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Policy mechanisms to accelerate electric vehicle adoption: A qualitative review from the Nordic region



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ABSTRACT

Electric vehicles are an important instrument to decarbonize transportation, offering a range of co-benefits such as reductions in local pollution, noise emissions, and oil dependency. Unfortunately, price, range, infrastructure and technological uncertainty are only some of the barriers to a faster adoption of these vehicles. To overcome these barriers, there is a broad call for public support and a growing body of primarily survey and choice experiment studies to show which policy mechanisms are effective, with mixed outcomes. In response, this paper offers a qualitative comparative analysis that draws on 227 semi-structured interviews with 257 transportation and electricity experts from 201 institutions across 17 cities within the Nordic region to discuss the reasoning and arguments behind EV incentives and policy mechanisms. A frequency analysis of the most coded responses favoured cost reduction mechanisms, in particular taxation exemptions; infrastructure support for public and apartment charging; the importance of consumer awareness, especially information campaigns; certain other specific policy measures like procurement programs and environmental zones; and more general policy principles. More in-depth, our analysis shows the debates around these mechanisms and how the pros and cons of these mechanisms differ per country, per transport segment, per phase of transition or market share, even per city. In short, this paper calls for strong stable national targets and price incentives combined with local flexibility to implement secondary benefits and more attention to awareness campaigns to advance the implementation of electric vehicles.

1. Introduction

Given recent advances in technical performance and improvements in cost, much scholarly attention has shifted beyond the purely technical and economic dimensions of electric vehicles (EVs) to issues of policies, policy mechanisms, and policy mixes [1]. Stokes and Breetz [2] as well as Heidrich et al. [3] for example demonstrate that political factors such as city, state and national policies for EVs can play a determining role in EV diffusion and acceptance. Through modelling, Mirhedayatian and Yan demonstrate the critical importance of policies when discussing EVs for urban freight transport [4]. Similarly, Ji and Huang note the necessity of strong, consistent, and stable policies for Chinese promotion of EVs [5]. In turn, Wolbertus et al., Zhang et al., Berkeley et al., and Hardman et al. all reveal, to varying degrees, how the strength of EV policies interacts with consumer preferences and purchasing patterns [6–9]. The design, implementation, scope, and interactions of EV policy have therefore become central in discussions about widespread EV transitions.

The Nordic region offers a particularly compelling case of testing

both the content of policies as well as expert opinions on policy effectiveness for multiple reasons. The close cooperation and integration between the five Nordic countries, Iceland, Finland, Denmark, Sweden and Norway, on a range of topics including climate change, electricity production and transportation is well established internationally. They share relatively strong climate policies, high public tax levels, and some of the highest renewable energy generation levels in the world. They also agree about the impact of transport (road, sea and air) on climate change. In fact, due to their low CO₂ emitting electricity generation from hydro, nuclear, bioenergy, wind and geothermal sources, for many of these countries transport is one of the primary remaining sectors emitting GHG emissions [10].

Yet, when it comes to the actual transition away from fossil fuel powered internal combustion engines (ICE), the countries have a different track record (see Figure 1 in [11]) and favour different assemblages of technologies (electrification, biofuels, hydrogen, public transport, etc.) and different policy mechanisms to shift the transport sector towards those new technologies. This paper draws on 227 expert interviews with 257 respondents across the five Nordic countries, 17

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cities, 201 institutions and a range of sectors to get a better and more complete grasp of these policy mechanisms and the choices behind them in relation to the introduction of EVs¹ in the Nordic countries.

In both the Nordics and the literature, electric vehicles are seen as an important tool to decarbonize transportation [12,13], while offering other co-benefits, including local health emissions [14], stabilizing the electricity grids and reduced oil dependency and noise pollution [15,16]. At the same time they face a range of impediments from the characteristics of EVs like price and range [17] to political interests and existing business cases [18], as well as a lack of consumer knowledge and practical driving experience [19]. This leads to calls for public support [20].

A growing number of articles has recently been published studying the policy mechanisms that have been set up in response. Some of these focus on specific measures [21] or countrywide programs [22–24] and a select few compare policies across countries [25]. Others generalize across the literature [19,26–29]. Together the literature by now has found a range of factors influencing EV adoption [see for a comprehensive overview [27]. However, as concluded by Coffman et al. [26], most of these literature reviews are based on surveys and choice experiment data, not in-depth qualitative research across multiple countries. Furthermore, Liao et al. [28] conclude that public choice experiments are showing mixed result about the effectiveness of the mechanisms. In addition, as Coffman et al. [26] argue, this mix in findings is further obscured by an unclear causality between the mechanisms and outcomes; the most obvious being the chicken and egg discussion around public recharging equipment.

Simultaneously, the incentives available *do* work, as indicated by the sale shares in Norway and Iceland, two countries with heavy purchase tax exemptions, especially when compared to the other Nordic countries that do not have such exemptions, as indicated by Table 1. This is confirmed in the literature, which concludes for Norway that the most effective mechanisms are aimed at the purchase costs [21] and toll roads or access to High Occupancy Vehicle (HOV) lanes [22]. However, not all countries or local authorities have such options, either fiscally or sociotechnically, and the differences in EV adoption rate are not surprising when incorporating the local political, economic, geographic and sociotechnical context for which policies need to be translated.² There is hence an increasing call for niche market policies [27] and more in-depth regional studies to study the ‘transferability of incentives [30]’ and to ‘build an understanding of best practices [26]’.

This paper contributes to these latter studies by offering a qualitative in-depth analysis of the above mentioned interviews where 257 respondents were asked the question: *What policy mechanisms can further accelerate the transition of electric mobility and vehicle to grid technology?* Due to the volume of data collected, the authors decided to split this question in two papers: This one detailing the EV policy mechanisms and another [11] discussing the suggestions for vehicle to grid (e.g. using EV batteries as a quick responding storage option to balance out electricity networks). Below this paper presents and discusses what these experts advise in terms of costs, recharging infrastructure, consumer knowledge and awareness, and more general policy directions. First, however, this paper offers a description of the method. It closes with a brief discussion and conclusion.

2. Research methods

To address the missing qualitative cross-country analysis in the

¹ The focus was on light private passenger battery electric (BEV) and plug-in hybrid (PHEV) vehicles, but experts also discussed other forms of electric mobility such as trucks, fleets, light duty vehicles, and public transportation.

² At the same time, the literature [10] highlights how much that drives EV adoption stems from the global market. Reductions in battery prices, new models in more car segments, but also fossil fuel prices and so on, are all developments where the Nordics have little influence over, except by offering a market where these products are sold.

literature this paper assesses the suggestions for and perceptions on public policy support for EVs in the Nordic region. Specifically, this section briefly describes the underlying method and provides an overview of the interviews [repeating similar methodological overviews in 11 and 36].

For the study we conducted 227 semi-structured interviews in the five Nordic countries while visiting 17 cities from late September 2016 until May 2017 (Table 2). The interviews crossed several sectors, including local, regional and national government ministries, agencies, and departments; regulatory authorities and bodies; universities and research institutes; electricity industry players; automobile manufacturers and dealerships; private sector companies working on charging equipment, transport software, alternative transport technologies or electricity and fuel traders; and industry groups and civil society organizations. Importantly, although these institutions were relevant for sampling purposes, individuals spoke in a personal capacity and were guaranteed anonymity. The data sample was gathered by selective and personal e-mail and phone invites, and a snowball question at the end of each interview.

The interviews lasted between 25 and 90 min and were conducted in person (primarily) or by phone if a meeting was impossible. Generally, the interviews were conducted by either one or two interviewers speaking with one to four experts. Only one of the interviews was not recorded but notes were taken. These recordings were transcribed and subsequently coded in NVIVO following an inductive, grounded approach; meaning that the interviews were coded based on arguments, adding new codes with new arguments, and only then gathered into higher level themes and categories.

The results that are presented here detail the reply to the question on EV and V2G policy mechanisms but also any mechanisms mentioned elsewhere during an interview. That already points to some of the benefits and downsides of semi-structured interviews. Even though the questions are pre-arranged, the final interview is influenced by the self-selection bias of interviewees as well as the preferences of the interviewer in terms of follow up questions. Another level of selection bias can be found in the level of expertise and background of the interviewees, as in some instances experts felt that certain answers were common knowledge so they skipped them and instead talked more in depth about other less frequently discussed challenges. With such biases influencing the outcomes, the results are non-comparable in a strict sense of the word. However, they are indicative of trends in the general public discourse in the countries we visited, as well as within the different sectors across our cases. In addition, they allow for the emergence of novel ideas [37] and a qualitative testing of arguments, both during the interview and the subsequent data analysis research.

Lastly, there is a timing issue. With a topic so relevant, often the fieldwork in one country could be seen as ‘outdated’ by the time the team finished the next country. For example, Iceland extended its incentives a month after the team left, just as Denmark rolled back on its earlier phase-out of EV incentives. Still, this timeliness is also a strength of semi-structured interviews for it offers relatively timely data collection (compared to written reports) and allows for a discussion of large topics with complex elements while highlighting underlying perceptions and values [38].

3. Results: Reducing costs, providing charging infrastructure, and informing consumers

This section presents the interview results. Importantly, after coding the different responses, adding new codes whenever a new argument/position was brought forward, the resulting responses were combined in more general themes. These themes include costs; infrastructure; information & awareness; governance principles; government actions; technology and R&D; and a focus on the EV market. For example, those codes related to the price differential of an ICE vehicle and EV were gathered under a cost focus. Similarly, the codes about charging were

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