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Article (Published Version)

Transport Policy 59 (2017) 165–173

Contents lists available at ScienceDirect

Transport Policy

journal homepage: www.elsevier.com/locate/tranpol

Imagined people, behaviour and future mobility: Insights from visions of electric vehicles and car clubs in the United Kingdom

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ARTICLE INFO

Keywords:
Electric vehicles
Car clubs
Futures
Visions
Imagined public
Mobility

ABSTRACT

This study focuses on imagined futures of personal mobility in the United Kingdom in the context of the need to reduce greenhouse gas emissions from transport. Focusing on two innovations, electric vehicles and car clubs, the study investigates how people, behaviour and mobility are imagined in a range of visioning documents about the future up to 2050, a timeline that is critically important for emission reduction targets. We find that people are imagined primarily as consumers in line with the rational actor paradigm, with many visions focusing on low-carbon vehicles as a sustainability solution. This simple technological substitution vision does not play to the strengths of electric vehicles, and diminishes their transformative potential. There are fewer car club visions; these show less car ownership, but retain high mobility and an economic growth perspective. Our findings support the idea that much future mobility visioning is used to support the status quo, rather than to explore a variety of futures with diverse portrayal of people, behaviour and mobility.

1. Introduction

How personal mobility is imagined is an important and topical debate, tying into discussions about greenhouse gas emissions and sustainable development, as well as technological innovation, economic growth and energy security. Growing pressures over road transport's contribution to anthropogenic climate change are compounded by concerns over air pollution and road congestion.

In the United Kingdom (UK), cars became the dominant mode of travel in most people's lives after World War II. Practices, landscapes, institutions, knowledge and cultural representations centred on the privately owned car, collectively making up *automobility* (Sheller and Urry, 2000; Schwanen, 2015a), came to dominate surface transport. However, since 1990 the use and private ownership of the car have stabilized and even declined, particularly among younger generations and in cities (Goodwin and Van Dender, 2013). How significant this 'peak car' phenomenon will be in the long term is not yet clear. On the one hand, systemic change is difficult to achieve because numerous path dependencies in terms of land use, policy, finance, expert knowledge, and people's practices and emotions trap the UK (and the Global North more generally) into continued reliance on the private car (Schwanen, 2016). On the other, there are a range of innovations that could reduce greenhouse gas emissions and that may durably reconfigure automobility, driving a systemic shift towards more environmentally and socially sustainable mobility in the future. Examples include technological innovations such as alternative power trains, including battery electric vehicles and plug-in hybrids, hydrogen vehicles and biofuels, all with the potential to greatly reduce fossil fuel use.

Other key innovations are social and institutional in nature and relate to, for instance, product-to-services shifts and the integration of information technology into mobility. At the intersection of the last two sit various forms of car sharing, including car clubs – short-term, membership-based rentals provided by a for-profit firm or not-for-profit organisation. Analysis suggests moving towards sustainable personal transport requires a combined strategy of technological improvements and demand side management, such as addressing transport mode usage, trip length and trip generation, although such a package is often seen as politically challenging (Potter, 2007; Marsden et al., 2014).

With many potential innovations and cultural shifts, visions about the future of personal mobility are very much dependent on normative assumptions about modal choice. While there are many studies about how new powertrains and other innovations might diffuse under a range of economic and institutional conditions (e.g., Shepherd et al., 2012; Straw and Rowney, 2013), there are far fewer that critically reflect on how

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http://dx.doi.org/10.1016/j.tranpol.2017.07.016
Received 8 July 2016; Received in revised form 18 July 2017; Accepted 24 July 2017

visions about the future of personal mobility are constructed and how users are imagined. Here "users" are those individuals who use a car as driver or passenger to satisfy their transport needs. The term is closely related to "consumers" but not identical; the latter is used in this paper to denote users when they purchase goods and services, such as vehicles or access to a car provided by a car club, in a market setting.

A relevant exception to the trend of downplaying the role of users is a recent study (Ryghaug and Toftaker, 2016) that examines how users are imagined in visions about the future of electric vehicles (EVs), constructed by a range of stakeholders from the car industry and government in Norway. The study found that stakeholders loosely divided people into groups by the likelihood or timing of EV adoption, and emphasized 'learning-by-doing', for example leasing an EV to convince potential users to buy one. Consumers were generally portrayed as rational actors concerned with cost; however, early adopters were considered to be of the most interest, and were portrayed as environmentalists, idealists and enthusiasts who were less concerned with cost and performance. This exercise offers insight into the imagining of (potential) users as consumers segmented by if, when and how they might be persuaded to purchase and use an EV. It follows the common practice in the literature on innovation diffusion inspired by Rogers (1995) to identify segments of imagined users in a sequential manner, from 'innovators' and 'early adopter', through early and late majority to 'laggards'. Most diffusion literature, however, does not explore how such frames or categories came to be cognitively constructed, nor does it tend to adequately capture the complexities of energy and climate choices (Stern et al., 2016).

Our study complements and extends the above work by critically examining how future visions of personal mobility are constructed. By investigating future-exploring documents by diverse and different stakeholders, it aims to identify how the future is imagined in terms of people, behaviour and personal mobility. The study is mostly descriptive in nature, seeking to portray the expectations and often unstated assumptions articulated in the examined documents. However, it is also inevitably normative in places, for instance when it assesses the observed portrayals. Different types of documents are identified in the literature, such as forecasts, which extrapolate from current trends; pathways, which look at possible routes to a (desirable) endpoint; and *visions*, or explicitly normative elaborations of desirable futures (e.g., Mcdowall and Eames, 2006).

In this paper, we take the position that *all* imagined futures are normative, as they inevitably make assumptions about the future in terms of behaviour, technological and economic development, and more. Even documents which intentionally focus on plausible futures tend, for the most part, to choose futures with assumptions that incumbent stakeholders consider desirable, such as continued high use of private vehicles; less desirable or (politically) more difficult futures with reduced car use are ignored or portrayed as implausible. The line between plausibility and desirability, in other words, is rhetorically porous. We therefore consider dichotomies between 'plausible' and 'desirable' futures less useful, and refer to all imagined futures as *visions*, and all the documents we study as *visioning documents*. Many of the documents contain different *scenarios*, i.e., narratives of trajectories in the future following specific assumptions about policies, prices, technological advances or other events. Scenarios can include *projections*, quantitative predictions about the future, e.g., in terms of EV numbers on the road or their percentage among private vehicles.

Given the current dominance of automobility, the study focuses on two innovations in private car technology, ownership and use: EVs and car clubs. EVs are arguably the automotive industry's 'winner' in the low-carbon vehicle technological innovation race (Bakker and Farla, 2015; Sovacool, 2017), and are prominently featured in the UK Government's new Industrial Strategy Green Paper (HMG, 2017). They offer technology-driven reduction in greenhouse gas emissions, whilst potentially continuing the dominance of private vehicle ownership. In contrast, car clubs are a fairly successful niche, with nearly 200,000 users, mostly in London (Steer Davies Gleave, 2015), that challenges some of the basic assumptions of automobility by severing the link between functionality and ownership. They offer a cultural and behavioural shift that potentially forms part of an emerging mobility services paradigm.

Between these two innovations, both technological improvements and the more challenging management of demand are considered; they are qualitatively different in institutional make up, drivers, and perceptions, allowing for a broader, more informative investigation of how future (more sustainable) mobility systems are imagined. These specific innovations are clearly distinct from recent developments in public transport, cycling and 'smart' mobility (including connected and autonomous vehicles). However, given that both (hybrid) EVs and car clubs have been around as alternatives to the still hugely popular, individually owned ICEV (internal combustion engine vehicle) for more than a decade, they are also cases from which wider lessons about the relationships between visioning and innovation in personal mobility can be drawn. We note, however, that we found far fewer documents focusing on car clubs, which also reflects a lacuna within UK research on transport by academics and researchers in non-university settings alike. While our original intention was to use the two equally in our research, we made EVs our main case study, using car clubs as a counterpoint to highlight implicit and explicit assumptions about transport futures.

We have chosen to investigate the UK for multiple reasons. Pragmatically, it was where the project's research team are based and funded. But beyond that, the UK is the sixth largest economy in the world (Giles, 2016), and is in the top fifteen in terms of national CO_2 emissions (Boden et al., 2015). The UK is also in need of more efficient, low-carbon transport systems, given that transport accounts for roughly 25% of national CO_2 emissions, approximately 2/3 of which comes from cars and vans (CCC, 2014). Focusing on the UK is also useful due to several differences in automobility and transport policy between it and other North-West European countries, including Germany, France, the Netherlands and Denmark. For instance, national government remained longer committed to road building (until well in the 1990s) and privatisation and deregulation have affected (public) transport to a greater extent than countries on the continent (Shaw and Docherty, 2013). In addition, despite devolution and localism, central government (the Department for Transport and the Treasury) remain very influential in transport policy in large parts of the UK, especially outside London and Scotland (Mackinnon et al., 2010; Mackinnon, 2015; Schwanen, 2015b). Lastly, while studies like Levidow and Papaioannou (2013) suggest the importance of visions and imaginaries for innovation processes in personal transport, there have so far not been any studies that have systematically analysed visions on future mobility in the UK.

We turn next to look at the importance of visions and imaginaries, and how they frame users, before detailing our own research design, then move on to results and analysis and a final discussion.

2. Background

2.1. Visions and imaginaries

In innovation studies there is now a well-established literature on visions of the future highlighting their generative potential. Visions, and the expectations they articulate, can motivate engineers and designers to initiate projects (Van Lente, 1993), be used to attract financial support for research and innovation (Fujimura, 2003), and raise interest from a wider range of stakeholders into a particular innovation, and thereby increase the legitimacy and uptake of innovations (Schot and Geels, 2008; Geels and Verhees, 2011). In fact, Ruef and Markard (2010) have argued that actors associated with a particular innovation might strategically inflate expectations or technological promise to attract resources and attention. This over-optimism can lead to a period of *hype*, during which attention (from media and the public) and expectations peak. Rather than being some latent or unintended side effect, visions and expectations are a key part of the process of technological innovation (Van Lente and Rip, 1998, Brown et al., 2000; Borup et al., 2006;

Hultman, 2009; Sovacool and Brossmann, 2014).

Future visions can also become accepted so widely that they start to function as 'sociotechnical imaginaries' or "collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology" (Jasanoff, 2015, p. 6). Sociotechnical imaginaries evolve over time and also compete with each other, and they can affect innovation processes, not at the level of individual projects and initiatives, but at the more aggregated level of an innovation pathway. For example, in a study on innovation and bioenergy in the UK, Levidow and Papaioannou (2013) consider links between imaginaries and specific innovation pathways. Their major imaginaries include 'oil substitution', in which fuels resulting in lower carbon emissions replace oil; electric cars, hydrogen fuels cells and biofuels are among the pathways considered. This evolution and competition highlight how visions must be credible, not only desirable, if they are to be successful imaginaries. Berkhout (2006) suggests effective visions achieve the right balance between utopia (desirable) and realism (plausible) through realistic strategies and tactics, and are – at least potentially – open to new entrants. It follows that a sociotechnical imaginary of a future in which automobility remains dominant, but with low carbon vehicles, cannot be easily reduced to either 'desirable' or 'plausible'.

2.2. Imagining users and behaviour

Visioning documents make various assumptions about the future and about the nature and behaviour of users of innovations. In the context of sustainable development, and especially when rapid technological change is required, "technology promoters have much to gain by having 'the public' on-side rather than resistant to innovation" (Walker et al., 2010, p. 931). While public engagement is an option, in technology, industry and policy circles an *imagined public* is also invoked, with presumed voice and subjectivity (Burningham et al., 2007; Walker et al., 2010), i.e., decisions are made with an imagined public response in mind. How the public are imagined can significantly shape innovation trajectories in visioning exercises. For example, if purchase is key, people might be imagined primarily as consumers (Burningham et al., 2007; Walker et al., 2010).

In the transport context, imagined publics tend to be portrayed as 'universal individuals' (Skinner et al., 2007), sometimes segmented into a number of groups (of interchangeable individuals). This is in line with reviews of transport models and philosophy (Timms, 2008; Banister et al., 2011), which suggests that for the past several decades transport modelling has been dominated by *methodological individualism*, focusing on representation of people as rationally acting individuals. This approach states that society can be fully explained in terms of the actions of individual actors, where "systems are little more than the sum of their parts and that their dynamics are reducible to accounts of the behaviour of their constituents" (Banister et al., 2011, p. 260), with the consequence that "system dynamics equal aggregations of the behaviour of lower-level units within systems" (Banister et al., 2011). This approach and has long been criticised for ignoring structural and cultural constraints (e.g., Dowding and Hindmoor, 1997). Furthermore, despite decades of academic research on the close linkages between travel, time use and longer-term decisions about residential location and car ownership within households and over individuals' life-course, transport behaviour remains widely imagined in the realms of policy, industry and the media as a collection of independent *choices* made by individuals, from daily travel to car purchase (Doughty and Murray, 2014).

A key question about the future of personal mobility is whether it is with or without personal vehicles (Stephenson et al., 2014). Much academic literature assumes that private car ownership will remain important and that ULEVs (ultra-low emission vehicles) will be of key importance in reducing transport's greenhouse gas emissions. A large number of studies have therefore focused on how consumers' purchase of alternative fuel vehicles (AFVs) can contribute to reduced emissions (e.g., Mabit and Fosgerau, 2011; Sierzchula et al., 2014; Braz da Silva and Moura, 2016; Hackbarth and Madlener, 2016). In studies of this kind publics tend to be imagined as rational consumers.

This framing can also be found beyond academia, for instance in government, industry and the media. A study of how electric vehicles (EVs) have been portrayed in Finland (Temmes et al., 2013) found that among actors in government, industry and the media an economic discourse dominated over ideas of social embedding. EVs were constructed either as a business as usual option or from a rational consumer perspective. Similarly, the representatives from government, the automobile and energy industries, NGOs and interest groups in Norway who participated in Ryghaug and Toftaker (2016) study understood users mainly as rational consumers concerned with cost. However, 'range anxiety' was also believed to be a major concern, but seen as an *irrational* fear, a psychological barrier that would disappear with experience. Such tensions between assumptions about behaviour highlight the need to unpack how users and behaviour are imagined in visions.

3. Research design

The discussion above indicates that many assumptions about the public and its behaviour are being made in visions of the future of personal mobility, both in academic research and – crucially – in the realms of policy and industry. Given that visions play a key role in innovation processes, those assumptions can have potentially significant effects on transition dynamics. This is particularly so when visions coalesce into sociotechnical imaginaries and when, as the multilevel perspective on sustainability transitions (e.g., Geels, 2012) suggested, innovations originating in protected niches are scaled up to durably reconfigure the prevailing system of automobility. Put another way, a niche is not necessarily a marginal innovation, but one with emergent or transformative potential.

While a few studies have begun to unpack the assumptions undergirding visions of the future of personal mobility, there is a need for further analysis. Research should systematically examine how the public, behaviour and mobility and their interrelations are imagined in future visions. Comparative research that considers different innovations – not only electric vehicles – and visions produced by different stakeholders in a specific territory over an extended period of time can be particularly effective in this regard. Our analysis for the UK seeks to provide that systematic and comparative perspective, by focusing on the two innovations discussed – EVs and car clubs. This section details our document selection and analytical approach.

3.1. Document selection and content analysis

We look at visioning documents prepared by, and on behalf of, a range of stakeholders in the UK transport sector, including government, industry, consultancies and transport coalitions. We chose documents published in 2002–2015, a period which saw a rise in the perceived need for low carbon transport (Banister et al., 2011) and a certain hype over EVs (and hydrogen-fuelled vehicles) (Geels, 2012). We selected documents that explicitly discussed EVs or car clubs, even if this was not their main focus, and contained projections about the mid-term future (2020s through 2050s), a period long enough for a socio-technical transition in personal mobility to unfold (Geels, 2012), and a time horizon with great emission reduction targets. We identified approximately 40 relevant documents through searches of the websites of well-known organisations (DECC, RAC, CarPlus, etc.), references in documents and academic journals, and suggestions from colleagues. We found far more documents that discussed EVs' role in the future than car clubs', with technological innovation a very common theme in future transport discussions, and EVs among the most commonly discussed technologies. This search is unlikely to have been exhaustive but gave a wide enough range of perspectives for analysis.

After initial screening, the set of documents was reduced to a more manageable 20, listed in Table 1. We believe these sufficiently cover the range of political, technological, economic and behavioural assumptions and perspectives found in identified documents without too much repetition, and which were suited to in-depth textual analysis. We tried to choose the most useful documents from different bodies. For example, we used a report (Straw and Rowney, 2013) by the Institute for Public Policy Research (IPPR), which focuses on whether the UK can become a leader in manufacture and domestic use of ULEVs, with the main thrust on plug-in vehicles, including EVs. We rejected an earlier (2011) report by IPPR on decarbonising road transport, as it had less original material to offer. When choosing documents from the Committee for Climate Change (CCC), we found the 2010 and 2013 documents different enough for interesting analysis, but did not select reports published in between. Finally, some documents did not sufficiently discuss imagined futures. For example, the Enevate project (see www.enevate.com) focused on accelerated introduction of electric mobility, including use of EVs in car clubs. However, the multi-national project had a limited focus on the UK, and its reports focused on the pilot programmes it launched, without a clear vision of the future.

In total, three documents focus explicitly on EVs and four on car clubs. The majority focus on low emission vehicles, the transport sector as a whole, or on energy futures of the UK economy. These wider studies address technological innovation, including EVs, much more than non-technological change, portraying low-carbon vehicles as the main route to transport emissions reduction; only a few mention car clubs, usually grouped with behaviour change as complementary action. This shaped our research, leading to a main focus on EVs, with car clubs offering a counterpoint by highlighting the agendas and assumptions of the EV-focused visions.

The documents we used also show a variety of methodologies and approaches. Several held workshops, consultations, interviews or similar stakeholder engagements (documents 1, 5, 9, 10, 12, 19, 20 in Table 1). The stakeholders most engaged were from the automotive industry, with government, energy sector, trade associations and other (mostly incumbent) actors also engaged. Fewer studies engaged with consumers, although two relied on surveys of users or consumers (3, 11). Some documents focused on reviewing and analysing previous research (7, 8, 12, 13, 18). Several studies involve quantitative modelling exercises (2, 3, 6, 11, 15). Others focus on constructing plausible scenarios under different assumptions (16, 19, 20).

3.2. Hybrid coding

Our analysis consists of a 'hybrid' coding approach. It combines *a priori* coding, focused on perceived drivers and barrier for innovations, assumptions about mobility and behaviours, policy recommendations, and projections for the future, combined with a grounded approach, where we looked for themes, narratives and frames (such as 'technological neutrality' and presumed continued car dependence) emerging from the documents themselves.

We loosely follow the methods of Boyatzis (1998) in developing a quality code. For example, in coding for *barriers*, we define a 'barrier' as something which prevents or delays development or uptake of an innovation, e.g., would lead to their being fewer electric vehicles on the road at some point in the future. We then identify 'barriers' in the texts either through explicit use of the word, or through indicators – descriptions of political, infrastructural, economic, technical, cultural or behavioural issues, which the text explicitly describes as causing possible delays or reducing uptake, or preventing and slowing technical development. We carefully exclude innovation issues which are not 'barriers', e.g., difficulty in reducing the carbon intensity of the electric grid might reduce the sustainability of EVs, but it is *not* a barrier to EVs, unless the text explicitly describes this as an issue which might reduce the development or uptake of EVs.

We primarily focus on quantitative content analysis, recording specific words, topics and issues in the text, e.g., listing explicit barriers described in the texts and minimising interpretation (Neuman, 2005; Neuendorf, 2002). However, some qualitative analysis is used, considering the tone and context of the texts to infer agendas and ideologies underlying them (Newbold et al., 2002), for example, in how the public is perceived or imagined – as active or passive users, stakeholders, knowledge providers, etc. In this paper, we draw on this analysis to explore how (and why) visions of the future imagine people, their behaviour and personal mobility in general.

Table 1
Final sample of literature depicting future visions of transport in the UK.

	document	year	produced by *(& for)*	focus	time horizon
1	Developing Car Clubs in Scotland (Ball, 2010)	2010	Richard Armitage for Transform Scotland Trust	car clubs	2015 (& 2027)
2	Car-sharing in London – Vision 2020 (Frost and Sullivan, 2014)	2014	Frost & Sullivan *for Zipcar*		2020
3	A new approach to predict the market … carsharing systems: Case study of London (Le Vine et al., 2014)	2014	Le Vine et al. (academic publication)		no timeline
4	A Car Club Strategy for London (Car Club Coalition, 2015)	2015	(members of the) Car Club Coalition		2025
5	Scope for the Transport Sector to Switch to EVs and PHVs (BERR and DFT, 2008)	2008	Arup and Cenex for BERR and DfT	EVs	2030
6	Market outlook to 2022 for BEVs and PHEVs (Hazeldine et al., 2009)	2009	AEA for CCC		2022
7	How to Avoid an Electric Shock: Electric cars: from hype to reality (Dings, 2009)	2009	Transport and Environment		2050
8	Market Delivery of Ultra-Low Carbon Vehicles in the UK (Lane, 2011)	2011	Ecolane for RAC Foundation	ULEVs	2020, 2030
9	Leading the Charge: Can Britain develop a global advantage in ULEVs? (Straw and Rowney, 2013)	2013	Institute for Public Policy Research (IPPR)		2030, 2050
10	Pathways to Future Vehicles: A 2020 Strategy (EST, 2002)	2002	EST (TransportAction) *for UK Government*	road transport	2020
11	Passenger car market transformation model (EST, 2007)	2007	Element Energy and Ricardo Ltd *for EST*		2020
12	The King Review of low carbon cars: Part I (King, 2007)	2007	Julia King for UK Government		2030, 2050
13	The King Review of low carbon cars: Part II (King, 2008)	2008	Julia King for UK Government		2030, 2050
14	Powering Ahead: The future of low-carbon cars and fuels (Kay et al., 2013)	2013	Ricardo-AEA Ltd for RAC Foundation & UKPIA		2050
15	Fourth Carbon Budget: Reducing emissions through the 2020s (CCC, 2010)	2010	CCC for UK Government	UK economy	2023–27 (& 2050)
16	The Carbon Plan: Delivering our low carbon future (DECC, 2011)	2011	DECC for Parliament		2050
17	Fourth Carbon Budget Review: technical report (CCC, 2013)	2013	CCC for UK Government		2050
18	Meeting Carbon Budgets–2014 progress report to parliament (CCC, 2014)	2014	CCC report to Parliament		2027, 2030
19	Future Energy Scenarios: UK gas and electricity transmission (National Grid, 2015)	2015	National Grid	gas & electricity	2020,50
20	Intelligent Infrastructure Futures: The Scenarios – Towards 2055 (Curry et al., 2006)	2006	Foresight Programme	futures	2055

4. Results

This section presents our results, starting from how people are imagined in visions about the future of EVs, car clubs and transport more widely. We then consider how human behaviour is interpreted and modelled in those visions, and finally discuss the broader question of imagined mobility and the narratives and agendas underlying these visions.

4.1. Imagining people

Despite some variation across the examined documents, there were strong similarities in how people tended to be imagined. First, in nearly every vision people are constructed as independent individuals who make their own choices. In other words, personal transport is considered in terms of individual people – or households – and their attitudes, behaviours and choices. As discussed in Section 2.2, this type of methodologically individualist analysis prevails in transport modelling and assumes nothing is lost in analysing transport through individuals over collective approaches.

Second, in most of the documents people are imagined mainly as users in the context of increased uptake of an innovation in the future. There is some consideration of people as subjects whose behaviour affects sustainability (primarily through uptake), but little thought of the public as stakeholders, knowledge providers, or partners in shaping the future. While many documents consulted stakeholders from business, industry and elsewhere, only two (Le Vine et al., 2014; EST, 2007) used primary research of people's opinions via user surveys. Only one document (Lane, 2011) called for including user voices in the innovation process, including an ULEV users' forum; yet even here the primary focus remained on user uptake.

Third, many of the documents, especially those with a focus on EVs or ULEVs more generally, imagine people as roughly identical, interchangeable users. When heterogeneity is acknowledged, it is usually in the form of population segmentation (into groups of interchangeable individuals) with calls to "*address the differing priorities of the innovation adoption segments*" (BERR and DFT, 2008, p.58). These segments loosely follow the sequential innovation diffusion model advanced by the likes of Rogers (1995), in which the innovators and early adopters are those who have already purchased EVs or joined car clubs, or are likely to do so soon. This segmentation focuses on the order of adoption (with consideration on how to support uptake for each segment) but not on heterogeneity of use or needs. Recent research on population segmentation (e.g., Brand et al., 2017) emphasises heterogeneity more, highlighting how EVs are more attractive to population sub-groups for reasons including upfront and running costs, variety of car types and brands, image and charging issues.

Several ULEV-focused documents show an explicit interest in serving a heterogeneous public. This is done by suggesting that a broad range of brands and models of EVs are required for different preferences and needs (CCC, 2014); modelling a variety of (rational) consumers with different preferences for vehicle attributes (EST, 2007); or using population segmentation to identify potential for behaviour change and define policies accordingly (King, 2008). However, the emphasis is on consumer choice and the need for EVs to replace ICEVs through mirroring existing choices and brand loyalty, rather than an analysis of different vehicles for different needs. The underlying assumption is that "*new technologies will only succeed commercially if consumer expectations of range, comfort, safety and speed continue to be met*" (King, 2007, p.44). In this particular framing, EVs need to mimic ICEVs and are to be sold as a technological substitute, minimising required institutional, infrastructural and behavioural change. This framing is premised on an implicit understanding of norms and practices as fixed and independent from technological artefacts, whereas actually norms, practices and competencies change and co-evolve with such artefacts (e.g., Shove, 2004). In other words, EVs mimicking ICEVs is portrayed as the only *plausible* way for them to succeed; but this portrayal is, in fact, limited and limiting. This framing does not play to the strengths of EVs, which are forced to compete on ICEVs' terms. Nor does it explore the full potential of electrified transport, which extends to a decentralised, smart grid with vehicle-to-grid elements, as well as electric bicycles, buses and mobility scooters.

Car club focused visions, notably, imagine a more heterogeneous public. For example, one London study forecasts the potential car club market by neighbourhood, considering income, education, age distribution, population density, public transport accessibility and car ownership per household (Frost and Sullivan, 2014). Another document draws on a stated-choice survey to model a population with varying parameters around ownership of car, bicycle or public transport seasonal ticket, and strategies regarding joining a car club, as well as individual journey choices (Le Vine et al., 2014). The need to invoke a more varied public might be the result of framing car clubs as part of a wider, integrated transport system, rather than a single, system solution; i.e., car clubs are not the solution for all people, so envisioning a variety of solutions for a heterogeneous population helps support their case.

4.2. Imagining behaviour

In the documents that have considered the behaviours of individuals, adopters and users are constructed in narrow terms, with rational economic actor models prevailing. In other words, people are primarily imagined as consumers whose transport behaviour is a set of choices that maximise their utility. It is also assumed that driving a car will remain the norm. Even the most recent documents take little to no account of peak car, which has been on the radar of the UK's Department for Transport since 2005 (Noble, 2005) – predating the large majority of the analysed documents.

People's vehicle purchases are assumed to follow rational actor models in most EV- and ULEV-focused documents, most prominently in those written by or for Government. Specifically, there is a perceived need to understand the low level of EV penetration when the theory suggests purchasing an EV would be the rational choice. Low uptake is most commonly interpreted as consumers weighing high upfront prices of EVs over their low running costs, i.e., having 'high discount rates' on vehicle purchase. Some documents call this behaviour 'sub-optimal' (King, 2008) or 'myopic' (CCC, 2010), or even suggest consumers need education about whole life cost (BERR and DFT, 2008), as "*people tend to discount heavily (or not take into account) future cost savings from fuel economy at the time of purchasing a car, even though it would seem to be in their own interests as well as those of the environment*" (King, 2007, p. 57). This imagining has a financial focus and comes with the assumption that increased EV uptake can be achieved through shorter payback times or reduced upfront costs. It induces a search for new business models: government and industry are encouraged to develop and support battery leasing and other new financial arrangements to reduce upfront cost, because these "*better align the time profile of costs and benefits from electric car purchase*" (CCC, 2010, p. 165).

There is ample support in the academic literature for the idea that financial factors play an important part in the uptake of EVs (e.g. Tran et al., 2002; Axsen et al., 2016). Evidence from Norway – global leader in EV market share (IEA, 2016) – suggests that fiscal measures and direct subsidies have been a critically important factor, but also that they are on their own insufficient to accelerate EV uptake (Figenbaum et al., 2015). Stimulating EV diffusion requires a package of policy measures that considers other sociotechnical and behavioural elements, which we will touch upon later in this section.

On the other hand, two of the documents in our sample prepared by the consultancy firm AEA explicitly mention that both car manufacturers (Hazeldine et al., 2009) and recent research (Kay et al., 2013) suggest consumer behaviour in vehicle purchase simply does not follow the rational economic model, implying that reducing upfront costs does not guarantee uptake. Nonetheless, they repeat the 'heavy discounting' argument, adding that consumers value minor benefits that do not accrue

significant financial savings; they do not offer alternative behaviour theories for vehicle purchase. Another consultancy firm study (Lane, 2011), commissioned by automotive services company RAC, criticises the focus on cost and fuel efficiency, highlighting how car symbolism (status, identity, etc.) can override economic rationality.

Drawing on rational actor models, many documents analyse behaviour in terms of barriers and incentives to purchase. Common assumptions in the documents are that consumers lack knowledge or awareness of EVs (or car clubs), or of their longer-term (financial) benefits, and that they take time to respond to new technologies, being biased towards the familiar. This leads to conclusions that increasing uptake requires increasing public awareness through marketing and other interventions (Car Club Coalition, 2015; CCC, 2014; Lane, 2011). In other words, behaviour change can be achieved through 'educating' consumers (e.g., BERR and DFT, 2008), matching the idea of consumer engagement as provision of information and addressing concerns (Barnett et al., 2012).

A salient example is the conundrum of how to respond to 'range anxiety', people's fear of not being able to charge EVs frequently or quickly enough. Vehicle range is a concern mentioned in nearly every EV-focused vision, with more than two thirds discussing it in the context of consumers' uptake of vehicles. There are broadly two responses: The first emphasises the need to increase battery range, often portrayed as a necessary technological breakthrough if EVs are to succeed. The second focuses on attitude and behaviour change, e.g., studies showing that familiarity with EVs and experience driving them reduces range anxiety. Several of our more recent documents discuss how experience, including driving an EV or other exposure, could reduce range anxiety or more broadly address the technical bias barrier (Kay et al., 2013; Lane, 2011; Straw and Rowney, 2013; CCC, 2014).

While our document sample is not exhaustive, our analysis suggests that while barriers to EVs are seen as a combination of technical, infrastructural, financial and user-related, there is a possible shift in analysis over time, with recent (post-2010) documents more focused on how to increase consumers' uptake. For example, identifying the limited range of models and brands of EVs as a barrier to uptake appears only in some documents from 2010 onwards, suggesting increased confidence in EV technology, and a shift towards enabling a mass market. Lane (2011) asserts that manufacturers are "rising to the challenge", and suggests that the technology is ready for mass commercialisation, leaving the real challenge on the demand side. Moreover, while vehicle range is discussed throughout, the phrase 'range anxiety', which problematises drivers and passengers, only appears in documents written from 2013 onwards. Such a shift might reflect increased confidence in ULEV technologies, and EVs in particular, and perhaps frustration about low uptake. The normative language of meeting a challenge, problematising users, and focusing on barriers to uptake suggests many documents see ULEV-dominated futures as desirable, rather than (merely) plausible.

The separation of technological development from consumer behaviour and demand has been criticised for lacking the socio-technical context in which technological innovation happens and neglecting broader change in society, often leading to overly optimistic predictions of 'technical potential' (e.g., Shove, 1998). It implies limited possibility for systemic change, as visions of technologies developed around users' current practices and behaviour, and consumers reacting only by buying or rejecting new technologies, leave little room for alternative trajectories, such as the full potential of EVs discussed in 4.1. This is a known pitfall of future visions (Geels and Smit, 2000), which assumes social practices are constant over time, when in fact they change, partly due to emerging technologies. Such assumptions imply that keeping practices (fairly) constant in the future is desirable; this matches the idea that for incumbent powerful actors, systemic change is more difficult.

As users' main role is seen as fairly passively adopting new technologies, it is not surprising that there is a focus in several EV or ULEV focused documents on behaviour as a choice of *which car they will buy*, not whether they buy a car or make other changes to mobility practices. Such projections portray plausible futures, but crucially, they limit possible futures to those with less systemic change. This matches arguments that imaginings of the public as rational consumers prevail when purchase is seen as key (Burningham et al., 2007; Walker et al., 2010). For example, the National Grid study (National Grid, 2015) suggests an ambitious society could adopt more environmentally friendly behaviours; but in transport this is interpreted only as buying 'greener' cars. Documents exploring EV penetration perpetuate this narrow behaviour focus: one econometric model (EST, 2007) has consumer choice affect the percentage of different car types sold, while total annual sales and even mileage per vehicle are held constant over time; another varies vehicle types by scenario, but not vehicle numbers (EST, 2002); a third study discusses average car journey lengths in the context of EV range, but not modal shifts or changes to driving patterns (BERR and DFT, 2008). Other behaviour change is also explored, for example through the Smarter Choices policies (Cairns et al., 2004), which encourage rationalisation of car trips (e.g. through switching to public transport). While emphasis and projections vary, such behaviour change is for the most part presented as marginal or complementary to the main (technological) shift, with significant change constructed as difficult, uncertain, or with limited impact. DECC (2011, p. 55) offer one example: "*more people choosing to take public transport, walk or cycle could mean up to a 5% reduction in urban car trips. However, uncertainties around the impact of individual initiatives, and barriers such as convenience, safety and appropriateness to journey, may prevent the highest levels of abatement from being realised*."

Car clubs are seen as part of these 'soft' policies in some EV or ULEV focused documents. However, a few car club focused documents (Frost and Sullivan, 2014; Car Club Coalition, 2015) assume policy intervention, such as raising public awareness, can lead to growth in car clubs and a non-trivial reduction in car travel demand, with 'car-light' lifestyles: "*Car clubs will play an important role in reducing the need to have a car because they offer an alternative to conventional car use models and can reduce habitual car use while still enabling access to a car for essential journeys*" (Car Club Coalition, 2015, p.15). These documents focus on systemic change, experience and habit; they portray 'car-light' futures as desirable and plausible. This does not necessarily contradict the rational actor approach if a broader focus is taken.

4.3. Imagining mobility

The above discussions show mobility imagined with a narrow representation of behaviour change and choice, and of people in general. We suggest that underlying this are powerful discourses that link mobility to economic growth, with great faith in technological progress. Existing patterns of mobility are seen as both an end in itself – a presumed need and right to travel – and a necessity for continued economic growth. Thus, most of the technologically focused documents imagine a desirable future with an ongoing, car-centric, car-owning automobility, as "*road transport underpins our way of life*" (King, 2007). Recent documents ignore the emerging discourse of peak car and rather place themselves in a much longer existing and more powerful discourse that sees jobs and economic growth intimately linked with mobility, particularly road transport. These links are most prominent in the King Reviews (King, 2007, 2008), and also appear in other documents by or for government (CCC, 2010; CCC, 2013; CCC, 2014; DECC, 2011), and in the work of consultancy firm AEA (Hazeldine et al., 2009; Kay et al., 2013). This neoliberal understanding of the links between economy and car-centric mobility is translated into visions of the future that can be defined as business as usual extrapolations of past trends and discourses. Despite this rhetoric, the evidence for investment in transport infrastructure as a means of economic growth is contested and the links are complex (Banister, 2012).

Technological progress is often seen as enabling continued high travel demand and car use, and therefore economic growth, while ensuring energy security and furthering sustainability goals. Such techno-optimism is evident in the documents from statements such as "*[t]echnological progress has been fundamental to furthering the universal objectives of growth and mobility*" (King, 2007, p.8). The faith in technology may also

help to explain why only one document (National Grid, 2015) details future scenarios where the UK's emission reduction targets, which are often portrayed as challenging but achievable through a mix of ULEVs and efficiency improvements to ICEVs, are explicitly missed. Powerful actors in the transport sector have an interest in continuing current trends of development, and this has long been a major barrier to shifting towards ULEVs (Kemp et al., 2000). However, the climate change agenda and emission reduction policies, and uncertainty about long-term oil price developments, might now be strong enough for at least some incumbent actors to consider a purely ICEV-based future untenable, making the technological shift to ULEVs the option most suited to the economic growth discourse.

The analysed documents suggest a shift over time as to which ULEV technology is imagined as the most promising. The earliest document (EST, 2002) is highly pessimistic about EVs and considers hydrogen to be more promising. There is, however, more optimism later: 2009–2010 documents (Hazeldine et al., 2009; Dings, 2009; CCC, 2010) suggest EVs have promise, with rollout depending only on price coming down, although there is also acknowledgement of hype around EVs (Dings, 2009). Some newer visions suggest electrification of some sort is nearly inevitable, with ULEVs here to stay (Lane, 2011; Straw and Rowney, 2013). This shift matches the growing hype over hybrids and EVs and growing disappointment with (hydrogen) fuel cells and biofuels since 2005 (Geels, 2012), and with researchers arguing that the time is right for electric mobility (Dijk et al., 2013) and that the automotive industry has chosen EVs as the 'winner' among low carbon technologies (e.g., Bakker and Farla, 2015). Of the two auto-industry commissioned reports, Ecolane, commissioned by RAC[1] (Lane, 2011), suggests that manufacturers and technology are ready, and now it is all about consumer uptake, whereas Ricardo-AEA, commissioned by RAC and UKPIA[2] (Kay et al., 2013), is the only recent report to still insist that a technology breakthrough is needed if EVs are to reach the mass market. The shift over time shows more documents seeing EV-centred futures as plausible, although this seems to have to do as much with hype around EVs – and disappointment with alternatives – as with technological progress of electrification.

Despite different ideas of the technologies propelling the cars of the future, we find most visions imagine futures dominated by continued automobility. This includes high demand for travel in a car-owning, car-driving culture where technology supplies lower emissions, with limited cultural or behavioural change and limited use of walking, cycling or other non-car modes. Differences between visions are mostly about speed of uptake and type(s) of ULEV that will flourish, not whether motorised transport is desirable. The consistency of these visions over time, and between actors, suggests the existence of a sociotechnical imaginary (Jasanoff and Kim, 2013; Jasanoff, 2015) of future mobility as an incremental continuation of the present (and past).

Nonetheless, there are alternative discourses of sustainable mobility that move away from techno-optimism and the equation of societal wellbeing with economic growth, giving a much greater role to behavioural change and a more 'flexible' user. Such discourses enable systemic change and non-technical innovation, including car clubs. Indeed, three of the four car club-focused documents show elements of such discourse, presenting a qualitatively different imagined mobility (Ball, 2010; Frost and Sullivan, 2014; Car Club Coalition, 2015), with a more integrated, service oriented transport system. They consider, and draw on, greater changes in society, by suggesting the sharing economy could benefit car clubs; raising questions of equality, with clubs increasing car access for non-owners; and stressing local benefits of car clubs, including reduced congestion and air pollution, and benefits for local economies. These visions assume society would benefit from moving away from private car ownership because reduced ownership will lead to lower car-based mobility levels and increased use of integrated transport. Demand reduction and modal shift are thus seen as integral to reducing emissions. Nonetheless, while current levels of car ownership and travel are not assumed necessary for sustained economic growth in those alternative discourses, there is still an assumed need for access to mobility, and the economic framings remain similar: a reliance on choice means a focus on raising awareness in order to increase membership and overcome barriers to adoption, with attachment to private cars and the difficulty of behaviour change seen as the most significant barriers.

Finally, we note that alternative narratives and approaches do exist, as exemplified by an important outlier among the collected documents, the Foresight work (Curry et al., 2006). It builds scenarios around two uncertainties: whether technological progress will deliver a low-carbon transport system, and whether people will accept intelligent infrastructure. By exploring futures in which people reject technology, or in which technology does not deliver its promised benefits, this work offers an alternative view to the prevalent techno-optimism in which people's main role is the uptake of technology. Questioning the inevitable success of economic growth and technology allows for fundamentally different future scenarios, in which society, economy and transport patterns change significantly, with some scenarios portraying transport as greatly reduced and mostly limited to the local scale; societal change means mobility is no longer seen as a right. Such scenarios might seem outlandish, but they help to expose the business as usual character of the vast majority of imagined futures.

5. Discussion and conclusions

The analysis above supports four main conclusions about how people, behaviour and mobility are imagined in visions of the future of personal mobility in the UK. First, partly in line with previous work, the documents we analysed imagine the public primarily as individual consumers, often framed as rational actors. Consideration is only given to the role of "users" as individuals seeking to fulfil their transport needs by using particular means of transport to get from A to B. Disregarded are other potential roles through which innovations and transitions may be advanced, ranging from the public as protagonists of sustainable lifestyles and political activists to producers of particular kinds of knowledge and to tinkerers or experimenters with new technologies and institutional arrangements.

The point here is not that this may or may not be an appropriate set of assumptions, but rather that diversity and heterogeneity in the ways in which citizens may be involved in innovation and transition processes is not given due consideration. In other words, the imagined futures portrayed might be plausible, but they are only a subset of plausible futures, constrained due to the dominant sociotechnical imaginary, and they certainly fail to include the full range of desirable options. This imagining might constrain, rather than further, diffusion of EVs and transition dynamics more generally.

Second, and following on from the rational actor framing, behaviour change in the analysed documents is portrayed primarily in terms of consumer choice, often limited to modal choice or even more narrowly to vehicle purchase choice. Financial considerations are often seen to dominate choice processes, even though there is ample acknowledgement of 'non-financial barriers', with solutions offered including provision of information and EV driving experience, and even a call for the industry to engage in appropriate marketing. Again, we suggest that rather than opening up behaviour change, this framing may work to limit the many different ways in which user practices can change. There are different possible explanations for this limiting behavioural narrative. One possibility is the perceived difficulty in changing car-based transport behaviour, making it politically easier to focus on technological innovation than consider demand management (Potter, 2007), with ULEVs seen as a "relatively painless form of behaviour change" (Marsden et al., 2014, p.74) that will succeed with the right policies. A more radical suggestion (Marsden et al., 2014) is that individual decision making and

[1] RAC Limited is a British automotive services company.
[2] United Kingdom Petroleum Industry Association.

choice models dominate policy discourse not because decision-makers have faith in their effectiveness, but because of a broader individualist discourse and opposition to significant behaviour change, which is seen as conflicting with the perceived imperative of economic growth; this would be in line with our next conclusion.

Third, we suggest the imagining of people as rational actors making consumer choices is underpinned by traditional and, from a sustainability perspective, problematic assumptions of strong links between economic growth and personal transport, specifically continued high demand for car use. Tensions are apparent between on the one hand, a preoccupation with economic growth and the power of incumbent actors, with the resultant narrowing of transport sustainability to emissions reduction, and on the other hand a deeper sustainability agenda that favours systemic change. To an extent, car club visions offer a counterpoint to the dominant framing. They question one part of the dominant paradigm, the link between car ownership and economic prosperity, and offer a vision of a different transport system, possibly with lower travel, but with mobility intact. This maintains people's right to travel and their access to efficient transport. At the same time, they are quick to suggest economic advantages of their own visions, such as cost savings on transport boosting smaller businesses and therefore local economies, and so remain in keeping with the growth and progress paradigms. The implication beyond the analysed documents is that the construction of future visions transcends actors, being detached from any particular agent. Nonetheless, specific actors can subscribe to multiple sets of assumptions and expectations simultaneously. For instance, some actors may subscribe to 'new' or 'innovative' transport platforms, while still subscribing to the 'older' types of master discourses and narratives. So, non-incumbent actors still risk becoming captured or co-opted by incumbent frames and discursive logics. The inverse can occur as well, with incumbent actors subscribing to more radical and transformative imaginaries.

Fourth, and despite the complexities described above, there is an element of determinism within such visions. The result comes close to the dominance of a single sociotechnical imaginary and effectively implies a fatalistic *la pensée unique* in which 'there is no alternative'. Some scholars have referred to this as 'colonising the future' or relying on 'selective remembrance' by presenting a single vision as if it will indeed become inevitable (Brown et al., 2000; Sovacool and Ramana, 2015). In this simplistic and static future, technological innovation – here in the form of electric vehicles replacing ICEVs one for one – allows a business as usual focus on economic growth by minimising the environmental burdens such growth will cause, while ignoring some of the broader possibilities and implications of electric mobility. Essential to the construction of this imagining of the future is an understanding of the public as a passive and undifferentiated actor performing the single role of the consumer who rationally chooses to adopt and use the technological innovation (cf. Walker et al., 2010). Any other role – citizen, knowledge producer, etc. – would complicate and potentially undermine the coming into being of the business as usual future. The observations that car clubs carry less weight in the examined visioning documents, and that the 'peak car' narrative is overlooked, also become understandable in this perspective: they deviate from the status quo preferred by powerful actors in the transport sector because they challenge the techno-fix and imply a transition pathway of reducing car numbers (and sales).

A contrast to this approach can be found in New Zealand's Ministry of Transport Future Demand project, which considered "How could or should our transport system evolve in order to support mobility in the future?" (Lyons, 2014, p.3). It recommends moving from predict and provide to debating desired mobility futures and providing for them. The report considers the possibility that peak demand has been achieved, and suggests dealing with uncertainty through improving understanding of changing demand patterns – with demand models 'refreshed' accordingly (Lyons, 2014).

By contrast, the consequences of the UK fatalistic view of the future are twofold. Not only does this framing help to reinforce currently prevailing understandings of the relationships between economy, transport, technology and environment; it also legitimises incumbency and incremental change instead of genuinely empowering disruptive innovations and systemic change in the way that might be needed for a sustainable transition (Schot and Geels, 2008; Kemp et al., 2007; Loorbach, 2010). In other words, visions of the future of automobility are, and must be understood, as profoundly political and as conditioned by prevailing power structures.

The analysis in this paper does not allow us to make strong, empirically grounded claims about the generative potential of visions of the future of personal mobility in the UK context; we have not examined how the visioning documents have influenced engineers, finance providers and other stakeholders. We nonetheless observe a paradox: visions of simple technological substitution do not play to the strengths of EVs and – often unintentionally – perpetuate ownership and use of ICEVs as the norm against which any other form of mobility has to compete. The dominant sociotechnical imaginary may diminish the transformative potential of the very vehicles it seeks to promote, by channelling resources, interest and attention away from transition pathways, actors and practices which are not centred on cars or individual ownership. Constructing visions of the future of mobility in which people, behaviours and mobility are portrayed as more diverse and complex than users who make a narrow range of rational choices and thereby contribute to technology-driven economic growth, is not only possible but highly desirable.

Acknowledgements

The comments from two peer reviewers and the editor on an earlier version of this manuscript are gratefully acknowledged. This work was supported by the Research Councils United Kingdom (RCUK) Energy Programme [grant EP/K011790/1, "Centre on Innovation and Energy Demand" (CIED)] and the Danish Council for Independent Research (DFF) Sapere Aude [grant 4182-00033B "Societal Implications of a Vehicle-to-Grid Transition in Northern Europe"]. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of RCUK Energy Programme or the DFF.

References

Axsen, J., Goldberg, S., Bailey, J., 2016. How might potential future plug-in electric vehicle buyers differ from current "Pioneer" owners? Transp. Res. Part D Transp. Environ. 47, 357–370.
Bakker, S., Farla, J., 2015. Electrification of the car – will the momentum last?: Introduction to the special issue. Environ. Innovat. Soc. Transit. 14, 1–4.
Ball, C., 2010. Developing Car Clubs in Scotland. Transform Scotland Trust, Edinburgh.
Banister, D., 2012. Transport and economic development: reviewing the evidence. Transp. Rev. 32, 1–2.
Banister, D., Anderton, K., Bonilla, D., Givoni, M., Schwanen, T., 2011. Transportation and the environment. Annu. Rev. Environ. Resour. 36, 247–270.
Barnett, J., Burningham, K., Walker, G., Cass, N., 2012. Imagined publics and engagement around renewable energy technologies in the UK. Public Underst. Sci. 21, 36–50.
Berkhout, F., 2006. Normative expectations in systems innovation. Technol. Anal. Strat. Manag. 18, 299–311.
BERR and DFT, 2008. Investigation into the Scope for the Transport Sector to Switch to Electric Vehicles and Plugin Hybrid Vehicles. Department for Business Enterprise and Regulatory Reform; Department for Transport.
Boden, T.A., Marland, G., Andres, R.J., 2015. National CO2 Emissions from Fossil-Fuel Burning, Cement Manufacture, and Gas Flaring: 1751–2011. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy.
Borup, M., Brown, N., Konrad, K., Van Lente, H., 2006. The sociology of expectations in science and technology. Technol. Anal. Strat. Manag. 18, 285–298.
Boyatzis, R.E., 1998. Transforming Qualitative Information: Thematic Analysis and Code Development. Sage.
Brand, C., Cluzel, C., Anable, J., 2017. Modeling the uptake of plug-in vehicles in a heterogeneous car market using a consumer segmentation approach. Transp. Res. Part A Policy Pract. 97, 121–136.
Braz da Silva, M., Moura, F., 2016. Electric vehicle diffusion in the Portuguese automobile market. Int. J. Sustain. Transp. 10, 49–64.
Brown, N., Rappert, B., Webster, A., 2000. Contested Futures: a Sociology of Prospective Techno-science. Ashgate Aldershot.

Burningham, K., Barnett, J., Carr, A., Clift, R., Wehrmeyer, W., 2007. Industrial constructions of publics and public knowledge: a qualitative investigation of practice in the UK chemicals industry. Public Underst. Sci. 16, 23–43.
Cairns, S., Sloman, L., Newson, C., Anable, J., Kirkbride, A., Goodwin, P., 2004. Smarter Choices - Changing the Way We Travel. UCL (University College London), London.
Car Club Coalition, 2015. A Car Club Strategy for London: Growing Car Clubs to Support London's Transport Future.
CCC, 2010. The Fourth Carbon Budget: Reducing Emissions through the 2020s. Committee on Climate Change, London.
CCC, 2013. Fourth Carbon Budget Review - Technical Report: Sectoral Analysis of the Cost-effective Path to the 2050 Target. Committee on Climate Change, London.
CCC, 2014. Meeting Carbon Budgets–2014 Progress Report to Parliament. Committee on Climate Change, London.
Curry, A., Hodgson, T., Kelnar, R., Wilson, A., 2006. Intelligent Infrastructure Futures: the Scenarios -Towards 2055. Department of Trade and Industry, London.
DECC, 2011. The Carbon Plan: Delivering Our Low Carbon Future. Department of Energy and Climate Change, London.
Dijk, M., Orsato, R.J., Kemp, R., 2013. The emergence of an electric mobility trajectory. Energy Policy 52, 135–145.
Dings, J., 2009. How to Avoid an Electric Shock. Electric Cars: from Hype to Reality. Transport & Environment, Brussels.
Doughty, K., Murray, L., 2014. Discourses of mobility: institutions, everyday lives and embodiment. Mobilities 1–20.
Dowding, K., Hindmoor, A., 1997. The usual suspects: rational choice, socialism and political theory. New Polit. Econ. 2, 451–463.
EST, 2002. Pathways to Future Vehicles. Energy Saving Trust, London.
EST, 2007. Passenger Car Market Transformation Model. Energy Saving Trust, London.
Figenbaum, E., Assum, T., Kolbenstvedt, M., 2015. Electromobility in Norway: experiences and opportunities. Res. Transp. Econ. 50, 29–38.
Frost, Sullivan, 2014. Car-sharing in London – Vision 2020.
Fujimura, J., 2003. Future Imaginaries: Genome Scientists as Socio-cultural Entrepreneurs. Genetic Nature/culture: Anthropology and Science beyond the Two Culture Divide, pp. 176–199.
Geels, F.W., 2012. A socio-technical analysis of low-carbon transitions: introducing the multi-level perspective into transport studies. J. Transp. Geogr. 24, 471–482.
Geels, F.W., Smit, W.A., 2000. Failed technology futures: pitfalls and lessons from a historical survey. Futures 32, 867–885.
Geels, F.W., Verhees, B., 2011. Cultural legitimacy and framing struggles in innovation journeys: a cultural-performative perspective and a case study of Dutch nuclear energy (1945–1986). Technol. Forecast. Soc. Change 78, 910–930.
Giles, C., 2016. UK slips below France in Global Economy Table. Financial Times, 4/10/2016. Available at: https://www.ft.com/content/7508bf1e-8a46-11e6-8cb7-e7ada1d123b1GILESGILES [Accessed February 14, 2017].
Goodwin, P., Van Dender, K., 2013. 'Peak car'—themes and issues. Transp. Rev. 33, 243–254.
Hackbarth, A., Madlener, R., 2016. Willingness-to-pay for alternative fuel vehicle characteristics: a stated choice study for Germany. Transportation Research Part A. Policy Pract. 85, 89–111.
Hazeldine, T., Kollamthodi, S., Brannigan, C., Morris, M., Deller, L., 2009. Market Outlook to 2022 for Battery Electric Vehicles and Plug-in Hybrid Electric Vehicles. AEA Group, commissionned by the Committee on Climate Change, Oxfordshire, England. http://www.ricardo-aea.com/cms/assets/Uploads/Papers-and-Reports/Sustainable-Transport/AEA-Market-outlook-to-2022-for-battery-electric-vehicles-and-plugin-hybrid-electric-vehicles-1.pdf (Last accessed. Didcot: AEA).
HMG, 2017. Building Our Industrial Strategy: Green Paper. HM Government.
Hultman, M., 2009. Back to the future: the dream of a perpetuum mobile in the atomic society and the hydrogen economy. Futures 41, 226–233.
IEA, 2016. Global EV Outlook 2016 Beyond One Million Electric Cars. International Energy Agency.
Jasanoff, S., 2015. Future imperfect: science, technology, and the imaginations of modernity. In: Jasanoff, S., Kim, S.-H. (Eds.), Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power. University of Chicago Press.
Jasanoff, S., Kim, S.-H., 2013. Sociotechnical imaginaries and national energy policies. Sci. as Cult. 22, 189–196.
Kay, D., Hill, N., Newman, D., 2013. Powering Ahead: the Future of Low-carbon Cars and Fuels. Ricardo-AEA.
Kemp, R., Loorbach, D., Rotmans, J., 2007. Transition management as a model for managing processes of co-evolution towards sustainable development. Int. J. Sustain. Dev. World Ecol. 14, 78–91.
Kemp, R., Truffer, B., Harms, S., 2000. Strategic Niche Management for Sustainable Mobility. Social Costs and Sustainable Mobility. Springer.
King, J., 2007. The King Review of Low-carbon Cars: Part I: the Potential for CO2 Reduction. HM Treasury, London.
King, J., 2008. The King Review of Low-carbon Cars: Part II: Recommendations for Action. HM Treasury, London.
Lane, B., 2011. Market Delivery of Ultra-low Carbon Vehicles in the UK: an Evidence Review. RAC Foundation. Ecolane, London.
Le Vine, S., Lee-Gosselin, M., Sivakumar, A., Polak, J., 2014. A new approach to predict the market and impacts of round-trip and point-to-point carsharing systems: case study of London. Transportation Research Part D. Transp. Environ. 32, 218–229.
Levidow, L., Papaioannou, T., 2013. State imaginaries of the public good: shaping UK innovation priorities for bioenergy. Environ. Sci. policy 30, 36–49.
Loorbach, D., 2010. Transition management for sustainable development: a prescriptive, complexity-based governance framework. Governance 23, 161–183.
Lyons, G., 2014. Future Demand: Summary Report. Ministry of Transport, New Zealand.
Mabit, S.L., Fosgerau, M., 2011. Demand for alternative-fuel vehicles when registration taxes are high. Transp. Res. Part D Transp. Environ. 16, 225–231.
Mackinnon, D., 2015. Devolution, state restructuring and policy divergence in the UK. Geogr. J. 181, 47–56.
Mackinnon, D., Shaw, J., Docherty, I., 2010. Devolution as process: institutional structures, state personnel and transport policy in the United Kingdom. Space Polity 14, 271–287.
Marsden, G., Mullen, C., Bartle, I., Flinders, M., 2014. Carbon reduction and travel behaviour: discourses, disputes and contradictions in governance. Transp. Policy 35, 71–78.
Mcdowall, W., Eames, M., 2006. Forecasts, scenarios, visions, backcasts and roadmaps to the hydrogen economy: a review of the hydrogen futures literature. Energy Policy 34, 1236–1250.
National Grid, 2015. Future Energy Scenarios: UK Gas and Electricity Transmission. National Grid, Warwick.
Neuendorf, K.A., 2002. The Content Analysis Guidebook. Sage.
Neuman, W.L., 2005. Social Research Methods: Quantitative and Qualitative Approaches. Allyn and Bacon, Boston, MA.
Newbold, C., Boyd-Barrett, O., Van den Bulck, H., 2002. The Media Book. Arnold, London.
Noble, B., 2005. Why are some young people choosing not to drive?. In: Proceedings of ETC 2005. Strasbourg, France, pp. 18–20. September 2005-Transport policy and operations-european policy and research-access to transport and future issues.
Potter, S., 2007. Exploring approaches towards a sustainable transport system. Int. J. Sustain. Transp. 1, 115–131.
Ruef, A., Markard, J., 2010. What happens after a hype? How changing expectations affected innovation activities in the case of stationary fuel cells. Technol. Anal. Strat. Manag. 22, 317–338.
Rogers, E.M., 1995. Diffusion of Innovations. In: 4th ed. Simon and Schuster, New York.
Ryghaug, M., Toftaker, M., 2016. Creating transitions to electric road transport in Norway: the role of user imaginaries. Energy Res. Soc. Sci. 17, 119–126.
Schot, J., Geels, F.W., 2008. Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. Technol. Anal. Strat. Manag. 20, 537–554.
Schwanen, T., 2015a. Automobility. In: Wright, J.D. (Ed.), International Encyclopedia of the Social and Behavioral Sciences, second ed. Elsevier, Oxford.
Schwanen, T., 2015b. The bumpy road toward low-energy urban mobility: case studies from two UK cities. Sustain. Switz. 7, 7086–7111.
Schwanen, T., 2016. Rethinking resilience as capacity to endure: automobility and the city. City 20, 152–160.
Shaw, J., Docherty, I., 2013. The Transport Debate. Policy Press, Bristol.
Sheller, M., Urry, M., 2000. The city and the car. Int. J. Urban Reg. Res. 24, 737–757.
Shepherd, S., Bonsall, P., Harrison, G., 2012. Factors affecting future demand for electric vehicles: a model based study. Transp. Policy 20, 62–74.
Shove, E., 1998. Gaps, barriers and conceptual chasms: theories of technology transfer and energy in buildings. Energy Policy 26, 1105–1112.
Shove, E., 2004. Efficiency and consumption: technology and practice. Energy & Environ. 15, 1053–1065.
Sierzchula, W., Bakker, S., Maat, K., Van Wee, B., 2014. The influence of financial incentives and other socio-economic factors on electric vehicle adoption. Energy Policy 68, 183–194.
Skinner, D., Rosen, P., Horton, D., 2007. Hell is other cyclists: rethinking transport and identity. Cycl. Soc. 83–96.
Sovacool, B.K., Brossmann, B., 2014. The rhetorical fantasy of energy transitions: implications for energy policy and analysis. Technol. Anal. Strat. Manag. 26, 837–854.
Sovacool, B.K., Ramana, M., 2015. Back to the future small modular reactors, nuclear fantasies, and symbolic convergence. Sci. Technol. Hum. Val. 40, 96–125.
Sovacool, B.K., 2017. Experts, theories, and electric mobility transitions: toward an integrated conceptual framework for the adoption of electric vehicles. Energy Res. Soc. Sci. 27, 78–95.
Stephenson, J., Hopkins, D. & Scott, M. Understanding Sustainable mobility: The potential of electric vehicles. HuMoComp, 2014 Brisbane, Australia.
Steer Davies Gleave, 2015. Carplus Annual Survey of Car Clubs 2014/15. Carplus, London.
Stern, P.C., Sovacool, B.K., Dietz, T., 2016. Towards a Science of Climate and Energy Choices. Nature Climate Change.
Straw, W., Rowney, M., 2013. Leading the Charge: Can Britain Develop a Global Advantage in Ultra-low Emission Vehicles? Institute for Public Policy Research, London.
Temmes, A., Räsänen, R.-S., Rinkinen, J., Lovio, R., 2013. The emergence of niche protection through policies: the case of electric vehicles field in Finland. Sci. Technol. Stud. 26, 37–62.
Timms, P., 2008. Transport models, philosophy and language. Transportation 35, 395–410.
Tran, M., Bishop, J.D.K., Banister, D., Mcculloch, M.D., 2002. Realizing the electric-vehicle revolution. Nat. Clim. Change 2, 328–333.
Van Lente, H., 1993. Promising Technology: the Dynamics of Expectations in Technological Developments. Universiteit Twente.
Van Lente, H., Rip, A., 1998. Expectations in Technological Developments: an Example of Prospective Structures to Be Filled in by Agency.
Walker, G., Cass, N., Burningham, K., Barnett, J., 2010. Renewable energy and sociotechnical change: imagined subjectivities of 'the public'and their implications. Environ. Plan. A 42, 931–947.