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Perspectives on Norway's supercharged electric vehicle policy

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ABSTRACT

Norway has achieved an unprecedented breakthrough for battery electric vehicles. The market share reached 17.1% in 2015, and the total fleet passed 2.7%, some 70000 vehicles. The multilevel perspective framework demonstrate how Norwegian incentives and policies gradually developed over a 25 year period through interactions between the international landscape, national governance networks, regimes and niches. Actors have been able to utilize windows of opportunities leading to the potential establishment of a BEV regime assimilated into the ICE regime from 2016. BEV incentives, some of which have been in place since 1990, did not yield results until the traditional vehicle manufacturers manufactured BEVs based on Li-Ion batteries from 2010. Norwegian purchase incentives are large enough to make electric vehicles a competitively priced alternative for vehicle buyers. Increased selection of models, improved technology, reduced vehicle prices, and extensive marketing have spurred further sales.

1. Introduction

The introduction of environmental innovations in the fossil fuel-based transportation sector, such as alternative energy carriers, will be required on a massive scale in order to be able to limit global warming from transportation activities. The lock-in effects of existing technology, development and the introductory costs of new technologies and the existing motoring practises are barriers limiting adoption. Understanding the processes involved in introducing such innovations will aid transportation policy makers in formulating more effective measures.

The combination of the electrification of transportation and decarbonisation of electricity will deliver deep cuts in CO_2 emissions (Williams et al., 2012). Battery Electric Vehicles (BEVs) reduce greenhouse gas emissions when the electricity they use is produced from renewables, as is the case for Norway, and to a lesser extent when the European electricity mix is used (EU WTW, 2014). BEVs emit no local pollutants and are up to three times as energy efficient as Internal Combustion Engine Vehicles (ICEVs) (Figenbaum et al., 2015b). Hawkins et al. (2012) emphasize the need for an improved life cycle analysis of BEVs, but also find that BEVs reduce greenhouse gases. The EU's emission trading scheme (EU ETS, 2015) includes electricity production, and since there is a cap on total greenhouse gas emissions, a 100% reduction will in principle be the result when BEVs replace ICEVs (OECD 2011; EU ETS, 2015; Figenbaum and Kolbenstvedt, 2015b). The effectiveness of EU ETS is a controversial issue. A comprehensive 2015 review found that EU ETS so far has functioned as intended (EC, 2015), but a stronger long-term price signal will be needed to provide incentives for investments in the sustainable transition to a low-carbon economy.

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Nomenclature

Acronyms

BEV	Battery electric vehicle, only powered by electricity
ICE	Internal combustion engine
ICEV	Internal combustion engine vehicle
HEV	Hybrid electric vehicle
PEV	Plug-in electric vehicle, includes both BEVs and PHEVs
PHEV	Plug-in hybrid electric vehicle, powered by electricity recharged from the grid and ICEs fuelled by diesel or gasoline, and alternatively, an ICE running as a generator producing electricity used in the motor

The market introduction of BEVs in Norway is an environmental transportation sector innovation that has diffused into a national market at an unprecedented rate. In this article, the Multi-Level Perspective (MLP) transition theory will be used to investigate why and how BEVs have entered the Norwegian market, and how the political framework, stakeholder activities and international developments interacted to create an environment in which BEVs could flourish. Contributions to the transitions theory literature come from the application of MLP on a real world case that has evolved further than cases previously studied in the transportation sector.

The article starts off with a presentation of the Norwegian context and status of BEVs. Section 3 presents the theoretical framework, research method and material used. Section 4 presents the interactions between actors, consumers and events at different levels, and how these have affected BEV diffusion. A conceptual MLP framework for Norway is presented in Section 5 followed by a discussion of results in Section 6. Implications for policy makers and transition theory development, as well as overall conclusions, are presented in Section 7.

2. Norwegian context

Generous incentives have positioned Norway as the leading BEV market in the world. A market share of 18% of new vehicle sales was attained in 2015 (OFVAS, 2016), whereas most other countries had shares below 1%. The share of the total passenger vehicle fleet reached 2.8% in 2015, increasing at a pace of 0.1% per month. Moreover, BEVs accounted for over 5.4% of the traffic flowing through the toll road ring around the capital Oslo in 2015 (Fjellinjen, 2016).

Consumers have bought 80%, and own over 85%, of the BEVs sold and registered in Norway (OFVAS, 2016; NPRA, 2016). In total, 140 000 passenger vehicles are sold in Norway every year. The total fleet consists of 2.6 million passenger vehicles that are driven an average of 13 000 km/year. Conditions for electric vehicle usage are favourable, as three-fourths of households park their vehicles on their own land and can therefore install charging facilities, while another 12% park less than 100 m away (Hjorthol et al., 2014). Most households also have a sufficient power capacity installed to charge electric vehicles, as electricity provides space heating for 74% of households (SSB, 2015b). The average household consumed 16 MWh of electricity in 2015 (SSB, 2016), while the energy consumption of a BEV would only add approximately 15%. The grid may however need reinforcement, as some utilities already say no to home charging faster than 3.6 kW (DN, 2014).

Since 2012, BEV policies have been anchored in climate policy (CPS, 2012). However, the first incentive became available as early as 1990. Norway has no ICEV production. Fuel prices are also among the highest in Europe, whereas electricity is cheap (Figenbaum et al., 2015a,b), with 96% produced in hydroelectric power plants (Figenbaum et al., 2015b). Powering all passenger vehicles in Norway would only consume approximately 5% of the hydroelectric electricity produced in a “normal year”.[1]

The Norwegian transportation sector is heavily taxed, which includes registration taxes on new vehicles, annual taxes, taxes on fuels and numerous toll roads. This regime makes it possible to create incentives by selectively foregoing taxes (Fearnley et al., 2015), thus influencing the types of vehicles sold. A range of BEV incentives have been introduced over the years along these lines, also including incentives providing users with special privileges as seen in Table 1.

BEV buyers typically belong to multivehicle households that have many of the same characteristics of early adopters as in Rogers’ (1962, 1995) theory on the diffusion of innovations, and on the buyers of new vehicles in general (Figenbaum et al., 2015a, 2014; Hjorthol, 2013), such as high income and higher education. They also live in large households in or around cities (Figenbaum and Kolbenstvedt, 2015a,b).

Fearnley et al. (2015) found that incentives reducing the purchase price have been the most effective in speeding up the diffusion of BEVs by evening out the sales prices of BEVs and ICEVs. Local incentives, such as bus lane access, exemption from toll road charges, parking free of charge and reduced ferry rates, were valued in 2014 (avoided costs and value of time savings) by BEV owners in Norway to be approximately 1 900 Euro/vehicle/year (Figenbaum et al., 2014), hence playing an

[1] Estimate: BEVs consuming 0.2 kWh/km, average vehicle driven 13 000 km per year, 2.6 million passenger vehicles, 125 TWh hydroelectric electricity production; normal year = average weather.

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