Multiple levels of transition governance and the break-through of the electric vehicle

Marianne Ryghaug and Tomas Moe Skjølsvold

Dept. of Interdisciplinary Studies of Science, Norwegian University of Science and Technology, NTNU, Norway. Contact: Marianne.ryghaug@ntnu.no

Abstract

While many ideas on transition governance focus on the early stages of transition processes, a pressing challenge pointed to by STRN scholars is to develop more insights into how to govern later transition stages in order to accelerate the process. In this paper we aim to meet this challenge by analysing the long-term transition towards developing and eventually adopting Electric Vehicles (EVs) in Norway. We study what on the surface appears as a national public goal to steer a mobility transition through demand side policies, but argue that the transition must be understood as guided by local and national policies in multiple countries, national and international industrial strategies, as well as key intermediary actors and interests groups. Changes in user preferences and cultural meaning are also important. Thus, the article feed into the debate on the multilevel nature of transition governance that spans global international, national and local scales and spaces.

1. Introduction

The mass-market adoption of electric vehicles (EVs) is widely seen as a cornerstone of the strategy to achieve the legally required carbon emissions cuts in the transport sector in Europe and elsewhere. Even though the first EV models appeared as early as late nineteenth century, the petrol vehicle has thus far remained the dominant technology due to being deeply entrenched in systems locked in by petrol car based production and consumption patterns, creating stable path dependent trajectories. However, during the last years, EVs have begun to challenge the market for petrol cars and we see an acceleration towards electro mobility, at least in some places such as Norway.

In this paper we adopt a socio-technical transition perspective as an instrument for our analysis highlighting the close alignment of social and technical elements, including policy, product technology, industry, markets, consumer behaviour, infrastructure, spatial arrangements and cultural meaning (Geels, 2005) to understand the unfolding shift to electro mobility in Norway. This means that we do not only focus on the emergence of a green innovation, but rather on the break-through, diffusion, tipping-points and the speed of

transitions and how this is linked to policy instruments and micro-politics across different geographical scales.

The current shift towards electric vehicles in Norway has mostly been linked to national financial and regulatory incentives to promote the adoption of electric vehicles. We recognize the importance of such traditional policy instruments (taxes, subsidies, exemptions). However, as we know that new technological regimes are not merely created, we emphasize how these policies have co-evolved and have been produced by the actions and strategies of many different actors. When observed as a longitudinal process it becomes clear that landscape changes and external events (such as the oil crisis in the 1970s, or Californian policy shifts in the early 1990s) have been essential to the trajectory of Norwegian EV developments, which began as an effort to instigate new, Norwegian industrial activity.

Further, when Norwegian niche actors from this industry entered the international automobility regime, they became exposed to the pressures and expectations within these regimes from which they were previously shielded. Thus, two key contributions from this study to the transition literature is to highlight:

a) *How national niches sometimes depend on international regimes, and the way that these regimes might overflow local niches in globalized markets*.
b) *How local policies aiming to stimulate changes in production and demand of e.g. mobility services, unexpectedly might feed into the development of niches in distant locations.*

By addressing the interrelation between technological change and the social and political environment in which the technology is put to use, as well as the availability of complementary technologies and user perceptions, we bring new insight into the research on the politics of transitions in the field of electromobility.

1.1. Electric mobility in Norway

In 2010, approximately 3000 battery electric vehicles (EVs) could be seen on Norwegian roads, and the annual sales of EVs were hardly visible in the annual vehicle sales statistics. As we write this chapter, eight years later, almost every other new car sold in Norway is a battery EV, and the total market share of EVs is around 30%. Battery EVs have become mainstream and are normalized elements in Norwegian mobility culture. The standard media narrative sees the Norwegian EV boom as a result of targeted policies aiming to stimulate EV demand. However, as we know from the transitions studies, transitions are never the sole outcome of a government intervention or a transport innovation, but the outcome of alignments between multiple developments (Geels et al 2012). Thus, we offer a counter-narrative to the typical EV success story that only focuses on national policies, by exploring the history of the Norwegian EV transition in-depth, introducing important

nuances and highlighting some issues that do not necessarily fit the dynamics described in to the first generation of MLP.

We also illustrate that many of the incentives that seem to underpin the current boom in EV demand were in-fact introduced one or two decades ago. These incentives primary objective were not to stimulate mass-market demand, but to nurture what many hoped would a Norwegian industrial venture: the production and export of Norwegian EVs. The quest for such an ambitious industrial undertaking was in part, fuelled by local policies in California and subsequent industrial strategies adopted by international incumbents to meet new regulations.

Norwegian electricity production is predominantly renewable (98%), based on hydropower (e.g. Skjølsvold, Ryghaug and Dugstad 2013). Space heating is also primarily electric. Thus, Norwegian climate mitigation efforts do not primarily target electricity and heat generation, but electrification of the transportation sector (Amaas and Peters 2017). Against this backdrop, the story of Norwegian policies boosting demand for EVs intuitively makes sense and is strengthened by the fact that Norway has been described as a particularly mass-motorized society (Østby 2004). Living standards and wages are high, with a "comfort oriented" energy culture in which electricity is both abundant and cheap (Aune 2007). Retrospectively, the electric car appears as a natural fit for Norway's national context. However, other factors such as the large Norwegian export of oil and gas as well as the importance of this industry for Norway's GDP might lead us to the conclusion that promoting the electrification of transportation is awry with incumbent oil and gas interests.

Even though the EV share is not higher than 3.7% of the total number of cars in Norway (Statistics Norway, 2017), the country has unambiguously taken a leading role in the introduction of electric cars, acting as a kind of laboratory for experiments in developing a market for EVs. A comprehensive package of local, often economic incentives, as well as the establishment of a state-owned enterprise called Transnova – the body providing financial support to charging facilities – has been identified as important for the rapid expansion of Norwegian EV sales (Figenbaum and Kolbeinstvedt 2013; Ryghaug and Toftaker 2014).

Incentives to promote electric vehicles in Norway include exemptions from tax on purchase, vehicle registration, and value added tax (VAT). Further, electric cars are exempt from road tolls and tunnel-use charges, are granted reduced fares on national road ferries, given the freedom to use bus lanes, benefit from public parking (sometimes with free charging included), and have access to a dispersed network of charging stations. EVs are typically priced in the same range as a petrol car in the same class. Operational costs of EVs are also relatively low due to effective engines fuelled by cheap electricity produced from Norwegian hydropower. The total savings being from up to one-fourth to one-fifth of the cost for petrol. Thus, altogether there is a solid package to stimulate EV demand in Norway. The above mentioned common story of these incentives pushing Norway to the role of global

forerunner in electro-mobility (Bjerkan et al. 2016) is however far too simplistic, as we will see in the following analysis.

The analysis is based on a compilation of findings from different research projects studying different aspects of electrification of the Norwegian transportation sector that the authors have been involved in. These projects have yielded many interviews with key actors involved in the introduction of electric vehicles in Norway, as well as interviews with users and document analysis. Thus, empirically, the paper is based on data from these previous studies, official transportation policy documents, as well as available secondary sources such as journal articles and books.

The paper is structured as follows. Section 2 briefly introduces the multi-level perspective (MLP). Section 3 applies the MLP as a framework for understanding the rise of the Norwegian electro-mobility system and analyses of the dynamics between policies, actors and market development across time and space. The discussion also feed into the debate on the multilevel nature of transition governance that spans global international, national and local scales and arguments relating to what has been called the second generation of MLP (Raven et al. 2012). Section 4 draws conclusions about low-carbon transitions and makes some evaluative remarks on what other countries can learn from Norwegian electro mobility experiences.

2. Analytical framework: A socio-technical transition perspective

Systemic transitions entail co-evolution and multi-dimensional interactions between industry, technology, markets, policy, culture and civil society (Geels 2012). To understand the development and increasing proliferation of electric vehicles in Norway, we mobilize a socio-technical understanding anchored in the multi-level perspective (e.g. Geels, Tyfield, and Urry 2014, Geels 2010). This entails a symmetrical understanding of the importance of social and technical elements of transitions and recognition that the elements in socio-technical systems are maintained, reproduced and changed by various actor groups (Geels 2012). Thus, transitions are seen as co-evolutionary processes, which take decades to unfold and involve many actors and social groups (e.g. firms and industries, policy makers and politicians, consumers, civil society, engineers and researchers). MLP further distinguishes between three levels: niches, regimes and landscape (Geels 2002). The top-level landscape is understood as exogenous to the system; it is the "technical, physical and material backdrop that sustains society" (Geels and Schot 2007, 403). Change is very slow with the exception of external shocks. Regimes are understood to be constructed of quite stable, institutionalized and large networks, while niches are smaller with less stabilized rules of conduct.

The understanding of agency in the MLP builds on institutional theory (Scott 1995) and sociological structuration theory (Giddens 1984), which implies that actors in regimes and niches make choices under the influence of regulative, cognitive and normative rules (see Geels 2010). These rules guide the actors, but actors also produce and re-produce the rules

through their enactment. The landscape agency is of a different kind, not necessarily determining what happens in regimes, but landscapes are understood to "provide deep-structural 'gradients of force' that make some actions easier than others" (Geels and Schot 2007, 403). Transitions, then, are typically understood as changes in the regime, often conceptualized as enabled by 'nurturing' niche technologies and solutions in such a way that they eventually grow into and destabilize the regime. A recurring issue in such transition processes is that there is a lack of coherence between the societal institutions, or 'the rules of the game' and the technologies being implemented. As an example, it is quite common for institutions to be shaped for centralized systems, while emerging systems are of a distributed character (Crettenand and Finger 2013).

Although we recognize that the MLP offers many clues about how to understand and analyze long term and encompassing transitions, we are also sensitive to the criticism of the MLP for being too focused on the semi-functionalistic aspects of systems, and too little focused on the actors involved in transitions and their practices (Åm 2015; Farla et al 2012; Smith & Raven 2012). We also support and build on recent attempts to better understand the formation of policy processes leading to transitions (Kern 2017), as how different network structures facilitate different levels of access to policy making processes (Normann 2015). Related to this, we do not only focus on how policies work as a factor influencing the diffusion of EVs, but more fundamentally, how and why policies have been shaped in the way they have.

We are also interested in the relationship between policies implemented in diverse geographic locations and processes unfolding across space in unexpected ways, thus tapping into the discussions about a second generation multi-scalar MLP that explicitly incorporates a spatial scale as proposed by Raven, Schot and Berkhout (2012). By indirectly taking a more spatially sensitive grasp of the formation and early growth of technological niches and their coupling with spatial systems of work, policies, production and innovation we contribute to the ongoing academic debate about near- and far-geographies of knowledge and its institutional and contextual underpinnings (Coenen et al 2004; Gertler 2010; Carvalho et al 2012) and a more geographically nuanced view of how protected niches that may lead to mobility transitions and new technologies in low carbon transport technologies emerge and unfold in relation to specific places and spaces. Including more spatial dynamics into the analysis is something that has been called for by several transition scholars (Späth and Rohracher 2014; Coenen and Truffer 2012), and in this article we seek to cater for this call by studying niche-regime-landscape dynamics in a scale-sensitive way.

Another important aspect of a socio-technical perspective on transitions in mobility is a renewed interest in the cultures of mobility, and the elements that constitute such cultures, as well as the role of this culture in mobility transitions (e.g. Hopkins and Stephenson 2014; Sheller 2012). Mimi Sheller's (2012) contribution is of particular interest to our discussion here. Sheller highlights how the niches, regimes and landscapes of mobility are all produced

by a set of three distinct elements: a) practices, b) networks, and c) discourses. Hence, understanding the journey of a new "solution" such as the electric vehicle from niche to regime, is not only a matter of understanding the proliferation of the technological artifact, or related infrastructural elements such as filling stations and repair shops. In the shift from niche to regime phenomenon, Sheller posits, practices change from embodying alternative sub-cultural mobilities to mainstream legitimized practices. Networks shift from being those of social movements rooted in 'green' lifestyles, to become those of durable interest groups and governing structures, while discourses shift from being counter-discourses that challenge dominant order to standard discourses that are used to legitimate existing actors and practices. Sheller's research adds further analytical depth to what Hopkins and Stephenson (2014) call mobility cultures, which are created out of materiality, cognitive norms and social practices. In our discussion, we will emphasize the relations between social and material aspects of electromobility, and the sometimes unexpected links that emerge between policy, practice, innovation and diffusion that we see as decisive in the shift towards electromobility in Norway. Some of these links were already apparent in the beginning of the century when Gjøen and Hård (2001) noted that by driving differently and viewing automobility differently, EV owners developed "user scripts" that challenged established political and engineering scripts while contributing to a cultural politics of automobility.

3. Analysis: Nurturing a Norwegian mobility regime shift?

Discussions about transitions often revolve around how to nurture niche industries, socio-technical configurations and technologies in order for them to flourish and gain foothold in regimes (Geels 2002). This somewhat broader consideration focusing on the regime level aptly suggests that transitions are about more than simply transplanting new technologies into social settings, but that they are also about producing new industries, business, practices and culture. In the following we will analyze why Norway has embarked on this particular transition pathway – from traditional fossil fuel cars to EVs – when, at first glance, nurturing an electric EV market appears to be a poor match with domestic industry interests heavily entrenched in an oil economy with no car industry to speak of. Thus, in order to understand the Norwegian policy developments and governance structure in this area, we must first turn back several decades in time and focus on a lesser known aspect of the Norwegian EV story: that of Norwegian car manufacturing and efforts to develop a domestic EV industry.

3.1 Early attempts to nurture an alternative EV industry in Norway

Over the last century, there have been several Norwegian initiatives to develop electric car and a motorized vehicle industry. The most famous might be the car manufacturing company 'Troll', who sold its first car in 1956, but went bankrupt already in 1958, having delivered only six cars. Electric vehicles were produced in Norway between 1918 and 1924 by a production company that was created to mitigate the problems of obtaining motorized

vehicles in the wake of World War One and delivered ten functional electric trucks (Asphjell, Asphjell and Kvisle 2013).

During the 1970s and in response to the oil crisis of 1973, interest in electric vehicles rose sharply. A company called ELBIL, which literally translates into 'electric car' delivered three electric vans to state service providers (Asphjell, Asphjell and Kvisle 2013, p.52). The most important development to this end, however, was that the owners of a plastic producing industrial firm, Bakelittfabrikken, aimed to produce a small, urban plastic chassis EV. This strategy was based on the sentiment that Norway was poor in oil but wealthy in electricity and that this situation should be reflected in the country's dominant mode of mobility (Asphjell, Asphjell and Kvisle 2013). A prototype was built, but no subsequent steps towards realization were taken.

The developments of the 1930s and 1970s illustrate how landscape shocks, e.g. a war or, in this case, the oil crisis, might open "windows of opportunity" for new niche transport technologies (Geels 2007). As the oil crisis ended, however, the dominant automobility regimes remained intact and Norwegian interest in EVs faded. After some initial work in the late 1980s the owners of Bakkelittfabrikken AS started a new company called PIVCO (Personal Independent Vehicle Company) in 1990. In Norway, the idea was institutionally nurtured through the provision of small scale research funding. Just as important, however, was the fact that the owners of the factory were inspired by local policy developments unfolding more than 9000 kilometres away from the small town of Aurskog: the enactment of the Zero Emission Vehicle (ZEV) legislation in California, which was seen to offer future commercial opportunities (Hoogma 2002; Buland 1994). This early work resulted in a feasibility study (Røste 2001), and an ambition to build a short range, two-seat prototype EV called a Personal Independent Vehicle (PIV) (Buland 1994).

Many saw Bakelittfabrikken as an opportunity to create new business and industrial opportunities in Norway, in competition with the comparatively large automotive industry in Sweden. The firm managed to secure loans and government subsidies, attract interest and support from a significant number of private and public actors, and obtain R&D funding from various sources (Hoogma 2002). The first prototype ('PIV1') was successfully tested in 1993, resulting in a new project for which PIVCO delivered a fleet of 13 EVs ('PIV2') to be tested in extremely cold conditions and rendered highly visible to the Norwegian public during the Winter Olympic Games in Lillehammer in 1994 (Asphjell, Asphjell and Kvisle 2013). For the trials, the PIV2 was re-branded as the 'CityBee'. On one level this resembles a niche experiment (Raven 2012). It functioned both as a marketing and public engagement activity to illustrate an alternative to the dominant mobility regime. Throughout this period, PIVCO's work was subsidized through funding from a national industrial fund, as well as supported by Oslo Energi, a large electricity producer (Røste 2001). During this period, some level of national nurturing and shielding activities of this small niche product were required and different phases of niche development as have been illustrated in the SNM literature could

be identified: starting with the development of concrete local projects, where actors work together to connect, network, share experience and replicate, eventually forming a more and more 'cosmopolitan' or global niche (Geels and Deuten, 2006; Geels and Raven, 2006; Seyfang et al., 2014).

The CityBee experiment worked, both in the sense that it demonstrated the potential of the vehicles and attracted the interest of several incumbent actors in Norway and abroad. Local electric companies were all early customers. These companies were interested in using the vehicles themselves for showcasing the various uses of electricity (Buland 1994). None of the actors involved in production or shielding, were from the traditional automobile industry. Rather, this niche was nurtured and protected mainly by incumbents in the Norwegian hydroelectricity sector, and thus represents a new set of activities envisioned as feasible in this regime.

Meanwhile, PIVCO was at this point not only inspired by developments abroad, but also attracted the interest of actors far away. In addition to implementing the Californian ZEV legislation, San Francisco was developing its profile as a pioneer of clean urban transportation, and was looking for supplements to their light rail system 'BART' (Bay Area Rapid Transportation System). To this end, they ordered approximately 50 vehicles from PIVCO to be used in their collective "station car program" (Asphjell, Asphjell and Kvisle 2013, p. 127), which was introduced as a way to allow people to get to and from stations in a simple way. Using cars for this purpose, raised a challenge to what has been described as a strong cultural preference for personal car ownership (Geels 2012).

This initiative was enabled in a sort of international cross-niche and cross-regime fertilization process, where a Norwegian hydropower regime was nurturing an electro-mobility niche, while a Californian public transport regime was nurturing a new niche for 'last mile' transport. Despite being geographically divided by the Atlantic Ocean and most of the North American continent, these developments became entangled to make possible the production of a distinctly new kind of car with a different ownership structure, script and intended use compared to traditional combustion engine cars. The development of PIVCO surged in 1995, a year characterized by several large publicity stunts in support of EVs in Norway. When delivering the first vehicles to San Francisco, the PIVCO management was escorted by the Norwegian king and queen, securing them massive media attention. The first Scandinavian Electric Car Rally from Gothenburg to Oslo was hosted the same year, with famous Scandinavian rally drivers behind the steering wheels. The sentiment amongst Norwegian actors was now that Norway was about to embark on a new and widespread EV industrial venture.

After some difficult years requiring intensive work in San Francisco, PIVCOs entry into the USA aroused substantial interest from the traditional automobile regime. This interest was amplified by the Zero Emission Vehicle legislation in California, which essentially established a credit-system in which car dealers had to earn credits from the sale of non-emission

vehicles in order to legally be able to continue selling petrol cars (Hoogma 2002). While actors like Chrysler and General Motors took legal action against the state, Ford was determined to comply with the new rules, thereby opening up a new window of opportunity for the Norwegian EV manufacturers. Ford acquired PIVCO to be able to meet the new California legislation and by the late 1990s, PIVCO was re-branded as Th!nk. The company that had been nurtured and enabled by work in alternative regimes had now been appropriated and made part of a traditional automobile production regime. This shift entailed large changes for Th!nk, which had to adjust to the production standards and ideals of Ford – not only up-scaling but also changing the ways in which vehicles were produced but much higher expectations with respect to performance. In the eyes of many Norwegians the 'EV-adventure' had now come to fruition. At the time, many believed that what PIVCO lacked to succeed as a car manufacturer was the sort of competence that Ford brought to the table (e.g. Røste 2013, p.7). In retrospect, however, an equally plausible interpretation is that Ford's acquisition of Th!nk was the beginning of the end of the Norwegian EV industry. We will soon return to this point.

Ford's acquisition of Th!nk in 1999 and the subsequent launch of the first model intended for mass marketing has been described by transport scholars as the early market phase of Norwegian EV development (Figenbaum and Kolbjørnstvedt 2013). At the same time, there were also other actors involved on the Norwegian EV scene and who were creating new companies to become part of the venture. Kollega Bil was established and started producing and leasing the EV brand 'Kewet' in Norway after buying the assets from a bankrupt estate in Denmark (Figenbaum and Kolbjørnstvedt 2013). Other external factors also presented themselves as favorable during this period. The big industrial conglomerate Norsk Hydro had to scale down its activities in the region, resulting in more extensive business development support, which also benefited Miljøbil Grenlands new EV leasing business operating in the area. Consequently, a Norwegian EV industry cluster was in the making, as was the political understanding that it was important to support the development of a domestic EV market (Figenbaum and Kolbjørnstvedt 2013). As noted by Gjøen and Hård (2002), politics here were not only conducted through formal processes, but through distributed processes of "micropolitics", where the strategies of actors like municipalities and individual drivers were important.

The Norwegian 'EV-adventure' was nurtured in several ways. First, through rather small scale national funding mechanisms meant to protect PIVCO and accelerate the industrial evolution of the company. Second, through local policy initiatives abroad, notably in the city of San Francisco and more broadly in the state of California. Third, actors promoting electro mobility began coordinating and organizing their action in a targeted way in the early 1990s, thus, fulfilling the role as "intermediaries" (Kivimaa 2014). The EV interest organization NORSTART was established in the early 1990s aiming to pressure the government and to unify what was still an uncoordinated business area (Buland 1994). The organization was quite successful, and several incentives to stimulate the demand for EVs were introduced in

Norway concurrently as the story of PIVCO and the Norwegian EV industrial adventure unfolded. EVs were exempt from purchase and import taxes in 1990. Some places implemented free parking in 1993, and most municipalities had free parking from 1999. EVs benefited from low annual road taxes from 1996 and were exempt from toll roads in 1997. The EV interest organization was not the only actor behind these policy developments. Another type of intermediary actor, the environmental NGO Bellona, who worked to raise awareness of the benefits of EVs must also be credited for their longstanding effort to secure favorable conditions for EVs in Norway, particularly in Oslo. With the emergence of what could be described as a new Norwegian EV industry cluster, stimulating the development of a domestic market was viewed as important. The result was a set of new incentives: the exemption from VAT from 2001 (25% in Norway) and experiments with allowing EVs to drive in the bus lane in the larger Oslo region from 2003 (permanent and nationwide from 2005, with minibuses being banned from 2009) and reduced rates on coastal ferries (2009), and exemption from VAT on leasing (from 2015).

Despite "wide-ranging political visions, far-reaching networks, and elaborate engineering scripts", the number of electric vehicles was still limited in 2002 (Gjøen and Hård 2002). However, after more than ten years of attempting to establish domestic manufacturing, the efforts to promote EV technology began to pay off. Buland (1994) asked whether a lack of tradition for car manufacturing actually could be seen as a benefit for producing a new electric car in Norway. The question is still relevant. The Norwegian 'EV adventure' was mainly driven by actors who had no prior interest or competence in car production. Thus, they were not restricted to a set of predefined car models and existing socio-cultural understandings about 'what' a car was or what a car could be. Nor were they restricted by existing manufacturing techniques and so called 'sunk investments' related to production modes and facilities, or networks of existing interests and selection environments. When approached by San Francisco, there was no threat to regime ideals about producing and selling cars to individuals. It might not be so strange after all that the EV challenge to traditional automotive regimes emerged from Norway, a country without a strong car manufacturing tradition.

3.2 The harsh reality of the international automobile regime and its fatal consequences for the Norwegian EV venture

In 2003 it became clear that Chrysler and General Motors had won the lawsuit against the state of California, and as a result, the ZEV regulations became weaker. This, combined with poor corporate economy, resulted in Ford pulling out of Th!nk. Compared to other cars in the same price range, the Th!nk car was small and relatively slow making it difficult to introduce to the American market. One explanation was that Th!nk was a poor match with American mobility culture, which remained stable and anchored in hegemonic ideals of personal ownership of large petrol cars. Th!nk was eventually acquired by other investors, who owned the company for two years without achieving much. The company was again bankrupt in 2004. This time Th!nk was bought by Norwegian investors who wanted to

revitalize the company by launching a new model that had been developed during the period of Ford ownership. The domestic Norwegian EV market was relatively stagnant in this period and the little demand that existed was not covered by Norwegian industry, but rather through second hand imports of French EVs manufactured between 1998-2002. The main EV market was located in the greater Oslo/Akershus region where commuters could save time driving in the bus lanes and in areas with high road toll charges (Figenbaum and Kolbjørstvedt 2013). According to Figenbaum and Kolbjørnstvedt (2013), what they called the market introduction phase started around 2009 when a new generation of Th!nk was launched by new owners, and the alternative Norwegian brand, Pure Mobility, which produced the models Buddy and Kewet, surfaced. In 2010-11 the industry leaders Mitsubishi, Peugeot, Citroën and Nissan began to launch EV models and Norwegian car dealers began importing them. Norwegian EV manufacturers soon went bankrupt. The Norwegian EV market really boomed after the introduction of Mitsubishi i-MiEV in 2010 and Nissan LEAF in 2011 (Lorentzen et al. 2017).

The period after 2009 has been the main object of attention in international discussions about the Norwegian EV boom, which is not so strange as it represents the period when a jump in sales statistics can first be observed. This period was none the less, not so significant when it comes to the introduction of new incentives and government support, which happened in the years before. However, an important development was that NORSTART became the 'EV Association', which entailed much stronger coordination efforts, as well as much more active efforts to enroll the Norwegian public as participants in the EV transition. NORSTART became visible as disseminators of information, they also worked to recruit EV drivers through free test drives, and they facilitated knowledge transfer through online platforms. Thus, they were an important intermediary organization (Kivimaa 2014). However, Norway's first governmental support scheme for public charging infrastructure took place in 2009-2010 (Lorentzen et al. 2017), resulting in the building of about 1800 chargers. In 2009 the government organization Transnova (later merged with Enova) was established to support the testing and implementation of climate friendly technologies in transport. Transnova ensured the coordination of (fast) charging infrastructure and supported charging facility developments across the country, resulting in a large network of charging stations across the country. As of June 2017 the number of publicly available Schuko-points was around 4400 and 2700 Type 2 points (Lorentzen et al 2017). From 2015 Enova introduced a support scheme aiming to cover Norwegian main roads with fast charging stations every 50 km and support the building of fast chargers in municipalities with less than two fast chargers available.

Developing an accessible and dispersed charging network has probably had an important symbolic effect, as it has made the strategy to support EVs highly visible. When it comes to actual charging behavior most studies show that EV drivers tend to charge their vehicles first

and foremost at home some also charge at work, while few use public charging stations daily or weekly (Lorentzen et al 2017; Norwegian EV owner survey 2017). There are indications, however, that a network of chargers throughout the country is a culturally important safety-net to mitigate everyday range anxiety.

3.3 User preferences and the growng EV market

The Norwegian EV transition should not be reduced to a tale of 'implementing effective policies'. Rather, there have been important changes in the ways Norwegians talk, think and act with respect to mobility during the last decades which illustrates that the Norwegian EV transition is an unfolding transition of mobility culture, including changed practices, networks and discourses (see e.g Sheller 2014; Hopkins and Stephenson 2014). Perhaps the most important development after 2009 has been the increase in social learning amongst drivers of EVs, and the gradual development of a mobility culture in which EVs are seen to 'work' well. Although EVs remained an 'incomplete innovation' within an alternative automobility niche for years because of aspects relating to size, driving range and comfort, more recent studies of actual Norwegian vehicle driver experiences tends to produce different narratives (see e.g. Ryghaug and Toftaker 2014; Ingeborgrud and Ryghaug, 2017) highlighting other qualities and stressing that EVs actually perform much better than expected compared to their fossil fuel counterparts by being quieter, easier to operate because of fast acceleration easier to park, and charge (because of charging at home or at work), as well as receiving more positive reactions from passers-by, colleagues, friends and family and are seen as environmentally benign.

The first EVs in use were mainly small two-seat passenger cars with limited driving range branded as an environmental transportation device and not as an ordinary car (Ryghaug and Toftaker 2014; Gjøen and Hård 2002). These compact EVs with limited range fitted well with the 'city car' user script, and most drivers were content with the performance of their cars and had adopted their usage accordingly, viewing most features as assets. From here, it is difficult to pinpoint the exact emergence of new markets and user segments as they developed. However, user studies conducted over the last years (Ryghaug and Toftaker 2014; Ingeborgrud and Ryghaug 2017) show how new users groups were attracted to the technology as it developed, and EVs began to resemble more traditional cars. The EV were also introduced in different public services such as the postal service and home care. A qualitative leap was made with the development of the five-seat car. With Tesla and other luxury cars being developed, a new EV market offered vehicles to those who wanted cars in the high end segment or families in need of a bigger EV with a longer driving range (Ingeborgrud and Ryghaug 2017).Thus, in stark contrast to what has been commonly perceived as the drawback of EVs, studies regarding Norwegian EV user preferences tell a contradictory story stressing the benefits of driving EVs and the embodied qualities of EV driving: strongly emphasis on good driving capabilities, comfort, and the experience of driving with a better conscience. EV driving in Norway seems to be culturally performative of environmental- and climate-related concerns, thus aligning with landscape changes related

to cutting greenhouse emissions and pro environmental actions. As an example, studies indicate that those who drive EVs today are more likely to be interested in acquiring other environmentally oriented technologies, such as solar panels (Throndsen et al 2017; Ingeborgrud and Ryghaug 2017).

Why has Norway succeeded in increasing – more so than other countries – the share of EVs compared to traditional cars? A broad set of incentives have been important, but detailed studies of actual EV users found that the understanding of the economic incentives varied (Ingeborgud and Ryghaug 2017). For some, the incentives were important to promote initial adoption in the transition from petrol to electric cars. For others, the driving pleasure related to EVs as green non-polluting cars was more important. The combination of economic and non-economic benefits represents a highly visible, concerted policy in support of EVs and has a dual effect: first, the comprehensive benefits provide instrumental motives to buy an EV; second, the policy package clearly identifies EVs as a preferred alternative of policy-makers for a more sustainable technology of mobility. In sum, we observe that there is an ongoing shift in the mobility culture where practices change from embodying alternative sub-cultural mobilities to mainstream legitimized practices, as suggested by Sheller (2014) and where networks change from being social movements focused on alternative 'green' lifestyles to those of more durable interest groups and governing structures (see e.g Ryghaug and Toftaker 2017), while discourses shift from being counter-discourses that challenge dominant stories to standard discourses that are used to legitimate existing actors and practices. Table one summarizes some key findings from our discussion.

Table 1: key events, dynamics, policies and market developments in the Norwegian EV transtition

	Event	*Key dynamics*	*Norwegian EV Policies*	*Market*
1970s	Proto PIVCO produced	Landscape shock: Oil crisis	None	None
1990	PIVCO started	Inspiration: California ZEV legislation Nurturing through research funds	None	None
1992	NORSTART, interest organization launched	Industry and interest coordination	Exemption from registration tax (1990)	Marginal niche market
1993	PIV1 tested	Backing from electricity production regime	Free parking experiments (1993)	Marginal niche market

1994	Fleet of PIV2 (CityBee) demonstrated at Winter Olympics	Backing from electricity production regime, niche experiment with large international audience	No new policies	Marginal niche market
1995	Fifty CityBees sold to San Fransisco c	Public transportation regime in San Fransisco wants new solutions for transportation around light rail stations. PIVCO now anchored in Norwegian hydropower regime and San Fransisco public transportation regime	No new policies	Marginal niche market in Norway, Public transportation in US
1999	Ford acquires Th!nk (formerly PIV/CityBee)	ZEV legislation in California requires selling zero-emission vehicles, pressures automobile production regime to change. Th!nk had been nurtured in hydropower and public transportation regime, but acquired by automobile regime actors.	Reduced annual license (1996), Road-toll exemption (1997), Reduced taxable benefit on company cars (1998)	Norway: public service, company fleets, and some private customers
2003	Ford sells Th!nk	Chrysler and General Motors win lawsuit against California, ZEV becomes less strict. Th!nk is now without incumbent automobile regime actor support	VAT (25%) exemption (2001), Local experiments with bus lane access (2003)	3,000 vehicles sold in Norway
2004	Th!nk goes bankrupt	Company unable to subsist in automobile regime without incumbent support.		Small, private urban market. Mainly import
2009	Car dealers begin importing EVs for mass market	Climate change as landscape is developed. Policies earlier intended to stimulate industry development now helps Norwegian vehicle market EV transition	Bus lane access permanent (2005), ferry ticket exemption (2009)	3,347 EVs registered (2010)
2013	EV market takes off	Positive user experiences produce new narratives about EVs. Positive media attention.		19,678 EVs registered. 500 chargable hybrids registered
2017	The sale of new EVs higher than the sale of new fossil cars	Large automobile regime actors use Norway as testbed for new models. Alternative regime actors (Tesla) have Norway as key market. Some public contriversy on EV incentives.		126,448 EVs, 58,213 chargable hybrids registered

4. Conclusions and reflections

Following the multi-level logic, transition policy should follow a two-way strategy: (a) stimulate the emergence and diffusion of niche-innovations, and (b) enhance selection pressure on the regime through economic instruments (e.g., carbon taxes) and regulation (Geels 2012). While it has been asserted that transport policies give moderate attention to the first and little attention to the second strategy (Geels 2012) one may easily be led to conclude that the current success of electromobility in Norway has been produced by the second strategy. However, as we have argued here such a shortcut would grossly oversimplify the narrative and lead to the neglect of the industrial ambitions that once underpinned the development of this (policy) strategy. Looking back, it is difficult to say how successful Norwegian policies for stimulating demand would have been without the industrial ambitions or if the strategy would even have emerged without its industrial predecessor. Further, we also know that focusing too much on the effects of policy on technology development can lead to a neglect of the political processes that bring about policy change (Normann 2015). In recent years there has therefore been an increased focus on the formation of policy (see e.g. Weber and Rohracher, 2012; Normann 2017; Kern 2017) when studying socio-technical transitions and our chapter contributes to this growing body of scholarship.

Our analysis has demonstrated that we must go many years back in time and understand the Norwegian attempts to develop an alternative car manufacturing industry in order to better understand why Norway chose to introduce the EV incentives. When observed as a longitudinal process it becomes clear that landscape changes and external events (such as the oil crisis, the sudden change in Californian policies) have been essential to the trajectory of Norwegian EV developments. As shown in the previous sections, it was the industrial strategy to develop EVs in Norway that contributed to the development of the policies (and most of the EV incentives) that we find today, even though at the outset, it seems non-intuitive that the strong policies have been related to attempts to nurture a niche for EV production as an alternative to combustion engine developments. The first serious efforts to commercialize Norwegian EVs (Th!nk) was launched already in the late 1990s out of the desire to establish a Norwegian EV production. However, local air quality, energy efficiency and increased use of Norwegian electricity were also important ingredients in the work to establish the EV as a promising technology. Environmental organizations and EV interest organization worked as intermediaries (Kivimaa 2014) creating favorable user conditions for EVs. These intermediary organizations worked to demonstrate the assets of EVs contributing to many of the local, as well as national incentives of EVs that Norway has today. Thus, we see that not only important sustained systemic government-affiliated intermediaries (such as Transnova) engaged in strategic niche management processes. Non-profit organization (such as the Norwegian EV Association) and Environmental NGOs, (such as Bellona) from an early stage, played an important contribution to the transition by initiating new policy, social

learning and market processes, as well as by articulating new visions and expectations that is typical of these kinds of intermediary actors (see eg. Kivimaa 2014).

From the literature on socio-technical transitions we know that niches are often sustained through demonstrations or experimental projects, which allow niche actors to learn about innovations in real-life circumstances. Niches tend to gain momentum if visions and expectations "become more precise and more broadly accepted, if the alignment of various learning processes results in a stable configuration ('dominant design'), and if social networks become bigger (especially the participation of powerful actors may add legitimacy and bring more resources into niches)" (Geels 2012, p.4). This resonates well with the Norwegian case, where EV driving was initially pioneered by actors outside of the automobility regime. They were able to act in this capacity because big car manufacturers had not yet moved into these areas. When they did, they often created strategic alliances with small firms, or took them over (Dyerson and Pilkington, 2005). Thus, in line with Späth and Rohracher (2014), we see how regime actors (such as Ford) also are niche actors experimenting with alternative technical configurations.

However, our analysis also highlights that such alliances with dominant regime actors might be treacherous, as the shielding, protection and flexibility of being a niche actor might be lost in the process. Our analysis reveals that when Norwegian niche actors tried to enter the international automobility regime, they became vulnerable to changes, volatilities and fluctuations within these regimes from which they were previously shielded. Thus, one contribution from this study to the transition literature is to highlight how national niches sometimes depend on international regimes for (policy) support, but that the actions in these very regimes might sometimes destabilize local niches. Thus, showing how territorial particularities and connections to global networks (policies, multinational organizations and industries) can provide an alternative explanation for disruptive changes in socio-technical configurations.

It has also been noted, that while the MLP has a strong temporal orientation, the spatial dimension has been less elaborated (Geels 2012; Raven, Shot and Berkhout 2012). The complications this creates for the transport domain are clearly visible in this analysis, as has been noted elsewhere, since many dimensions of the automobility regime are national or international, while some dimensions are local, resulting in the fact that national mobility regimes can have local variations, and local actors may also support more radical niche-projects locally or elsewhere that can form the seeds for future transitions (Geels 2012). It has been noted that the literature on socio-technical transitions document many cases studies, where almost all assume a national setting (Raven, Shot and Berkhout 2012). This framing of transitions as predominantly national have been pointed out as being in juxtaposition to other studies of innovation looking at the globalization of science, technology and innovation (see e.g. Korsnes og Ryghaug 2016), and in regional studies and economic geography arguing that actors and institutions at multiple spatial levels interact to

create spaces where innovations happen (Raven, Schot and Berkhout 2012;) and the need for a relational understanding of geography, space and scale in sustainability transitions (Hansen and Coenen 2015; Coenen et al 2012)

Following, this, there have been calls to elaborate further on the spatial dimension of transitions (see Bulkeley et al., 2011; Geels 2012; Raven, Shot and Berkhout 2012). Building on this argument, it is interesting to revisit recent debates on the relations between technological innovation systems and space, which focus on how industries located in one country may relate to international technological innovation systems (Normann and Hanson 2017). A commonly mobilized argument in this debate is that a lack of domestic market represents a barrier for internationalization. In light of the analysis of the Norwegian attempt to develop a technological niche market of electric vehicles (and the automotive industry's long term lack of a Norwegian domestic market), the dynamics are even more complex. The work by Norwegian actors to access international markets contributed to making the Norwegian alternative automotive industry more vulnerable rather than more robust, as one might anticipate. Later, the market niche created by comprehensive Norwegian support mechanisms for the introduction of EVs benefited actors in the international technological innovation system. Meanwhile, this indicates that market demand can be actively created by active and comprehensive political nurturing as demand factors have been shown to be one of the biggest challenges for introducing a new technology. However, the role of the EV users was not very significant during the 1990s, when the incentives were introduced. Environmental NGOs, however, represented the users in their battles to provide local traffic-related benefits for the very few EVs on Norwegian roads.

In sum, the Norwegian EV transition can be described as a two-stage process. The first stage (1990-2009) focused on nurturing a domestic EV industry. During these two decades a comprehensive package of policies was introduced. The actual Norwegian market for EVs, however, remained limited. The second phase (2009-present), focused less on industry development. This period is characterized by changes in practices, discourses, perceptions and mobility culture. Today EVs are mainstream, and most EV drivers report that their EVs are better, more comfortable cars compared to petrol cars (Ryghaug and Toftaker 2014; Ingeborgrud and Ryghaug 2017). The emergence of the Norwegian EV culture appears to have been influenced by landscape developments – primarily climate change – and the pleasure related to driving green and non-polluting cars has been very important, sometimes more so than the economic benefits (Ryghaug and Toftaker 2014).

Our study also acknowledges the multi-level nature of governance and policy arrangements and the need to overcome "a containerized view of space", either from the local to the national or from the local to the global, in line with earlier claims (Coenen and Truffer 2012: 370). Earlier studies have for instance suggested that we should identify and assess the strategic leeway of city and regional policies in a more reflexive way (Carvalho et al 2012).

The analysis of this paper also underline this point, as we have demonstrated that localized EV policy and technology developments in Norway should be understood in relation to localized innovation milieus and global knowledge mobility such as San Francisco city policies, regional developments in the US and the multinational corporations such as Ford. Thus, our study provides a more nuanced view on the places and spaces over which new technologies and protected niches may emerge and unfold. In line with Carvalho et. al (2012; 393) our empirics show "how relations and networks constructed with distant places and players are not only relevant in the development of localized clean tech innovations, but also influence and are influenced by these distinct embedded dynamics".

We also find that the energy or transport regime need not only take into account local, regional or city level which have perhaps been the most common way to expand the MLP to include more space-sensitive dynamics. Our case show that the transport regime needs to be conceptualized within a global scope, even if important elements (such as laws and regulations) of the system are organized at the national level. Previous research attending to the spatial character of transitions have demonstrated that local energy systems to some degree may affect the global regime by creating new constellations and influencing the energy policy and may suggest a potential for upscaling to a national and international level (Späth and Rohracher 2014).

Looking at Norway, being a very small actor in relation to the global transport regime, it is then perhaps possible to argue that it may potentially have had an effect of the overall transport regime as it has certainly paved the way for EV policy debates on national levels, served as both a test site and a demonstration site for established (incumbent) industry actors and suggested the potential for upscaling EVs on the international level. Thus, our analysis clearly point to the way that three levels of the MLP (niche, regime and landscape) is often implicitly conflated with specific territorial boundaries as pointed out by Raven et al (2012: 64), where "regimes tend to be depicted with national features; (…) landscape dynamics with international features and niches with (sub-) national or local features" is misleading. Such a reading of the MLP clearly obscures important scalar nuances as illustrated in this paper where local, industrial (niche technology) ambitions and strategies in Norway, are related to city and state level US policies and international regime actor strategies. Thus, we see the way local, national and international politics, as well as business strategies is not taken place in isolation of each other (as also pointed out by Bulkley et al 2011).

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