, which already has a similar scheme in operation, this may explain the higher level of support. It is interesting that most of the French comments are supportive, given that they have seen the scheme in operation.

The negative comments tended to focus on cost and practicality of the scheme:

“I wouldn't be so keen on this as ensuring there are enough pick up and drop off points for shared cars would be practically impossible”

“Seems too expensive for me”

6) For your personal mobility needs, how do you feel about a co-operative model of car ownership where the local community purchases the car? You would own shares in the car, with one or more vehicles available to book, as you needed it and depending on the type of journey you e.g. an electric car for short trips or a hybrid for longer trips.

The third model of ownership is based on a cooperative car sharing scheme. Here, the user community buys shares in a vehicle or number of vehicles for use by its members, some schemes already in operation are commercially operated but work on similar principles. Vehicles are available from set locations and can be pre booked, but trips are not bounded in the same way as the Boris Bike scheme, so the vehicles can be used for longer journeys. A summary of the comments is shown in Table 6.

Table 6 - Attitudes to car sharing

| Theme | Count |
|--|-------|
| 6.1 Car club would not be suitable for impromptu use | 10 |
| 6.2 Concerns about care and responsibility of the vehicles | 6 |
| 6.3 Car Club model - Good idea in principle | 38 |
| 6.4 Car Club model - Would be suitable for others | 6 |
| 6.5 Car Club model - Not a good idea | 27 |
| 6.6 Car Club model - Unsure | 15 |

Again, it can be seen there is some support for this model, although there is also more uncertainty about how the scheme would operate, such as who would be responsible for vehicle maintenance or what would happen if the vehicle was damaged:

“Not a good idea because there would be a lot of arguing if you crashed it”

“Who would be responsible for maintenance and servicing”

There were also concerns that a vehicle might not be available when needed:

“There is also the problem to whether you needed a vehicle last minute, but there isn't a car available to use”

Figure 6 shows the positive statements to car sharing by country.

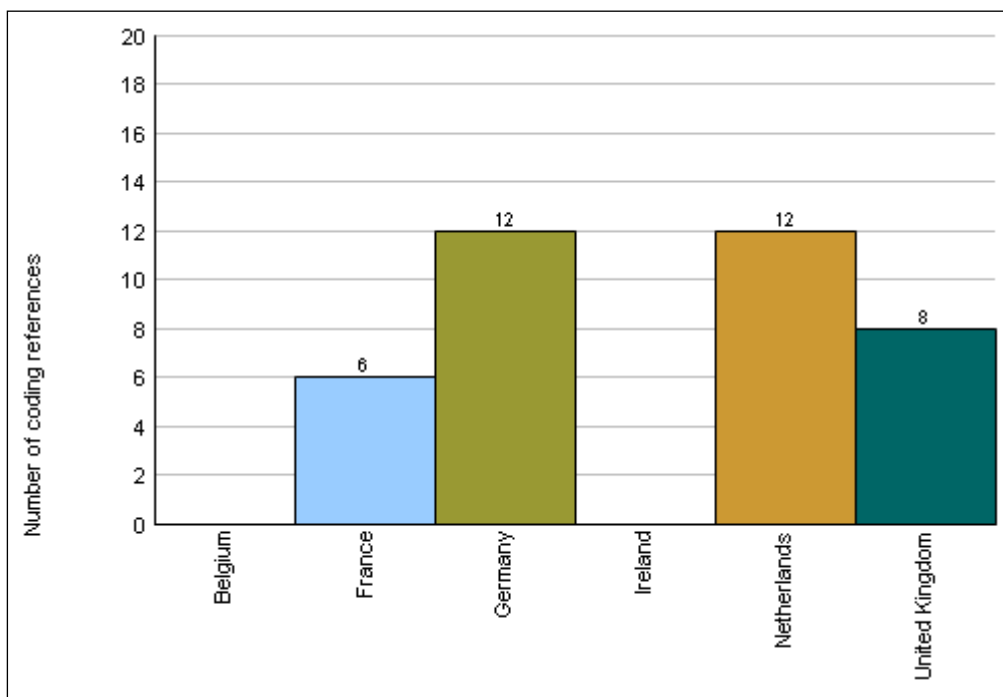


Figure 6 - Positive attitudes to car sharing

It seems that the British are less open to car sharing than the Dutch and Germans; the French also seem to have a favourable opinion – albeit from a small sample size.

7) For your personal mobility needs, how would you feel about leasing a car on the existing car rental model often used by tourists? You would pay a fee to use the car for a set period of time and return it when it is no longer needed.

The last model is based on what is already offered by commercial car hire companies, whereby a fee is paid to hire a car for a fixed period of time. The responses are shown in Table 7.

Table 7 - Attitudes to rental model

| Theme | Count |
|---|-------|
| 7.1 Rental model would depend on cost | 21 |
| 7.2 Rental model - Good idea in principle | 36 |
| 7.3 Rental model - Would be suitable for others | 4 |
| 7.4 Rental model - Not a good idea | 35 |
| 7.5 Rental model - Unsure | 4 |

This model was seen as very cost dependant, with 21 related comments:

“As long as it is cheaper than owning your own car, this is fine”

“If the price was right this would be an option I would consider”

There was also a feeling that this might not offer flexibility or would be suitable for regular use:

“Because I do not live in a big city, I do not think this option gives me enough freedom”

“I need the car everyday so it doesn’t seem useful to me”

The country profile of the positive responses is shown in Figure 7.

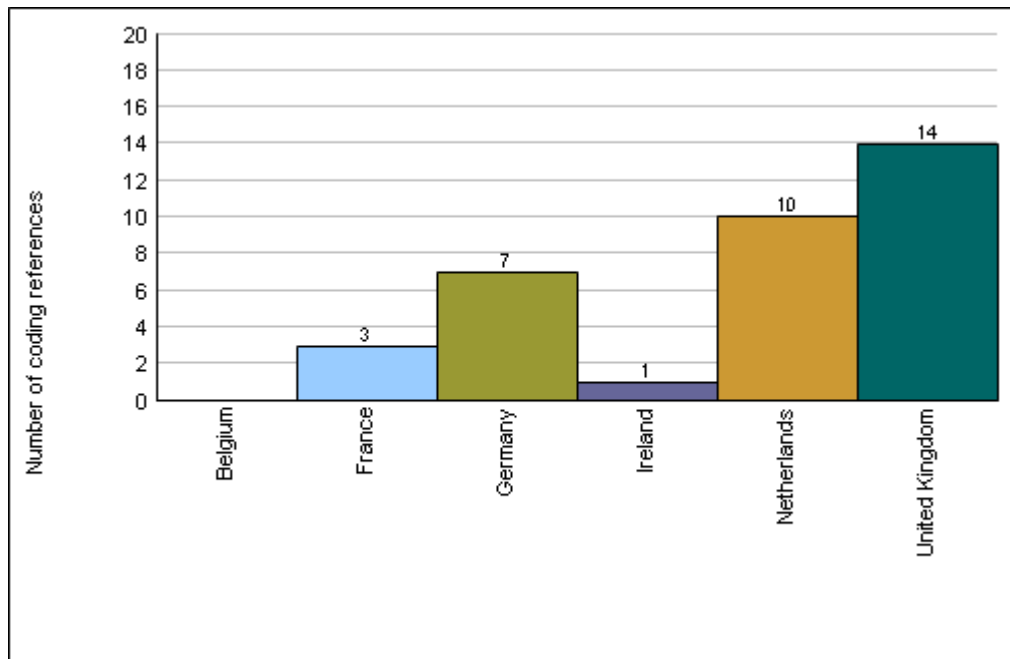


Figure 7 - Positive attitudes to rental model by country

It seems that this model is slightly more favourable to the British, although there does not seem to be overwhelming support from any country in particular.

8) Sometimes, electric car share schemes involves far more basic vehicles than you may be used to – lacking many of the modern conveniences that come as standard in today’s market place. How would you feel about using a car without features such as central heating, air conditioning or a radio – if these could prolong the battery life?

The next question examines whether respondents would be willing to accept more basic vehicles. EVs that might be used for electric car share schemes or the Boris Bike might be more basic than what a user might be used to in order to maximize battery range, make the vehicles simple to operate and ease the maintenance burden. The themes that were prevalent are shown in Table 8.

Table 8 - Attitudes to extras

| Theme | Count |
|---|--------------|
| 8.1 Would like the vehicle to have music | 10 |
| 8.2 Would like the vehicle to have heating | 32 |
| 8.3 The vehicle does not need extras | 20 |
| 8.4 Extra are not needed if vehicle is intended for short trips | 15 |

Here opinion was mixed. Several comments noted that heating was a safety feature, both in terms of driver comfort and demisting the windows:

“It’s dangerous to drive in winter without heating”

“It is not safe without heating as the windows need to demist”

Whilst twenty comments thought vehicles could do without extras, some comments thought that vehicles only intended for short journeys didn’t need such extras:

“For short distances, not having these extras would be acceptable to me”

9) What do you think car ownership patterns will look like over the coming decade and what would you like them to look like?

The respondents were then asked what they thought car ownership patterns would look like over the next decade. Some of the responses are shown in Table 9.

Table 9 - Attitudes to car ownership

| Theme | Count |
|---|--------------|
| 9.1 There will be less cars due to high costs | 7 |
| 9.2 There will be smaller and or more efficient cars | 2 |
| 9.3 There will be more cars | 3 |
| 9.4 New ownership models will become popular due to costs | 12 |

There seemed to be less of a defined consensus of what the future might bring. One trend seem to highlight that new ownership models might arise, in particular car sharing:

“Car-sharing must be developed to address traffic jams in the city, to improve air quality and to give people who can’t afford a car the opportunity to drive one”

“[A] pragmatic use of cars (renting, sharing) will increase”

Also increasing costs will play a part in the number of cars on the road:

“I think there will be a change – rising petrol costs mean less people can afford a car”

“[W]ith running costs increasing as they are this may in fact force some change not through choice but purely and simply because of the economics of car ownership and running”

10) What could make you want an electric car?

The final question simply asked respondents what would make them want an electric car. Responses are shown in Table 10.

Table 10 - Attitudes to electric vehicles

| Theme | Count |
|---|-------|
| 10.1 EVs need better range | 27 |
| 10.2 EVs must be quicker to recharge | 9 |
| 10.3 EVs must be cheaper to buy | 54 |
| 10.4 Better charging infrastructure is needed | 16 |
| 10.5 Need to perform as well as ICE cars | 6 |
| 10.6 (Proven) Environmental benefits | 20 |

The responses given reinforce the findings of the initial survey, with cost being the primary concern:

“At the moment, the price is too high”

“Price. I have looked in to this as a commute car but I cannot justify the price”

Charging infrastructure is also a motivating factor:

“[T]he possibility to recharge the car everywhere”

“[A] greater distribution of charging points”

Also the time it takes to charge an EV in relation to the time it takes to fill a conventional car with petrol or diesel was also mentioned as a barrier:

“Technologies to speed up the charging process”

“[R]echarging points that would only take a maximum of 10 minutes”

Range anxiety was also a concern:

“My biggest concern is their current range”

“[R]ange is an important barrier”

A major factor in that made EVs an appealing choice was the environmental benefits:

“The main reason is ecological”

“Electric vehicles are a benefit to the environment”

This last factor is one that did not come across as strongly in the initial survey, where cost and infrastructure were the dominating factors.

Stakeholder Workshop Findings

To date there have been four stakeholder workshops. The initial workshop was held in Cardiff, June 2012, which served as a test for the methodology employed. Feedback suggested that the format was suitable so it was rolled out to the rest of the ENEVATE regions, with further workshops held in Helmond (Netherlands), Paris (France) and Rouen (France) and more planned for the remainder of the programme. Whilst the initial Cardiff workshop was held over 4 hours, time constraints meant that the subsequent workshops were conducted in 1 – 2 hours. This meant that a ranking exercise done in Cardiff was not carried out elsewhere.

As discussed earlier, the discussions were focused on three topics, each of which is discussed in the following sections.

Financial Inducements

The first group was asked to discuss what financial inducements would make EVs more attractive. It was widely acknowledged that the upfront cost of EVs is a barrier, even though they may work out more cost effective in the long-term. There was a lot of support for ways to reduce the purchase cost, such as reduced or no tax. However, consumers might view these suspiciously as they can be withdrawn at any time. It was also noted that consumers are often not aware of the whole-life costs of owning and running a vehicle, indicating that this could be an area for some consumer education. Delegates at the Cardiff workshop also commented that the second-hand market for EVs was unknown, with depreciation not really quantifiable at present.

Alternative models of ownership were also discussed in the form of car sharing and leasing schemes, these were largely seen as positive. The model where the car is purchased but the battery leased was discussed at several of the workshops; however, some delegates pointed out that this is not feasible in Germany as this is classed as transporting hazardous materials for a third party.

Free charging, parking and use of toll roads were also popular incentives, as was subsidized charging equipment both for home and the workplace. An interesting proposition that was discussed in Paris was the option of having free use of an ICE for short periods for longer trips such as vacations.

Infrastructure

The next group discussed infrastructure. There was a general feeling that a mix of infrastructure would be needed depending on location. In urban areas, consumers are less likely to have off-street parking, making charging at home more difficult. At the same time, in rural areas distances travelled may be greater so battery swap or fast charging between towns might be needed. Charging at work and also at transport hubs (such as park and ride) were also mentioned. It was felt that whilst charging points need to be visible and there should be enough to meet demand, too many could give the wrong message, particularly if they are rarely used.

Interoperability was also highlighted as a major issue, both in terms of infrastructure and payment or membership schemes. It is crucial that plugs are standardized so that consumers can plug into any charger – it was also noted that not all vehicles can accept a fast charge at present. There also needs to be a coherent payment scheme at least on a national level, but preferably on a European level. This again will ensure that consumers can use any charging point they wish.

An interesting point that came up in several discussions is that fleet or local government use of EVs will help promote their use, in particular if they install infrastructure that others can use.

Range Anxiety

The last group focused on range anxiety. Discussions were based on whether this was a major barrier and how this can be overcome. It was felt that in most cases drivers will easily adapt to the range of EVs. However, longer journeys still pose a problem. Fast charging at locations where other activities were on offer was one solution, with the use of range extenders being another. Information on the location and availability of charging points was also seen as important, with links to SatNav being a possible solution.

There was also a feeling that education was needed to overcome range anxiety. Consumers need to be realistic about the journeys they actually undertake. Again, this is another example of why EVs are suited to fleet use, as fleet managers are more able to determine the journeys undertaken by a vehicle and plan accordingly. It was also noted that charging is not a linear process – charging to 80% is much quicker than a full charge and may well be adequate for most journeys.

Discussion

As with the initial survey, high purchase price is seen as a major barrier to the uptake of EV, with this being a major theme of both the follow up survey (54 responses mentioned it as a problem) and a point for discussion at the stakeholder workshops. One of the reasons for the follow up survey was to see how open consumers might be to alternative models of ownership as a way of alleviating the high purchase cost. A comparison of the responses to the four models proposed is shown in Figure 8.

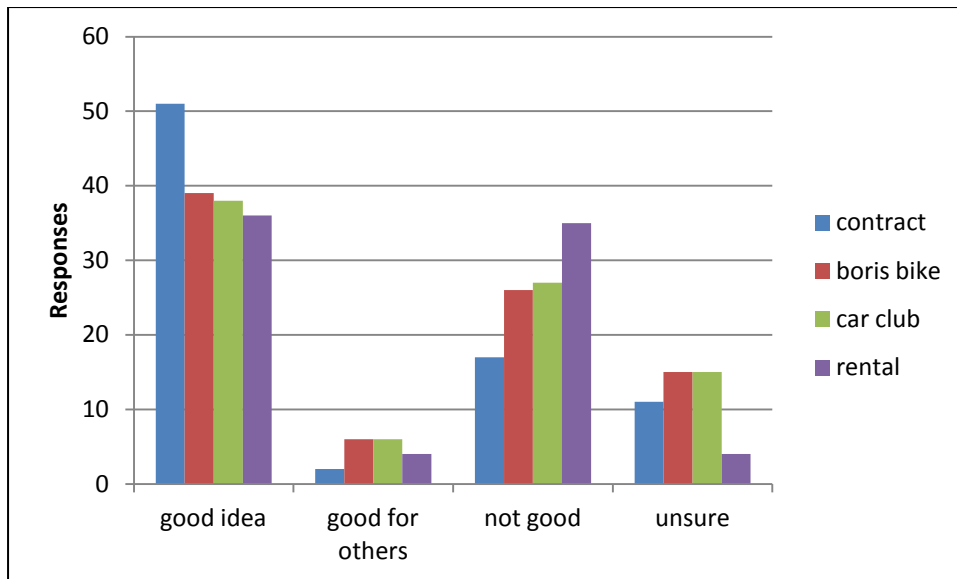


Figure 8 - Comparison on alternative models of ownership

From the responses received, it seems that the leasing model seems like the most favourable model, with the rental model being least favourable. There were, however, many caveats – most notably that any new model of usage should be financially advantageous and easy to use. Respondents in many cases appreciated the convenience of having a car at their disposal whenever they needed it, particularly if they had families or needed their car for work. This may be why the contract model is seen as most favourable – it allows consumers access to a vehicle at all times. There appeared to be some regional differences between attitudes to alternative models of ownership. However these should be treated with caution, as there may be other factors influencing these outcomes, such as whether the respondent lives in a rural or urban location or has had previous experience of the models suggested.

One of the themes that emerged throughout both the follow up survey and the workshops is the need to tailor EV schemes and infrastructure to the location. Attitudes to public transport seemed to be more positive in urban locations and less so in rural areas. It was also noted that for urban dwellers charging an EV at home could be difficult if there was no off road parking, particularly if they lived in an apartment. This suggests that an EV might make more sense as a vehicle for rural use, where use of a car is essential due to lack of public transport infrastructure, but off road parking is readily available, making charging at home feasible.

Another suggestion that was highlighted in the workshops in particular, was fleets and local authorities might be best placed to adopt the EVs in the immediate future. Fleet managers are better equipped to calculate the whole life costs of vehicle use, and as such are more aware that the lower running costs go at least some of the way to offsetting the high initial purchase price. They also have a better idea of the typical journeys their vehicles undertake, so are able to decide if an EV would be suitable in terms of range and plan for charging. It was also mentioned that fleet use could promote the use of EV, as consumers would see more of them on the roads.

Further Work

The final action of this work package will be to combine the findings of all the work to date to make a toolkit for use by any organization wishing to implement an EV scheme. The toolkit will allow organizations to examine possible options and gauge their suitability using an iterative filtering process. The toolkit development will be done in conjunction with several local authorities throughout the ENEVATE region in order to ensure it meets the requirements of potential users.

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