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The lifestyle implications of **electric vehicle** adoption

A Briefing provided by the Institution of **Engineering and Technology**



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Images

Image on page 5 - Electric vehicle charging station (kind permission of Elektromotive Limited)

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Contents

Introduction 3
Users and the Adoption Cycle 3
How Green are Electric Vehicles?..... 4
What changes are needed to user journeys and to driving? .. 5
Charging and paying - how will users pay for electricity?..... 5
Batteries - will changing technology affect my purchase? 5
Will charging connectors impact on housing stock?..... 6
Conclusion..... 6

This briefing sets out some of the key issues surrounding the electric vehicles debate and puts them in context. It looks at the questions being asked by society who are examining the claims being made and the possible lifestyle implications of electric vehicles on their lives. The briefing does not offer answers to the issues identified, instead it sets out these issues and aims to highlight the most burning questions, in order to assist the debate.

By identifying the issues that society will need to think about, both technical and non-technical audiences will be able to use the briefing note as an initial reference point to help explain the lifestyle implications of EV adoption to their own, wider communities.

The aim of this briefing is to look at the issues and questions arising from early trials to help facilitate a useful flow of information. As the programme continues the IET will keep track of the information available and use focus groups to find out where understanding is lacking (or where new questions have arisen). We turn now to five topics which may influence the decisions made by new users.

Introduction

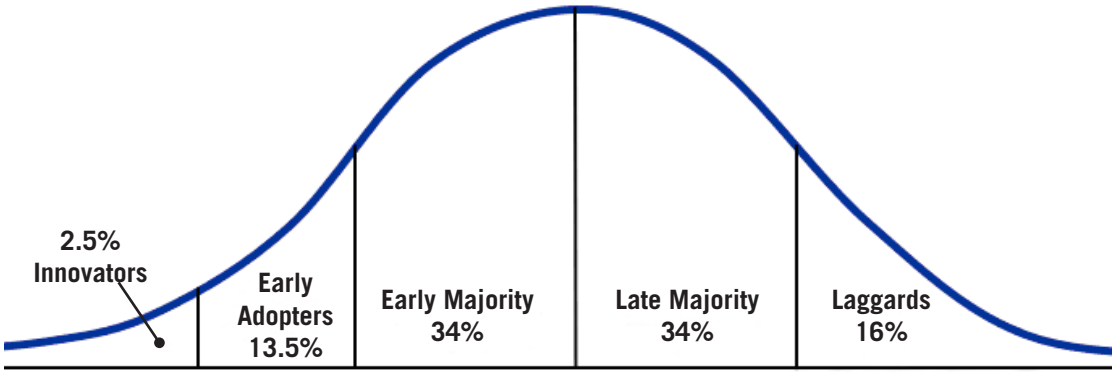


The projections for growth and levels of investment by electric vehicle manufacturers are healthy signs that the market for electric vehicles is real and will continue to grow, with more and more people expected to use EVs in the future. The opportunities and issues that this brings will have lifestyle implications for large parts of the population. Yet, electric vehicle take up, is not a foregone conclusion.

Informed public engagement on the debate surrounding electric vehicles, will require adequate, evidence-based information that covers the various issues pertinent to user requirements. The IET facilitates the sharing of factual knowledge and, working with partners, seeks to enable the two-way transfer of information and understanding between society and the engineering and technology profession, to ensure the effective introduction of new technologies which may prove beneficial to society.

Users and the Adoption Cycle

Before any assessment of society's questions can be made it is useful to start with a recap of the technology adoption lifecycle. This cycle, describes the different stages and types of users who engage at different stages, when new technology is being developed and rolled out.[1]



Source: Everest Rogers, Diffusion of innovations model

Four components dictate the spread of new technologies; the innovation itself, the range of communication channels used, time, and the structure of society; with the 'diffusion' of the innovation happening via communications channels over time amongst society. Each individual will progress through five key stages;

1. knowledge - awareness and understanding
2. persuasion - gathering evidence, assimilating into beliefs and evaluating required change
3. decision - commitment to change
4. implementation - adopting new behaviours and adapting expectations
5. confirmation - validating decision and extending commitment

Electric vehicles are already available to buy and have been extensively trialled. Therefore, based on the current discourse, the next group to make a decision on electric vehicle adoption are the early adopters. In the persuasion stage early adopters seek out information about the new technology and move on to the decision stage, weighing up the advantages and disadvantages of electric vehicles to reach a decision on whether or not to adopt.



This stage is crucial; the decisions of early adopters, who are the most high profile group of opinion formers, will set the scene for the early majority. It should be noted that innovators do not have a significant impact on the early majority, where they are seen as risk takers who will buy into a product regardless of the evidence. As a result, the early majority take their cues in their own decision stage on the comments and feedback from early adopters.

In short, the early majority do not have the time to fully assess the pros and cons of electric vehicle adoption and will go with the feedback from the early adopters; the early adopters will make their decisions based on the factual information available. If this information is lacking, inconsistent or incomplete electric vehicle adoption will have limited success. The five factors which help as part of this decision making stage are:

- Relative Advantage - does the solution offer an advantage over conventional vehicles?
- Compatibility - is this compatible with my values, needs and lifestyle?
- Complexity or simplicity - how easy are electric vehicles to use?
- Trialability - can I try an electric vehicle out before I go ahead?
- Observability - are my fellow opinion formers (early adopters) aware of, or even interested in electric vehicles?

These will vary widely from individual to individual within the early adopter category, based on their circumstances, and as such information needs to be broad and widely available, rather than niche and only disseminated to certain groups.

How Green are Electric Vehicles?

While many are aware that the zero emissions of electric vehicles at the roadside are only part of the pollution equation, there will be others who lack awareness of the electricity supply situation - especially in light of emerging changes to generation and distribution. Given that there is already no surplus of low carbon generated electricity in the UK, the 'green-ness' of electric vehicle usage will depend on user behaviour, and this may be a point of confusion or misconception for some. Additional considerations of variable cost to charge and potential changes in energy prices need to be taken alongside the green cost of production and scrapping, in any decision to adopt.



These are some of the questions which surround the debate on the green credentials of electric vehicles, and some are beginning to stick. Looking at some of the factors which help shape the decision making process, what relative advantage do electric vehicles provide over existing vehicles in terms of carbon emissions? Are the arguments in their favour simple or complex?

While the well-to-wheel concept works for some people, and CO_2 or particulate emissions may be the concern of others, all of this is taken in the context of the fuel supply and in the back of the minds of some people, there is a coal fired power station pumping out emissions to power an electric vehicle.

A coherent argument with limited jargon and worse case scenarios in terms of fuel mix could help to concentrate minds on the green credentials of electric vehicles.

Other questions within this area

- Will we need to generate more energy to meet the increased demand from electric vehicles? Shouldn't the first step toward a low carbon strategy be reduced demand for energy?
- How will electric vehicle rollout affect grid loading?
- How will consumers react to being incentivised to charge at times when low carbon capacity is available on the grid?
- Will the economy be affected by the loss of jobs in the petroleum industry? Both from refining and petrol station redundancy?

What changes will be needed to the way users plan their journeys and to driving styles?

Due to limited range, for the immediate future, electric vehicles will to a large degree form part of a multi modal chain for long distance journeys. This will impact on public transport which may already be overcrowded, and will require additional consideration in journey planning. Where users plan their journey and set off, yet need to change the destination part-way through, there may be implications where they find the destination is now out of range.

Drivers will also have to adapt their driving and behavioural styles, from remembering to charge (and remembering how long it takes) right up to the use of in-car systems which can vary depending on weather conditions.

These changes that drivers need to make, can give the impression that electric vehicles rather than being a step up from conventional vehicles are more of a step down. Coupled with 21st Century expectations of instant access, electric vehicles may be perceived as a bottle neck to productivity and more of a leisure pursuit.

On three of the decision making factors (relative advantage, compatibility and simplicity) when looking at the issue of journey planning and driving style, electric vehicles do not currently appear to meet the grade. How will society accept a change to electric vehicles given their perceived weaknesses within the field of range and being nimble? What can be done to influence perceptions?

Other questions within this area

- When will current government incentives run out, and how will this affect the future running costs? How will the government plug the gap in tax revenue as electric vehicles increase?
- Will home and vehicle insurance have to be combined?
- How easy will it be to switch between driving styles, should the need arise to drive a conventional car?

Charging and paying - how will users pay for electricity use?



In urban areas, electricity coverage is near universal, this has often been touted as a positive thing for electric vehicle take up as it allows cars to be charged either through installed street charging points, in the home, in parking bays at shopping locations, at the homes of others, internationally and at work. Yet, with electricity payment managed on a per location basis, this rigid payment infrastructure must be adapted to cope with a mobile user of electricity.

The current solution, payment cards for charging points and home charging paid through electricity bills, both present their own problems. Charging points are developing on a regional rather than parallel basis and users require access cards for each network, electricity bills are generated sometime after the event which doesn't enable effective use management.

When we factor in charging at other locations such as work and internationally, the problem is magnified and very quickly the relative advantage of widespread electricity coverage is diminished by the complexity of paying for use.

Other questions within this area

- How will electricity be paid for? On a fixed price per kilowatt? On a variable price depending on the charge type (fast-charge, full-charge)?
- How quickly will SatNav companies be able to include the location of charging points in their software as they come online?

Batteries - how will changing technology affect my purchase?

Arguably, the most important part of an electric vehicle is the battery, rather than the motor. This increased criticality of the battery is offset by the flexibility of it; batteries can be upgraded, interchanged and shipped separately to the vehicle. This flexibility can however lead to complexity.



Different manufacturers have different approaches to battery supply, some have suggested that batteries may be leased as part of the vehicle, others that the battery will be sold as part of a complete package or even sold separately to the vehicle. These different models may cause uncertainty for consumers.

If batteries are to be sold separately either at the outset or in the future, will we see standardisation across OEM's (much like

the AA/AAA model for smaller battery applications)? Of equal concern is what happens when an upgraded battery becomes available, under a leasing arrangement upgrading may be easier than the cases where the battery comes complete as part of the unit. This complexity of choice, may be an Achilles heel at the outset of electric vehicle rollout.

Other questions within this area

- What happens when the efficiency of a battery starts to degrade noticeably?
- Will users be able to change rather than charge batteries at stations?
- How will the unit cost of a vehicle be calculated, and how will users be able to calculate a future resale value?
- Will batteries be made in the UK? If so how will we balance raw material supply and skill requirements?
- Will the battery have a separate warranty?

How will charging connectors impact on the existing housing stock?

Perhaps the most important requirement for electric vehicles will be the need for them to work 'out the box'. For this to happen there needs to be a common set of standards for the installation of home charging points, and also standardisation for the plugs to connect to both charging points and home charging points.



Coupled with this, there will be implications for the upgrade of existing housing stock to allow users to charge their vehicle at home. In particular, where no secure parking exists, such as with flats, users will need secure solutions for vehicle charging

Electric vehicles are often sold with the label 'they are not for everyone' when confronted with the question of whether or not they are suitable for those living in flats and no off-street parking, but that message will not be satisfactory as adoption rates rise. This area scores low on the compatibility and trialability factors, because significant steps have to be taken by the user to accommodate electric vehicles into their lives.

Other questions within this area

- Will electric vehicles change the way districts and communities are built?
- Health and Safety is a large issue, and whilst quieter cars are desirable in urban areas, pedestrians will need to rely less on sound for safety. How this be balanced?
- How will cars and connectors be kept secure when charging in public places?
- Are electric vehicles as sturdy as conventional cars? What changes will be required for MOT/service schedules?

Conclusion

What society knows and what we think society knows about electric vehicles are two separate things. A coherent evidence base needs to be built up to allow rebuttal of incorrect claims being made about electric vehicles, in conversations which take place far beyond technical conferences. These are the conversations which matter, the ones where opinions are developed, challenged and former in consumer's mind, and as we approach the early adopter stage, opinions will start to develop more rapidly.

This briefing highlights some of the initial questions being raised by society as it analyses the lifestyle implications of electric vehicles. The aim is to reach consensus on the importance of these issues and in subsequent stages of this process the IET will help to assess, through scenario planning and gap analysis, where more information is needed to help with the decision making process.

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[1] Based on several studies, but made popular in Diffusion of Innovations by Everett Rogers, first published 1962



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