Transportation Research Part A 130 (2019) 507–516

Contents lists available at ScienceDirect

Transportation Research Part A

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

# The role of practical, cognitive and symbolic factors in the successful implementation of battery electric vehicles in Norway

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ARTICLE INFO

*Keywords:*
Battery electric vehicles
Adoption
Domestication
Users
Incentives
Policy

ABSTRACT

Reducing emissions from privately-owned cars plays a central role in reaching targets for global greenhouse gas emissions. Electrification has been one strategy to meet this goal. Norway has been a forerunner and is today the country with the highest proportion of privately-owned battery electric vehicles (BEVs) in Europe. Thus, studying Norwegian experiences with electric mobility should be useful for those working with the electrification of person transport in other countries. In this paper, we analyze user experiences with different models of BEVs, symbolic dimensions of BEV ownership and use, and the significance of incentives promoting BEVs. We argue that the total package of incentives not only provides instrumental motives to buy BEVs but represents a highly visible, national policy in support of BEVs that has been important for adoption, giving BEVs a symbolic certification as an environmentally sound mobility choice. The paper also points to the way incentives for BEVs have different meaning to different drivers according to BEV model and driving experience. Hence, we stress the importance of not treating BEVs as a homogenous technology when developing policy. We argue that the combination of the economic and symbolic value of incentives, technical and practical dimensions of BEVs and not least growing environmental concerns have fostered the successful introduction of BEVs in Norway. The paper is based on in-depth interviews with different segments of BEV drivers in 2013 and 2015, as well as data from two surveys conducted by the Norwegian Electric Vehicle Association in 2016 and 2017.

## 1. Electric vehicles in the transport system

Cars have become the centerpiece, or 'the leading object', of the modern transport system (Lefebvre, 1971). Apart from providing the possibility to travel almost everywhere at any time, the car is also a symbol of freedom, signaling social status and giving expression to one's identity (Steg et al., 2001; Hoogma et al., 2002; Steg, 2005; Heffner et al., 2007; Skippon and Garwood, 2011; Burgess et al., 2013). In this regard, transitions to sustainable transport cannot fail to take automobility into account (Kemp et al., 2012). The gasoline vehicle has been and still is the dominant technology for car transport, although it is possible to trace the first EV models back to the late nineteenth century (Hoogma et al., 2002). There have been many subsequent waves of interest in developing and testing electrically powered personal vehicles (Orsato et al., 2012; Sørensen, 2015; Skjølsvold and Ryghaug, 2019) but it is just recently that electric vehicle use has drawn significant attention from policy makers and scholars as EVs have begun to challenge the market for petrol and diesel cars. One of the few places where this has happened is in Norway – a country where transport by road and car is the most prevalent.

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https://doi.org/10.1016/j.tra.2019.09.045
Received 3 January 2019; Received in revised form 16 August 2019; Accepted 23 September 2019
Available online 12 October 2019
0965-8564/ 

### 1.1. Electromobility in Norway: Conditions, ambitions and incentives

Electric vehicles (EVs) are vehicles that are partly or fully powered by electric motors and include battery electric vehicles (BEVs), plug-in hybrid vehicles (PHEVs) and range-extended electric vehicles (REEVs). In this paper, we focus on BEV owners and we refer to 'EVs' when discussing the electric vehicle market more generally. The BEV sale in Norway is growing and reached a 48% market share (of new cars sold) in the first quarter of 2019 (The Norwegian Electric Vehicle Association, 2019a).[1] Norway has indisputably taken a lead role in the introduction of electric cars, acting as a kind of experimental laboratory for the development of an EV market. The analysis and discussion of Norwegian experiences should be useful for those working with electrification of the private car fleet in other countries. However, when trying to learn from these experiences, we must take into consideration some peculiar properties of Norway as an energy nation.

Norway has a unique position when it comes to energy production given that most of the electricity generated comes from renewable energy sources such as hydropower (Statistics Norway, 2019a).[2] Electricity has historically been relatively cheap in Norway (about one fourth the cost of petrol, see Hovland, 2018) and with a high level of security of supply. Moreover, 78% of Norwegians live in detached, semi-detached or row houses (Statistics Norway, 2019b), giving most people access to EV charging at home and creating less dependence on public infrastructure for regular charging. Thus, few countries can claim similarly beneficial conditions for the electrification of the transport sector as Norway.

There has also been, and still is, a rather strong political drive to reduce greenhouse gas emissions from the transport sector in Norway. The Norwegian Parliament has decided on the goal that all new cars sold by 2025 should be either zero emission (electric or hydrogen) or low emission (plug-in hybrids) (White Paper 33 2016–2017). One strategy to this end was the establishment of Transnova in 2009 (now merged with Enova) – a body providing financial support to charging facilities – and not least a comprehensive package of national and local incentives. Among others, EVs are exempted from vehicle registration tax and value added tax[3]. This makes the cost of EVs – which are still more expensive to produce than fossil-fueled cars – more or less equivalent to the cost of a new comparable petrol or diesel car (i.e. the electric version of a VW Golf costs almost the same as its petrol counterpart). Further, EVs have until recently been fully excepted from road tolls and tunnel-use charges, granted reduced fares on national road ferries, given access to bus lanes, free public parking (with or without free charging), and a dispersed network of charging stations. Local governments, however, have some degree of autonomy and have created or withdrawn some of these incentives locally. Another important factor is that the operational costs of EVs are relatively low due to more efficient engines compared to petrol and diesel car engines and relatively low electricity prices.

Norway's role as a global forerunner in the field of electromobility has been interpreted as resulting from strong incentives for purchase and ownership of BEVs (Bjerkan et al., 2016; Fridstrøm and Østli, 2017). However, Asphjell et al. (2013) point to how the EV market in Norway is as well a result of longstanding efforts from NGO activists, industry actors and politicians carried out since the 1980s. Building on this, Ryghaug and Skjølsvold (2019) explain the Norwegian EV transition as a two-stage process. In the first stage (from 1990 to 2009) a comprehensive package of incentives was introduced, but the primary goal of these incentives was not to stimulate mass-market demand, but to nurture what many hoped would be the next Norwegian industrial venture: production and export of Norwegian EVs. The market demand for EVs in Norway remained limited during this period. In the second phase (2009–), EVs have become mainstream in Norway, and this period has been less characterized by a focus on industry development. Instead, there have been great changes in how Norwegians think, talk and act with respect to automobility, not least due to a growing focus on climate change. The transition towards electromobility in Norway may thus be understood as a transition of mobility culture, including changed practices, networks, and discourses (Ryghaug and Skjølsvold, 2019; see also Sheller, 2014; Hopkins and Stephenson, 2014). The table (Table 1) below gives a brief overview of the Norwegian EV story from 1990 to 2019.

Besides economic incentives, the successful introduction of EVs is often ascribed to technological development, in particular the development of more advanced battery technology. However, as noted by sustainability transitions scholars, transitions are long-term processes which are not caused by changes in one single element such as high oil prices, a transport innovation or a government intervention (Kemp et al., 2012). Many technologies have "failed due to lack of support or because car drivers and consumers developed alternative, unexpected behavior" (Kemp et al., 2012: 4). Transport is a profoundly complex socio-technical system and a reduction of its fossil-fuel dependence goes beyond that of technological change (Watson, 2012) to encompass changes in social and cultural practices as well (Stephenson and Hopkins, 2014). With this in mind, this paper explores the interplay between technology, policies, values and use when analyzing the introduction of EVs in Norway. We argue that incentives and the technical development of EVs have been important, but we also stress the importance of symbolic dimensions of EV ownership and use that has not been thoroughly dealt with in most previous studies. In short, we will argue that the combination of incentives, by means of their practical as well as symbolic value, a growing environmental concern and not least comfortable driving experiences with EVs has fostered the successful introduction of electric cars in Norway.

[1] If we look at the numbers for March 2019 only, the market share of BEVs was 58.4%.

[2] The share from hydropower was 93.5% and wind power 3.7% in May 2019.

[3] This is an added purchase tax of 25% of the original value of the item. For instance, if a new car costs 20,000 Euros this would add up to 25,000 Euros with the value added tax included.

**Table 1**
Key events, some EV models on the Norwegian market, incentives and number of EVs from 1990 to 2019. Sources: Asphjell et al., 2013; Ryghaug and Skjølsvold, 2019; The Norwegian Electric Vehicle Association, 2019a.

| Year | Key events | Some EV models on Norwegian market | Incentives | Number of EVs |
|---|---|---|---|---|
| 1990 | PIVCO (Personal Independent Vehicle Company) started in Aurskog, Norway | | Temporary exemption vehichle registration tax | Data not available |
| 1992 | NORSTART (later Norwegian Electric Vehicle Association) | Kewet Eljet 2 (later Buddy) | | – |
| 1993 | | Prototype PIV1 by PIVCO (Norwegian brand) | Free parking experiments | – |
| 1994 | Fleet of PIV2 (CityBee) demonstrated at Winter Olympics in Lillehammer, Norway | | | – |
| 1995 | 50 CityBees by PIVCO sold to San Francisco's 'Station car program' | | | – |
| 1996 | | CityBee (sold to sponsors/private owners and enterprises, in total 65 cars) | Permanent exemption vehichle registration tax<br>Exemption yearly fee | – |
| 1997 | | | Exemption road toll | 147 |
| 1998 | Kollega bil in Oslo takes over production of Danish Kewet (later Buddy) | | | 187 |
| 1999 | Th!nk (former PIV/CityBee) established, bought by Ford | Renault, Volvo | 'EL' (EV) on licence plate for all EVs<br>Free parking on municipal parking spots | 285 |
| 2000 | | | Reduced tax company cars | 468 |
| 2001 | | | Exemption value added tax | 625 |
| 2002 | | Nissan | | 871 |
| 2003 | | | Trials with use of bus lanes in Oslo and Akershus County | 1081 |
| 2004 | | Toyota, Chevrolet | Permanent access bus lanes | 1183 |
| 2007 | | Buddy Electric | | |
| 2009 | | Tesla Roadster | No fee national road ferries | 2753 |
| 2010 | | Mitsubishi i-MiEV | | 3347 |
| 2011 | Sales of Nissan and Mitsubishi takes off | Nissan Leaf, Citroën C-Zero | Exemption congestion charge | 5381 |
| 2012 | Parliament enacts Climate Agreement and ensures fee exemptions until 2018 or when reaching 50.000 EVs in Norway | Tesla Model S | | 9565 |
| 2013 | Positive attention to EVs in media. Sales of Tesla takes off | BMW i3, Ford Focus Electric | | 19,678 |
| 2014 | | Volkswagen e-Golf, Kia Soul, Renault Zoe | | 42,356 |
| 2015 | | | | 73,312 |
| 2016 | | Chevrolet Bolt, Opel Ampera E | | 101,126 |
| 2017 | | | | 138,477 |
| 2018 | | New Nissan Leaf, Tesla Model 3 | | 194,900 |
| 2019 | | | | 215,711 (by 31. March) |

## 2. Previous studies and theoretical framework: A sociotechnical perspective on EV use

As pointed out by Plötz et al. (2014), successful market strategies and policies depend on knowledge of the characteristics and needs of early adopters. Studies of EV use have focused on both adoption and non-adoption behavior examining intentions to buy EVs and different kinds of test drive studies of EVs (see Rezvani et al., 2015 for a review). Analysis of non-users can be effective in mapping out perceived barriers to electric vehicle use and provide insights for understanding factors leading to non-adoption. For instance, a study of petrol car drivers in Norway revealed how they assumed it to be demanding to drive EVs as opposed to petrol cars, citing driving range and the subsequent need to plan ahead regarding when and where to charge as barriers to electric car adoption (Ingeborgrud, 2014; see Noel et al., 2019 for a discussion on public perspectives on barriers to EV adoption in the Nordic region).

Most studies on the intention to buy EVs pursue three sets of factors that are seen to influence EV adoption: technological aspects, consumer characteristics, and context factors, such as fuel prices, electricity prices, and the availability of charging stations. Studies focusing on consumer characteristics tend to emphasize the importance of lifestyles, (Axsen et al., 2012), pro-environmental attitudes, (Carley et al., 2013; Krupa et al., 2014; Axsen et al., 2015) socio-economic characteristics, (Plötz et al., 2014) or a combination of these (Mohamed et al., 2016), which are then used to map potential future market segments. Most of these studies are based on surveys of non-users employing a research design in accordance with the theory of planned behavior (Ajzen, 1991) and/or an attempt to model EV deployment. Some of these studies show that pro-environmental attitudes and more environmentally-oriented lifestyles, as well as affective attributes, such as pleasure and joy, are likely to influence EV purchase intentions (Schuitema et al., 2013) and that specific groups, such as middle-aged men living in rural or suburban areas are the most likely early adopters of EVs in Germany (Plötz et al., 2014).

There are few studies of actual BEV users (Bjerkan et al., 2016), although a handful of studies have been conducted in European countries: in France (Pierre et al., 2011), Germany (Cocron et al., 2011), the UK (Graham-Rowe et al., 2012), and Denmark (Jensen et al., 2013; Friis, 2016). These studies fall under the category of 'test drive studies' where participants are recruited into a research project and are given an EV for a short period to gain experience. A compelling finding from one of these studies is that emotions such as 'feeling good' or 'less guilty' about driving were articulated by people who drove EVs for a trial period (Graham-Rowe et al., 2012). Another study found that preferences for EVs changed significantly after real experience with an EV, and that the EV experience also caused people to re-evaluate the characteristics of internal combustion engine vehicles (Jensen et al., 2013).

These are all interesting observations, but the test drive approach to studying EV adoption has limitations due to the design of the test-driving experiments, the recruitment of test-users, and due to the non-realistic conditions of EV acquisition set forth by most test drive studies. For instance, the EV is given to users for a period in exchange for the time and effort they put into taking part in the research project. To enhance our understanding of how attitudes influence EV adoption, how attitudes may change over time, and inversely, the ways in which EV adoption shapes attitudes and practices, it is important to study real (unforced) adoption. This includes for instance EV adopters' support for different EV policies, both at the time of buying an EV and after some time driving an EV (Rezvani et al., 2015). There is also a need for in-depth qualitative research that can disentangle consumers' perceptions of particular policies related to EVs and more detailed studies of how policies contribute to shaping attitudes and intentions to buy EVs (Rezvani et al., 2015; see also Coffman et al., 2017; Kester et al., 2018).

In this paper, we will focus on BEV owners' perceptions of BEVs as well as BEV policies in Norway. We will argue that BEVs are used for reasons extending beyond the 'rational' or 'technical', stressing the need to account for the socio-technical dimensions of automobility, as also pointed out by Sovacool and Axsen (2018). By using a domestication perspective (Lie and Sørensen, 1996; Sørensen, 2005), we focus on how BEVs have become integrated into users' everyday lives through learning processes, the creation of new routines and meaning. Domestication has been described as a process consisting of three overlapping dimensions: cognitive, practical and symbolic. The cognitive dimension refers to how people learn to use new technologies. The practical dimension concerns the ways in which users integrate the technology into already existing routines and establish new routines through use. The symbolic dimension refers to the ways in which users attach meanings to a new technology, including self-representation, by means of using technology. A domestication perspective highlights that technologies are not fixed entities, but rather, that they acquire specific forms of use and meanings when they are adopted and embedded to specific localities (Silverstone et al., 1992). Such perspectives does not only focus on how technologies are 'accepted' by means of practical use, but as well how people learn to use a new technology and not least, the symbolic values and meaning creation that is central to the adoption process.

## 3. Methods

This paper combines results from an interview study and two surveys. First, we did semi-structured interviews with 18 BEV drivers in Norway to gain in-depth knowledge of BEV drivers' reflections and experiences concerning BEV ownership and use. We asked participants to tell us about their BEV and what it meant to them in everyday life, as well as how they used their BEV on a regular day to day basis. Interviews also covered reasons for buying a BEV, how they got information about the BEV purchase, if the BEV ownership made them change any other routines in the households, charging routines, and their thoughts about the incentives and the development of the EV market in Norway. Eight interviews were conducted from April to September 2013, while a second round of interviews was conducted in October and November 2015.

The BEV models that dominate the market have changed significantly during the last decade. While pioneer brands Think and Buddy comprised more than half of all BEVs in 2009 and 2010 in Norway, contemporary users tend to favor Nissan Leaf (52224 registered cars), Volkswagen e-Golf (34580 registered cars) and high-end models such as Tesla Model S (18944 registered cars) (The

Norwegian Electric Vehicle Association, 2019b).[4] In the first group of interviewees from 2013, six drove a Nissan Leaf, one drove a Mitsubishi i-MiEV and one a Buddy model.[5] The second round of interviews was conducted with ten people driving Tesla models to gain understanding of how newer BEV models (larger, more luxurious and with longer driving range) potentially attracted new user groups. For these interviews, we also asked explicitly if interviewees had tested the Tesla before the purchase and if environmental concerns were part of the BEV choice. Interview respondents were recruited through emails and social media in our private and professional network and we also used a snowball method for recruitment in which we asked interviewees to name other BEV drivers to be included in the study.

Interviews lasted from one to almost two hours, and every interview was recorded and transcribed verbatim. The interviews were carried out in Norwegian and the quotes have been translated from Norwegian into English by the authors. We analyzed the interview material inspired by grounded theory methods (Charmaz, 2006) and took on an abductive analytical approach (Reichertz, 2007). We made open codes from the interview transcriptions, such as 'BEVs are easy in everyday life' and 'BEVs are comfortable to drive'. Further, we categorized open codes into analytic codes in line with our theoretical framework of domestication, e.g. 'the practical car' and 'the environmentally friendly car'. The analytic codes served as point of departure for the result section.

Second, we used data from a yearly survey among members of the Norwegian EV Association (NEVA). We have used data from surveys conducted in 2016 and 2017 (from now referred to as NEVA 2016 and NEVA 2017). The NEVA 2016 survey was distributed through email to approximately 40,000 EV owners and 3422 EV owners completed the survey. The NEVA 2017 survey was distributed through email to approximately 50,000 EV owners and 12,665 EV owners completed the survey. Upon purchasing an EV in Norway most purchasers are awarded a one-year membership in the EV association, and thus the sample does not merely exist of the most dedicated enthusiasts. The surveys asked why EV drivers chose to buy an EV, how they use it, and reflections about their EV and EV policy.

When asking EV users about the importance of incentives there is of course the risk that they overstate the importance for fear of losing benefits. Earlier studies using similar data sets have also shown their limitations when it comes to capturing "the complexity of factors which underlie decision making, and thus the full value of public incentives for EV adoption" (Bjerkan et al., 2016:179). Thus, combining the survey with in-depth interviews is expected to give more nuanced answers regarding the significance of incentives, as well as contributing to a more comprehensive understanding of BEV adoption and user experiences with BEVs.

A weakness of the approach is that the two sources of data were not produced to inform each other from the outset of this study but was designed separately. Thus, it would be better if the surveys had been carried out based on the analysis of the interviews or vice versa. The interviews were analyzed first. We then turned to the surveys to see if we could find similar patterns there. Even though the two sets of data were produced uninformed of each other, we would argue that seen together, they strengthen each other as we found similar interpretations of BEVs across the two data sources – which, in total, had a timespan from 2013 to 2017. The interviews also gave more in-depth and nuanced interpretations that to a certain extent could inform interpretations of survey answers.

## 4. The domestication of BEVs into Norwegian households

This section will focus on the domestication of BEVs into Norwegian households – more precisely, the overlapping cognitive, practical and symbolic dimensions of BEV ownership and use. There is not one simple answer to the growing BEV market but many factors playing in. For instance, Fig. 1 illustrates the many reasons given by BEV owners for buying a BEV in Norway.

The following analysis is structured in three subsections focusing on 1) technical and practical dimensions of driving BEVs, 2) environmental concerns connected to BEV ownership and use, and 3) the significance of BEV incentives. We could argue that these topics encompass the three most important factors from the reasons given in Fig. 1.

### *4.1. Technical and practical dimensions of driving BEVs*

The cognitive and the practical dimension of BEV domestication is closely linked as the BEV drivers had to shape their driving practices according to knowledge and experience – particularly concerning battery capacity and driving range. One of the most discussed points related to BEVs, and what makes them unique as compared to other cars, is the set of practices related to battery charging. Our interviews demonstrate that BEV drivers perceived the charging process as easier than filling their car 'the traditional way' at petrol stations. One of the Nissan Leaf drivers said that he was glad he did not have to worry about filling at the station, stating that "electric cars are easier for me; they are actually more comfortable than petrol cars because I can charge at home." Several interviewees confirmed this and pointed to how home charging in particular made BEVs more convenient in everyday life than a traditional petrol or diesel-fueled car.

Overall, BEV drivers described their EV as *more comfortable* than their (previous) petrol car, both by means of technical equipment and driving experiences. This has also been found in other studies of Norwegian BEV users (Ryghaug and Toftaker, 2014; Ingeborgrud, 2014; Anfinsen et al., 2018). A Nissan Leaf owner said that her family had some reservations about buying a BEV, but were convinced after trying one. She described her BEV as possessing "…a very good automatic gear shift, great acceleration, quick

[4] The total stock number of BEV models by 31. March 2019.

[5] This is a small compact BEV developed from the Danish EV model Kewet and was introduced (and further developed) as 'Buddy' to the Norwegian market 20 years ago.

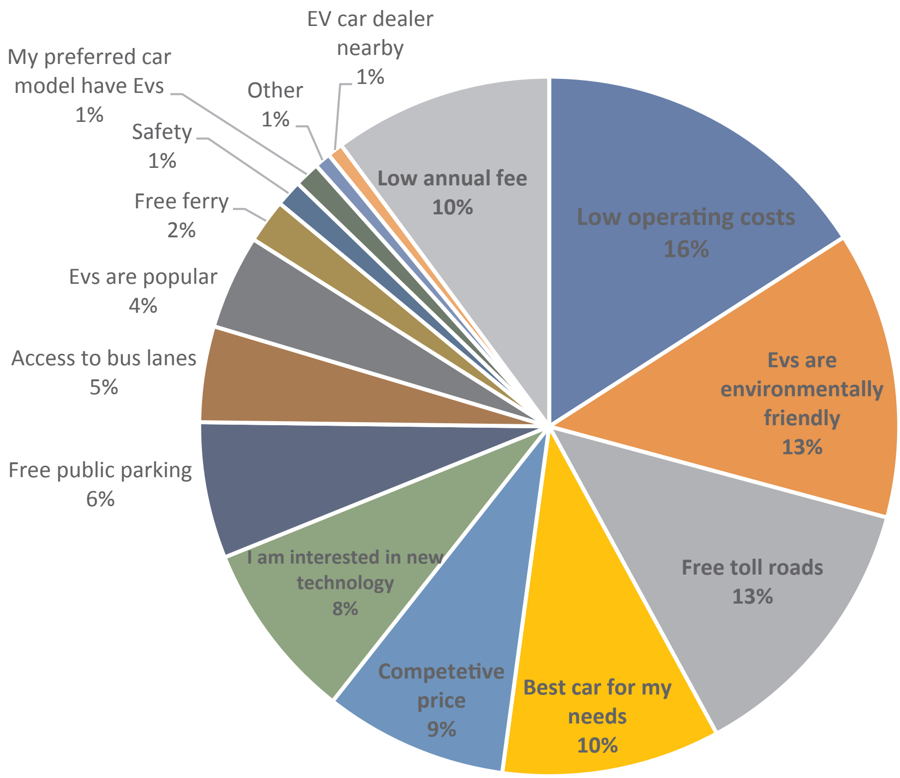


**Fig. 1.** Reasons for buying a BEV. Source: NEVA 2017.

and solid, with very good driving characteristics". Other Nissan Leaf drivers pointed in addition to the absence of noise as an important aspect of driving comfort, as also mentioned in other studies looking into benefits of driving EVs (Noel et al., 2018).

We found that those driving Tesla were very enthusiastic about the driving comfort. They often referred to the extreme acceleration of the car and how this made the car "fun to drive," an opinion shared even by people who reported a lack of interest in cars. One interviewee said, laughingly: "Do not try it if you do not intend to buy it!" The interviews with Tesla users also showed that these drivers had not necessarily been interested in EVs as such but claimed that they were above average interested in technology. This became evident by the ways in which they described themselves and not least their very enthusiastic descriptions of their Tesla as a high-tech and spacious car as compared to other BEV models. Our interviewees described their Tesla as an extraordinary car with an "X-factor", as a "space craft" and/or as a "computer on wheels". An enthusiasm for new gadgets and technology clearly triggered interest in EVs in general and this also became visible in the NEVA survey from 2017, where 93% of respondents agreed or strongly agreed with the claim "I think it is exciting with new technology".

Regardless of type of BEV, all BEV owners (except from the interviewee driving a Buddy model) described their BEVs as very comfortable to drive. The comfort aspect included the mentioned driving characteristics, but also the ways in which they considered their BEV as a safe, silent and exciting technology. Importantly, the comfortable driving experience was also related to a more symbolic dimension, as we will discuss in the next section.

### *4.2. Environmental concerns connected to BEV ownership and use*

There was a clear symbolic dimension involved in the domestication of BEVs and this was connected to environmental concerns. In the survey from 2016, 68% of respondents listed 'EVs are environmentally sound' as a reason for buying an EV (NEVA, 2016). In the survey from 2017, 75% of the respondents agreed or strongly agreed with the claim 'Climate change is a big problem', which may be taken as an indicator of environmental awareness (NEVA, 2017). From the interview study, we found that driving small to medium-sized BEVs, such as Buddy, Mitsubishi i-MiEV and Nissan Leaf, was related to having pro-environmental attitudes. The Buddy driver made it particularly clear that she bought the BEV out of environmental concerns and not due to monetary savings. A Nissan Leaf driver stated:" I think of myself as a more environmentally friendly person when I am driving the EV. I drive with a better conscience, and it feels less polluting to drive an EV." She also interpreted the EV driving as part of a greater collective non-polluting project, laughingly admitting that she clearly identified with other Nissan Leaf drivers. Occasionally, they even waved and greeted each other when they were out driving, exemplifying the way BEV driving, for some, clearly had become part of a shared sustainability project.

Moreover, interviewees pointed out how BEVs do not contribute to local air pollution in urban areas and considered driving a BEV to be an efficient way of reducing local pollution. This framing of BEVs made driving with spiked tires (which produce more local air pollution) seem as incompatible with the green image of the car. A Nissan Leaf driver framed it like this: “I could never drive with spiked tires – that would ruin my whole green image of driving a BEV!” Environmental concerns by means of reducing local pollution was an important reason for driving BEVs according to our interviewees, and this was affirmed by 89% of respondents in the survey from 2016 reporting that they drove without spiked tires (NEVA, 2016).

Thus, survey respondents as well as interviewees stressed the importance of driving a less polluting vehicle. Still, when the survey from 2017 asked whether economic benefits or environmental considerations were most important for respondents’ choice of electric car, 72% answered economic benefits while 26% claimed their choice was mostly motivated by environmental considerations (NEVA, 2017). Important to note in this regard is that qualitative studies of EV drivers in Norway (Ryghaug and Toftaker, 2014; Ryghaug et al., 2018) have shown that some of those that were not motivated by environmental concerns when *buying* an EV claimed to become more energy and environmentally aware as a *result* of driving EVs and more eager to scrutinize and alter quite deep-rooted mobility practices. This was also found in the surveys where 60% of respondents in 2016 claimed to have become more energy aware *after* acquiring a BEV (NEVA, 2016) and 58% of respondents in 2017 agreed or strongly agreed with the claim “I have become more energy conscious after I purchased an electric car” (NEVA, 2017). This was particularly visible among Tesla drivers were 69% agreed or strongly agreed with this claim (NEVA, 2017). The Tesla drivers in our qualitative interview study explained that their Tesla had triggered an interest in sustainable mobility and energy consumption more generally, and that acquiring a Tesla contributed to a change in their mobility practices. For instance, Tesla owners wanted to try long distance travel and one interviewee had started substituting airplane travel with car travel from Trondheim to Oslo (about 500 km). This was made possible with Tesla’s battery capacity and the network of superchargers.

The interviews showed that BEV users practiced their environmental awareness in different ways. While some mentioned the refusals of driving with spiked tires, others were more interested in driving in an energy optimal way. For example, a Nissan Leaf driver said he had been interested in EVs for a long time because he wanted to have a more environmentally friendly car and specified what this meant to him: “When you have this type of car [a BEV] it is because you aim to use as little energy as possible. I am very aware of trying to drive energy efficiently.” The interest in energy efficient driving also seemed to generate an interest in producing electricity. In the survey from 2016, 39% of respondents reported that they considered installing a photovoltaic system (NEVA, 2016). From the interviews, we found that one important reason for becoming interested in solar energy was rooted in a desire of being self-sufficient with energy for the car as well as the house. These new energy attentive practices were also related to the cognitive dimension of BEV domestication as BEV owners had to ’read up’ on environmental and energy related aspects, in particular when confronted by BEV sceptics or non-users. This was also visible from the survey where 43% agreed or strongly agreed with the claim ’I often have to clarify myths concerning how environmentally friendly EVs really are to people I meet’ (NEVA, 2017). A comparison with Tesla owners showed that 65% of Tesla owners agreed or strongly agreed with this claim (NEVA, 2017).

Overall, both interviews and surveys confirmed that, among BEV owners, BEVs were perceived as environmentally sound cars. Driving a BEV may therefore be interpreted as one way to engage in matters of sustainable energy consumption in general and sustainable transport in particular, in line with theories of material participation (see e.g. Marres, 2012; Ryghaug et al., 2018). However, while comfortable driving experiences and environmental concerns were important, one cannot discuss EV adoption in Norway without relating the discussion to the comprehensive list of EV incentives. EV incentives have been identified as a main driver behind the rapid expansion of EVs in Norway (Bjerkan et al., 2016; Ryghaug and Skjølsvold, 2019), but there is a lack of knowledge concerning how EV owners perceive these incentives (Ryghaug and Toftaker, 2016; Bjerkan et al., 2016). In the next section, we will take a closer look at the significance of these incentives.

### 4.3. The significance of BEV incentives

The incentives played an important role in recruiting BEV drivers, as only 23% of the respondents in the NEVA survey from 2016 claimed that they would have bought a BEV without tax exemptions (value added tax and vehicle registration tax), and 43% would have bought a BEV without use incentives (such as exemption from road tolls, access to bus lanes and free public parking). Moreover, only 21% would have bought a BEV without ’low operating costs’ (NEVA, 2016). Low operating costs is not a government-introduced measure as it is an effect of fuel and electricity prices, but many BEV drivers still regarded this as an incentive. Concerning use incentives, 53% regarded exemption from road toll an important incentive, 14% reported free parking as important while 12% found access to bus lanes important (NEVA, 2016).

Overall, this points to the importance of economic support in giving EVs a market advantage and the results are similar to previous findings on the effectiveness of measures and incentives in promoting EVs in Norway (see Figenbaum and Kolbenstvedt, 2013; Figenbaum et al., 2015). The Norwegian EV policy was also described as successful by our interviewees, expressing that environmentally friendly technologies should be given economic advantages to speed up deployment. Moreover, interviewees pointed to how a long-term consistency regarding EV policy was crucial for the EV market to succeed. Overall, the incentives were regarded as a tool to make EVs affordable compared to petrol or diesel fueled cars and played a major role in users’ decisions to buy an EV.

However, we found that BEV drivers regarded the importance of incentives (in particular *use* incentives) in accordance with their BEV model, driving experience and residency.[6] For instance, a Nissan Leaf driver emphasized that, historically, incentives alone had

[6] Some of the areas with the highest density of EVs have been related to local incentives such as in Asker outside Oslo, where the ability to drive in

not been enough to speed up BEV deployment, but that the technical improvements played an important part: "Before these new bigger EVs were available, not that many people bought EVs despite the fact that many EV incentives have existed since the mid-1990s." Another Nissan Leaf driver pointed to that the BEV market in Norway was not so big until BEVs became "nice" and "practical for family use". The interviewee driving a Buddy model (one of the early models available on the Norwegian market) connected the importance of incentives to the technical level of BEVs and explained the incentives as a kind of compensation for how early BEV adopters were expected to deal with what she described as the technology's 'teething problems'. These problems were, for her as a Buddy driver, related to the car's size, range and safety – which were not perceived as problems by those driving middle-sized to large BEVs such as Mitsubishi i-MiEV, Nissan Leaf and Tesla.

Though interviewees driving middle-sized to large BEVs did talk positively about incentives, these were generally explained as an extra bonus given to BEV drivers, and they claimed that incentives did not play a key role in their enthusiasm for BEVs compared to other cars. A Nissan Leaf driver put it as following: "Once you've got used to driving an EV the incentives are not that important anymore, but they are important in the decision of buying an EV in the first place because they prevent economic risk." This may be interpreted as how incentives were crucial for users' decision of buying a BEV (in particular economic benefits such as exemption from VAT), but that the desirability of BEVs in the longer run were less connected to incentives. Instead, as users got more experience with their BEVs they emphasized how the technical level of BEVs, driving characteristics and the feeling of driving a less polluting vehicle played a significant role post purchase.

An important finding from the interview study was that the total package of incentives were very important symbolically: interviewees explained how incentives 'encouraged' them to buy a BEV and that incentives, and not least that it was quite predictable how long these would last, communicated a strong signaling effect from national governments of BEVs as an environmentally sound mobility choice. We know from previous research that politicians' attitudes towards specific technologies may have influence on potential users (Næss and Ryghaug, 2007), and when politicians clearly show that BEVs are a priority area in Norway this may have a positive effect on peoples' attitudes towards BEVs. To this end, the incentives played a more diverse role than simply making it more affordable to buy and own a BEV – they also contributed to make potential BEV users aware of BEVs and gave clear signals that deployment of BEVs was an important political strategy to cut emissions from the transport sector. This gave BEVs a symbolic certification as an environmentally friendly car choice.

## 5. Conclusion: Towards socio-technical systems change?

In this paper, we have highlighted that there are practical as well as symbolic dimensions that are important for BEV adoption. Our interviewees perceived their BEV as being more comfortable than petrol or diesel cars. All BEV owners in the interview study (except the one driving a Buddy model) highlighted great driving characteristics and also considered their BEV to be a safe, silent and exciting technology. Moreover, interviewees presented their BEV ownership as a means to engage in pro-environmental actions. There were also some elements of cognitive work involved in domesticating BEVs, such as being updated on environmental and energy related aspects of BEV ownership and use. We have argued that the combination of comfortable driving experiences, environmental concerns and BEV incentives fostered the domestication of BEVs as a convenient technology of mobility. A successful introduction of BEVs thus requires attention to such material as well as symbolic dimensions of ownership and use.

As noted by Kemp et al. (2012), public concerns about climate change and the environment provide a window of opportunity for transitions to sustainable mobility, but they are in doubt as to whether such concerns translate into real consumer demand for green cars. Our research suggests that such a translation is taking place in Norway. Previous research has pointed to a need for collective action with respect to climate change (Aune et al., 2016), and that such action has been found to be hard to carry out because of a perceived lack of available options (Næss and Ryghaug, 2007). Acquiring and driving BEVs seem to fill in this gap in a Norwegian context. Thus, the electrification of private cars has enabled BEV users to engage in climate change issues and promote a pro-environmental identity.

This paper has expanded on scholarly debates by highlighting that there are differences concerning how incentives are perceived among BEV drivers. We found that BEV owners perceived the importance of incentives in accordance with their BEV model, driving routines and residency. For instance, while Nissan Leaf and Tesla owners explained incentives (in particular use incentives) as an extra bonus of BEV ownership, the Buddy owner considered incentives as an important compensation for what she found to be technical weaknesses of her BEV and by means of being a BEV pioneer. Our study points to the importance of not treating BEVs as a homogenous technology when it comes to developing policy. For instance, BEV models could be taken into account when revising incentives.

Importantly, the total package of incentives represent a highly visible, concerted national policy in support of BEVs. This has resulted in a dual effect. On the one hand, incentives provide instrumental motives to buy a BEV. On the other hand, they represent a symbolic certification of BEVs and clearly identifies this technology as a preferred alternative towards sustainable mobility in Norway. To this end, incentives have contributed in making a particular type of BEV culture in Norway, with practical as well as symbolic effects, where BEVs are far less contested than in countries with less concerted action towards promoting BEVs (see e.g. Ortar and Ryghaug, 2019 for a discussion on EVs among European citizens).

(*footnote continued*)
the bus lane made commuters save a lot of time, and in the islands in the western part of Norway where one had very high saving on toll roads (see e.g. Mersky et al. 2016 for a discussion on local incentives and geographical variables).

This paper has highlighted that to stabilize EVs as a viable transport technology they need to be studied as socio-technical elements in relation to policies as well as user perceptions and practices. Most likely, EV incentives will change in the years to come as the number of EVs grows and EV owners will be forced to contribute to the costs of maintaining transport infrastructure, i.e. by paying fees on toll roads. At the same time, it seems reasonable to expect continued technological development and design of new EV models. Changes with respect to policy and technology may obviously lead to changes in the domestication of EVs. By removing incentives, EVs may become less attractive both practically and symbolically, as this may be interpreted as less support for EVs as a viable sustainability solution. Moreover, a wider sharing of positive user experiences with EVs as well as their environmental qualities – both locally and climate-wise as energy production gets cleaner – could also contribute in pushing forward electromobility as crucial to the much-needed transition of the transport system.

## Acknowledgements

We would like to thank Professor Knut Holtan Sørensen and Professor Tomas Moe Skjølsvold and two anonymous reviewers for valuable comments and suggestions for this paper. We would also like to thank Sigurd Lundheim for assisting with analyzing data from the NEVA 2017 survey.

## Funding

This work was supported by The Research Council of Norway [grant number 209697].

## Declaration of Competing Interest

None.

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