Chapter 8
Nurturing a Regime Shift Toward Electro-mobility in Norway

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Abstract Sales of electric vehicles (EVs) have exploded over the past several years in Norway, to the point that new EVs now outnumber new gas-driven cars in current sales. The popular narrative about how this transition came about suggests that it was the result of a targeted set of policies aiming to stimulate demand for EVs. In this chapter, we tell a different story. In looking at the history behind these ambitious policies, we aim to show that the policies were originally implemented to stimulate the development of a Norwegian EV industry. During the 1990s, much work was done among various industrial actors, NGOs, and policy-makers to establish a new Norwegian niche industry venture, which was partially inspired by local policies implemented in California. The venture did not come to fruition, but the policies eventually did, together with changes in mobility culture, creating one of the world's strongest EV markets. The story illustrates the importance of understanding not only how policies work, but also how they are produced and how their effects travel across geographical borders.

Keywords Electro-mobility · Transition · Policy · Scale · Culture

8.1 Introduction

In 2010, approximately 3000 battery electric vehicles (EVs) could be seen on Norwegian roads, and their sales were hardly visible in annual 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 is approximately 30%. EVs have become mainstream and are normalized elements in Norwegian mobility culture. Their

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established presence suggests that it is now possible to speak about a transition and raises the question as to how we might understand these developments.

The story of a Norwegian EV transition has received substantial international interest. The standard media narrative sees the Norwegian EV boom as a result of targeted policies aiming to stimulate EV demand. This chapter offers a counter-narrative by exploring the history of the Norwegian EV transition in depth, introducing important nuances to the story and posing some challenges to the transition framework, as explicated through the first generation of multi-level perspective (MLP). On the one hand, we illustrate that many of the incentives that seem to underpin the current boom in EV demand were, in fact, introduced more than a decade ago and, in some instances, as much as 20 years before sales figures peaked. On the other hand, we show that the primary objective 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 quest for such an ambitious industrial undertaking was partially fueled by local policies in California and subsequent industrial strategies adopted by international incumbents to meet new local regulations.

In the mid-1990s, a Norwegian transportation researcher concluded that Norwegian EV policies were a failure (Buland 1994), echoed in the international literature (Hoogma et al. 2002: 184), stressing that the small Norwegian market emerged from *distinct and specially created circumstances […] that cannot easily be copied to other countries*. In this chapter, we explore the transition, more than 20 years later, when many of the same policies are making international headlines, and Norwegian authorities are being praised for the success of the electric car market.

Currently, EVs in Norway are part of a narrative of climate mitigation. While the environmental merits of EVs are sometimes contested in the media and popular debate, life-cycle analysis indicates that EVs have substantial climate benefits in European contexts, even in settings where electricity is produced by coal or gas (Hawkins et al. 2013; Ellingsen et al. 2016). In Norway, this positive effect is even greater because Norwegian electricity production is predominantly renewable (98%) and based on hydropower (e.g., Skjølsvold et al. 2013). Therefore, the low-hanging fruit of Norwegian climate mitigation is not to reduce fossil fuels in electricity generation (as is the case for many other countries), but to electrify the transportation sector (Aamaas and Peters 2017).

Against this backdrop, the story of Norwegian policies intuitively boosting demand for EVs makes sense and is strengthened by the fact that Norway is 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 EV appears to be a natural fit for Norway's national context. However, factors such as the large Norwegian export of oil and gas, and its importance for Norway's GDP, might lead us to conclude that promoting transportation electrification is misaligned with incumbent oil and gas interests.

The Norwegian mobility transition does not entail reduced car sales. The year 2016 ranked third for car sales in Norway, with 154,603 new private cars registered, which was a 2.6% increase from 2015. Approximately 30% of these were EVs or chargeable hybrid EVs. Another 10% were nonchargeable hybrid EVs. Of all EVs sold in Western Europe in 2014, 35% were sold in Norway. By September 2017, the sales of new electric passenger cars continued to grow, reaching a record-high 28.6% of the market share. If the current trend continues, the share of electric cars will continue to grow.

Although the EV share is not higher than 3.7% of the total number of cars in Norway, the country has taken a leading role in introducing electric cars, acting as a kind of laboratory for experiments in developing a market for EVs. Consequently, interest in the Norwegian experience has been high among international analysts and practitioners working with electrification. As noted, this interest has clustered around policies. There has been a strong political drive to reduce greenhouse gas in the Norwegian transportation sector. A comprehensive package of local economic incentives, as well as the establishment of a state-owned enterprise called Transnova (now merged with Enova), which provides financial support for charging facilities, was important for rapidly expanding Norwegian EV sales (Figenbaum and Kolbenstvedt 2013; Ryghaug and Toftaker 2014). Incentives to promote EVs in Norway include exemptions from sales tax, vehicle registration, and value-added tax (VAT). Furthermore, electric cars are except from road tolls and tunnel-use charges, granted reduced fares on ferries, can use bus lanes, benefit from public parking (sometimes with free charging), and have access to a dispersed network of charging stations. This appears to be a solid package to stimulate EV demand.

One aspect of the package that has received substantial interest is its effects on the price of EVs. An electric car in Norway is typically priced in the same range as a gas-driven car in the same class (in other words, the electric version of a VW Golf costs almost the same as its gas-driven counterpart and benefits from tax reductions, ranging from €7000 to €8000). Furthermore, operational costs of electric cars are relatively low, due to effective engines fueled by cheap electricity produced by hydropower. The total savings of driving EVs depend on a variety of factors (such as driving style, and use of toll roads and ferries), but the cost of fuel (electricity) is about one-fourth to one-fifth of the cost for petrol. For instance, driving a Nissan Leaf, with an annual mileage of 15,000 km, costs about €2800 less annually than a comparable gas-driven car.

In a white paper from 2012, the Norwegian government stated that the comprehensive package of electric car incentives would be prolonged until either 2017 or the number of EVs rose to 50,000. As this objective was reached in 2015, the incentives have been widely debated since then. In December 2016, Norway had 100,000 EVs, several years earlier than expected. The incentives will be revised and adjusted in parallel with market development in the years to come, but the government promised to keep the tax incentives until at least 2018. However, the ambitions are still high as seen by the Norwegian Parliament's goal that all new cars sold by 2025 should be either zero emission (electric or hydrogen) or low emission (plug-in hybrids).

As we have seen, there are strong incentives in Norway for purchasing and driving EVs, but the common story of these incentives making Norway the global forerunner in electro-mobility (Bjerkan et al. 2016) is too simplistic. In fact, the Norwegian story illustrates that economic incentives alone cannot explain or ensure large sales. Many economic incentives were introduced during the 1990s or early 2000s, without any significant effects on the market: EVs remained a niche market (Figenbaum et al. 2015). Viewed this way, we might widen our perspective and look at the role of other changes. The technological development of electric cars, particularly their battery technology, is one very tangible aspect. Furthermore, there are more subtle changes in how Norwegians talk, think, and act with respect to mobility. In the words of Sheller (2014), it is possible to observe not only a technological transition, but a transition of practices, networks, and discourses; in other words, an unfolding transition of mobility culture (see also, Hopkins and Stephenson 2014).

The analysis is based on a compilation of findings from a number of different research projects studying different aspects of electrification of the Norwegian transportation sector in which the authors have been involved. These projects yielded numerous interviews with both users and key figures involved in the introduction of EVs in Norway, as well as document analysis. Empirically, the chapter 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 chapter is structured as follows: Sect. 2 introduces the multi-level perspective (MLP). Section 3 applies MLP to the Norwegian electro-mobility system and analyses of the dynamics between policies, actors, and market development across time and space. This empirical application has the character of an interpretive assessment, with trade-offs between breadth and depth. While the assessment is broad, in order to address various dimensions of the electro-mobility system and change initiatives, many nuances and complexities must be relegated to the background in favor of larger patterns, strategic decisions, and important events. The discussion also highlights some challenges to the MLP framework identified through the analysis. Section 4 draws conclusions about low-carbon transitions and makes some evaluative remarks on what other countries can learn from Norwegian electro-mobility experiences.

8.2 A Socio-technical Transition Perspective

Systemic transitions entail coevolution and multi-dimensional interactions between industry, technology, markets, policy, culture, and civil society (Geels 2012). To understand the development and increasing proliferation of EVs in Norway, we used a socio-technical understanding anchored in the MLP (e.g., Geels et al. 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). Transitions are coevolutionary processes that 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 landscapes (Geels 2002). The top-level landscape is 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 constructed of stable, institutionalized, large networks, while niches are smaller, with less stabilized rules of conduct.

The model 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 regulatory, cognitive, and normative rules (see Geels 2010). These rules guide actors, who also produce and reproduce the rules through their enactment. The landscape agency does not necessarily determine what happens in regimes, but *provides deep-structural "gradients of force" that make some actions easier than others* (Geels and Schot 2007: 403). Transitions are changes in the regime, often enabled by nurturing niche technologies and solutions to 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 more distributed (Crettenand and Finger 2013).

Although we recognize that the MLP offers many clues about how to understand and analyze long-term, encompassing transitions, we are also sensitive to criticism that MLP focuses too much on the semi-functionalistic aspects of systems, and not enough on the actors involved in transitions and their practices (Åm 2015; Farla et al. 2012; Smith and Raven 2012). We also support, and build on, recent attempts to better understand the formation of policy processes leading to transitions (Kern and Rogge 2017), as to how different network structures facilitate different levels of access to the policy-making process (Normann 2015). It will be central for us to discuss not only how policies work as a factor influencing EVs diffusion, but more fundamentally, how and why policies have been shaped in the way they have. Furthermore, we are interested in the relationship between policies implemented in diverse geographic locations and processes unfolding across countries and continents in unexpected ways.

Another important aspect of a socio-technical perspective on transitions in mobility is a renewed interest in the cultures of mobility, the elements that constitute such cultures, and the roles of these cultures in mobility transitions (e.g., Hopkins and Stephenson 2014; Sheller 2012). Sheller's (2012) contribution is particularly interesting for our discussion. Sheller highlights how the niches, regimes, and landscapes of mobility are all produced by a set of three distinct elements: practices, networks, and discourses. Understanding the journey of a new solution, such as the EV transitioning 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. The shift from niche to regime phenomenon posits that practices change from embodying alternative subcultural mobilities to mainstream legitimized practices. Networks shift from being those of social movements rooted in green lifestyles to those of durable interest groups and governing structures, while discourses shift from counter-discourses that challenge dominant order to standard discourses that legitimize 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. Our discussion emphasizes the relationships between social and material aspects of electro-mobility, and the sometimes unexpected links that emerge between policy, practice, innovation, and diffusion that we see as decisive in the shift toward electro-mobility in Norway. Some of these links were already apparent at the beginning of the century, when Gjøen and Hård (2002) 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.

8.3 Analysis: Nurturing a Norwegian Mobility Regime Shift?

Discussions about transitions often revolve around how to nurture niche industries, socio-technical configurations, and technologies for them to flourish and gain a foothold at the regime level (Geels 2002). This somewhat broader consideration at 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 this section, we will analyze why Norway 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 EV industry of which to speak. To understand Norwegian policy developments and governance structures in this area, we must first look back several decades and focus on a lesser-known aspect of its EV story—Norwegian car manufacturing and efforts to develop a domestic EV industry.

8.3.1 Early Attempts to Nurture an Alternative EV Industry in Norway

Norway launched several initiatives to develop electric cars and engaged in multiple initiatives to launch and develop a motorized vehicle industry. Two Norwegian pioneer cars were developed in 1895 and 1896: the Irgens and the Vestby (but the

companies were short-lived). Subsequent attempts at launching an automobile industry also failed. The car manufacturing company, Troll, sold its first car in 1956, but went bankrupt in 1958, having delivered only six cars. EVs were also produced in Norway between 1918 and 1924. The production company, Staværn Bilfabrikk, was created to mitigate the problems of obtaining motorized vehicles after WWI. The company delivered 10 functional electric trucks (Asphjell et al. 2013).

During the 1970s, interest in EVs rose sharply in response to the oil crisis of 1973. A company called ELBIL (which literally translates into electric car) delivered three electric vans to state service providers (Asphjell et al. 2013: 52). However, the most important development in this period was that the owners of Bakelittfabrikken AS, a plastic industrial firm, aimed to produce a small, urban, plastic-chassis EV. This strategy was based on the notion that Norway was poor in oil but wealthy in electricity, which should be reflected in the country's dominant mode of mobility (Asphjell et al. 2013). A prototype was built, but no subsequent steps were taken.

The developments of the 1930s and 1970s illustrate how landscape shocks, such as the oil crisis, might open windows of opportunity for new niche transportation technologies (Geels and Schot 2007). However, the dominant automobility regimes remained intact after the oil crisis ended, and interest in EVs decreased. After some initial work in the late 1980s, the owners of Bakkelittfabrikken AS started a new company, called Personal Independent Vehicle Company (PIVCO) in 1990. The idea was nurtured through funding from the Natural Sciences Research Council of Norway, resulting in a feasibility study published around the time of the company's founding (Røste 2001). The study's practical outcome was the ambition to build a short-range, two-seat EV, called a personal independent vehicle (PIV) (Buland 1994). This rekindled interest in electric mobility was also inspired by events on the other side of the world. Enactment of the Zero Emission Vehicle (ZEV) legislation in California offered future commercial opportunities (Hoogma et al. 2002; Buland 1994).

Bakelittfabrikken was an opportunity to create new business and industrial opportunities in Norway to compete against the comparatively larger Swedish automotive industry. The firm secured loans and government subsidies, attracted interest and support from a significant number of private and public actors, and obtained R&D funding from various sources (Hoogma et al. 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. These EVs garnered a great amount of public visibility in its trials during the 1994 Winter Olympic Games in Lillehammer (Asphjell et al. 2013). The PIV2 was re-branded as the CityBee for these trials. The Lillehammer demonstration was surprisingly successful. On the one hand, it was a niche experiment (Raven et al. 2012). On the other hand, it was spectacularly visible, functioning as both a marketing activity and a public-engagement activity to illustrate an alternative to the dominant mobility regime. PIVCO's work at that time was subsidized by funding from a national industrial fund, as well as supported by Oslo Energi, a large

Oslo-based electricity producer (Røste 2001). Some level of national nurturing and protection of this small, niche product was required.

The CityBee experiment demonstrated the vehicles' potential and attracted the interest of several incumbent actors in Norway and abroad. Local electric companies Oslo Energi, Østfold Energi, and Stavanger Energi were all early customers. These companies were interested in using the vehicles for marketing purposes and showcasing various uses of electricity (Buland 1994). It is important to note that these actors were not from the traditional automobile industry, so the experiment did not belong to the international automobile-production regime. They were mainly part of the electricity-production sector, which was an alternative regime.

Meanwhile, PIVCO attracted international interest. San Francisco was developing its profile as a pioneer of clean, urban transportation and was looking to supplement its Bay Area Rapid Transportation System (BART) light rail system. The city ordered approximately 50 vehicles from PIVCO for its collective station car program (Asphjell et al. 2013: 127), in order to challenge a strong cultural preference for personal car ownership (Geels 2012). It is likely that this initiative was made possible by combining actors from two different kinds of regimes: one was traditionally involved in providing hydropower and electricity in Norway, and the other was involved in rail-based public transportation in San Francisco. Together, they enabled production of a distinctly new kind of car with a different ownership structure, script, and intended use than that of traditional cars. PIVCO's development surged in 1995, with several large publicity stunts in support of EVs in Norway. When delivering the first vehicles to San Francisco, 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, including famous Scandinavian rally drivers. Norwegian actors in the EV sector was that Norway was about to embark on a new, widespread EV industrial venture.

After some difficult years requiring intensive work in San Francisco, PIVCO's 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 established a credit system in which car dealers must earn credits from selling non-emission vehicles to legally continue selling gas cars (Hoogma et al. 2002). Actors like Chrysler and General Motors took legal action against the state, but Ford was determined to comply with the new rules, opening up a new window of opportunity for Norwegian EV manufacturers. Ford acquired PIVCO in order to meet the new California legislation requirements. By the late 1990s, PIVCO was re-branded as Th!nk. The company that had been nurtured and assisted by work in alternative regimes was now appropriated and made part of a traditional automobile-production regime. This shift entailed large changes for Th!ink, which had to adjust to Ford's production standards—not only upscaling but also changing how vehicles were produced, with much higher performance expectations. In the eyes of many Norwegians, the EV adventure had now come to fruition. The standard narrative highlights how Ford's *massive automotive competence* was what PIVCO had been missing (Røste 2013: 7). However, in retrospect, an equally

plausible interpretation is that Ford's acquisition of Th!nk was the beginning of the end for the Norwegian EV industry. We will return to this point, but let us first look at some other parallel developments.

Ford's acquisition of Th!nk in 1999, and the subsequent launch of the first model intended for mass marketing, has been described by transportation scholars as the early market phase of Norwegian EV development (Figenbaum and Kolbenstvedt 2013). At the same time, there were other actors creating new companies to become part of the Norwegian EV 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 Kolbenstvedt 2013). Other external factors were also 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 Grenland's 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 Kolbenstvedt 2013). As Gjøen and Hård (2002) noted, politics were not only conducted through formal processes, but also through distributed processes of micropolitics, in which strategies of actors, such as municipalities and individual drivers, were important.

The Norwegian EV adventure was nurtured in several ways. First, there were small-scale national funding mechanisms meant to protect PIVCO and accelerate the industrial evolution of the company. Second, there were local policy initiatives abroad, notably in San Francisco and the state of California. Third, actors promoting electro-mobility began coordinating and organizing their actions in a targeted way in the early 1990s. The EV interest organization NORSTART was established in the early 1990s, aiming to pressure the government and 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 as the story of PIVCO and the Norwegian EV industrial adventure unfolded. EVs were exempt from sales and import taxes in 1990. Some places implemented free parking in 1993, and most municipalities had free parking starting in 1999. EVs benefited from low annual road taxes starting in 1996 and were exempt from toll roads in 1997. NORSTART was not the only actor behind these policy developments. The environmental NGO Bellona, which worked to raise awareness of EV benefits, must also be credited for its long-standing effort to secure favorable conditions for EVs in Norway, particularly in Oslo. With the emergence of a new Norwegian EV industry cluster, stimulating the development of a domestic market was important. The result was a set of new incentives: exemption from VAT, starting in 2001 (25%); experiments with allowing EVs to drive in bus lanes in the greater Oslo region, starting in 2003 (permanent and nationwide, starting in 2005, with minibuses banned, starting in 2009); and reduced rates on coastal ferries (starting in 2009), and exemption from VAT on leasing (starting in 2015).

Despite *wide-ranging political visions, far-reaching networks, and elaborate engineering scripts*, the number of EVs was still limited in 2002 (Gjøen and Hård

2002). However, after more than 10 years of attempting to establish domestic manufacturing, the efforts to promote EV technology began to pay off. Buland (1994) asked if a lack of tradition for car manufacturing actually could be beneficial for producing a new electric car in Norway. The question is still relevant. The Norwegian EV adventure was mainly driven by actors with no prior interest or competence in car production. They were not restricted to a set of predefined car models and existing sociocultural understandings about what a car was or could be. Nor were they restricted by existing manufacturing techniques and the so-called sunk investments related to production modes and facilities, or networks of existing interests. When PIVCO was approached by San Francisco, there was no threat to regime ideals about producing and selling cars to individuals. It might not be so strange that the EV challenge to traditional automotive regimes emerged from Norway, as a country without a strong car manufacturing tradition.

8.3.2 The Harsh Reality of the International Automobile Regime and Its Fatal Consequences for the Norwegian EV Adventure

By 2003, it was clear that Chrysler and General Motors had won the lawsuit against the state of California, so 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 gas-driven 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 developed during the period of Ford ownership. The domestic Norwegian EV market was relatively stagnant in this period. What little demand that existed was not covered by Norwegian industry, but by secondhand imports of French EVs manufactured between 1998 and 2002. The main EV market was located in the greater Oslo/Akershus region where commuters could save time, driving in the bus lanes and areas with high toll-road charges (Figenbaum and Kolbenstvedt 2013). According to Figenbaum and Kolbenstvedt (2013), 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 Buddy and Kewet models), surfaced. From 2010 to 2011, 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 the Mitsubishi i-MiEV in 2010 and Nissan LEAF in 2011 (Lorentzen et al. 2017).

International discussions about the Norwegian EV boom focused on the period after 2009, which is not so strange, as it represents the first period in which a jump in sales statistics can be observed. In our analysis, this period was less significant because the introduction of new incentives and government support was limited. However, one important development was NORSTART becoming the EV Association, which entailed much stronger coordination efforts and much more active efforts to enroll the Norwegian public as participants in the EV transition. NORSTART disseminated information (such as on charging infrastructure), recruited EV drivers with free test drives, and facilitated knowledge transfer through online platforms. Norway's first governmental support scheme for public charging infrastructure took place in 2009 to 2010 (Lorentzen et al. 2017), resulting in approximately new 1800 chargers (Schuko-point, household sockets). The government organization Transnova (later merged with Enova) was established to support testing and implementing climate-friendly technologies in transportation. Transnova ensured the coordination of (fast) charging infrastructure and supported development of charging facilities, resulting in a large network of charging stations across the country. As of June 2017, there were approximately 4400 publicly available Schuko-point and 2700 Type 2 point charging stations (Lorentzen et al. 2017). In 2015, Enova introduced a support scheme to cover Norwegian main roads with fast-charging stations every 50 km and support building fast chargers in municipalities with less than two fast chargers available, on a first-come first-served basis. In 2015 and 2016, Enova awarded 50.5 million kroner (kr) to support the construction of 230 fast chargers on a number of routes in Norway (Lorentzen et al. 2017).

Developing an accessible, dispersed charging network probably had an important symbolic effect, as it made the EV support strategy highly visible. Most studies show that EV drivers most often tend to charge their vehicles at home (97% on a daily or weekly basis, for those living in detached housing; 64% for those in apartment buildings). Some people charge at work (approximately 37%), while a few (approximately 15%) use public charging stations daily or weekly (Lorentzen et al. 2017; Norwegian EV owner survey 2017). However, a network of chargers throughout the country may be a culturally important safety net to mitigate everyday anxiety about vehicle range.

8.3.3 User Preferences and the Growing EV Market

The Norwegian EV transition should not be reduced to a tale of implementing effective policies. Rather, there have been important changes in how Norwegians talk, think, and act with respect to mobility during the last decades. It illustrates that the Norwegian EV transition is in an unfolding transition of mobility culture, including changed practices, networks, and discourses (e.g., Sheller 2014; Hopkins and Stephenson 2014). Perhaps the most important developments after 2009 have been the increase in social learning among drivers of EVs and the gradual

development of a mobility culture, in which EVs work and are embedded in Norwegian mobility culture. Throughout the period discussed, there have been a few, but important, studies of user preferences related to EV driving in Norway. These studies point to the possibilities of reframing what constitutes a car, a task that historically has been difficult to achieve (Hård and Jamison 1997). Gjøen and Hård (2002) illustrated that EV driving contributes to undermining what were then very dominant ideas about automobile design, anchored in fossil-fuel-powered vehicles. EVs remained an incomplete innovation within an alternative automobility niche for years because of aspects relating to size, driving range, and comfort. However, studies of actual Norwegian driver experiences tend to produce different narratives (e.g., Gjøen and Hård 2002; 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 (due to fast acceleration), park, and charge (due to charging at home or at work); receiving more positive reactions from others; and being seen as environmentally benign. The first EVs were mainly small, two-seat passenger cars with limited driving range branded as an environmental transportation device, rather than an ordinary car (Ryghaug and Toftaker 2014; Gjøen and Hård 2002). These compact EVs with limited range fit well with the city-car users' script. Most drivers were content with their cars' performance 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 several years (Ryghaug and Toftaker 2014; Ingeborgrud and Ryghaug 2017) show how new user groups were attracted to the technology as it developed, and the EVs on the market began to resemble more traditional cars. EVs were also introduced in different public sectors, 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 for those who wanted higher-end EVs or families needing a bigger EV with a longer driving range (Ingeborgrud and Ryghaug 2017).

In stark contrast to the commonly perceived drawbacks of EVs, studies regarding Norwegian EV-user preferences stress the benefits of driving EVs and their embodied qualities: strong 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, aligning with landscape changes related to cutting greenhouse emissions and pro-environmental actions. As an example, studies indicated that those who drive EVs 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 in other countries—its share of EVs compared to traditional cars? A broad set of incentives has been important, but detailed studies of actual EV users found that their understanding of the economic incentives varied (Ingeborgrud and Ryghaug 2017). For some, the

incentives were important to promote initial adoption in the transition from gas to electric cars. For others, the driving pleasure related to EVs as green, nonpolluting 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 mobility technology. In sum, we observe that there is an ongoing shift in the mobility culture, in which practices change from embodying alternative subcultural mobilities to mainstream legitimized practices (Sheller 2014) and networks change from social movements focused on alternative green lifestyles to more durable interest groups and governing structures (e.g., Ryghaug and Toftaker 2016). Discourses shift from being counter-discourses that challenge dominant stories to standard discourses that legitimize existing actors and practices. Table 8.1 summarizes some key findings from our discussion.

Table 8.1 Key events, dynamics, policies, and market developments in Norwegian EV transition

	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 Francisco	Public transportation regime in San Francisco wants new solutions for transportation around light rail stations. PIVCO now anchored in Norwegian hydropower regime and San Francisco public transportation regime	No new policies	Marginal niche market in Norway, public transportation in USA

(continued)

Table 8.1 (continued)

	Event	Key dynamics	Norwegian EV policies	Market
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)	3000 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)	3347 EVs registered (2010)
2013	EV market takes off	Positive user experiences produce new narratives about EVs. Positive media attention		19,678 EVs registered. 500 chargeable hybrids registered
2017	The sale of new EVs higher than the sale of new fossil cars	Large automobile regime actors use Norway as test bed for new models. Alternative regime actors (Tesla) have Norway as key market. Some public controversy on EV incentives		126,448 EVs, 58,213 chargeable hybrids registered

8.4 Conclusion

Following the multi-level logic, a 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 (such as carbon taxes) and regulation (Geels 2012). Although transportation policies pay moderate attention to the first strategy, and little attention to the second one (Geels 2012), it can be easy to conclude that the current success of electro-mobility in Norway was produced by the second strategy. Such a shortcut would grossly oversimplify the narrative and lead to neglecting 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 these industrial ambitions or if the strategy would even have emerged without its industrial predecessor. Furthermore, focusing too much on the effects of policy on technology development can lead to neglecting the political processes that bring about policy change (Normann 2015). There has been an increased focus in recent years on forming policy (e.g., Weber and Rohracher 2012; Normann and Hanson 2017; Kern and Rogge 2017) when studying socio-technical transitions. Our chapter contributes to this growing body of scholarship.

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 "be-come 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 in-to niches)" (Geels 2012: 4). This resonates well with the Norwegian case, in which EV driving was initially pioneered by actors that were not involved in the automobility regime. They could 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). Our analysis also highlights that alliances with dominant regimes might be treacherous, as the shielding, protection, and flexibility of being a niche actor might be lost as a result.

As shown in the previous sections, the industrial strategy to develop EVs in Norway contributed to developing many of the incentives that we find today. However, it seems non-intuitive that strong policies were 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) were launched 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 EVs as a promising technology. Environmental organizations worked toward creating favorable user conditions for EVs and demonstrating the assets of EVs contributing to many current local and national EV incentives:

> [T]he incentives have been added one at the time until the market finally responded with in-creased sales… the prolonged EV interest and lobby organizations that fought for better incentives is what resulted in Norway having the largest EV incentives in the world the largest EV fleet and yearly sales per capita. (Figenbaum and Kolbenstvedt 2013)

Our analysis demonstrates that this narrative is too simplistic. We must go many years back in time to understand the Norwegian attempts to develop an alternative car manufacturing industry to better understand why Norway chose to introduce these incentives. When observed as a longitudinal process, it becomes clear that landscape changes and external events (such as the oil crisis and the sudden change in Californian policies) have been essential to the trajectory of Norwegian EV developments. Furthermore, when Norwegian niche actors tried to enter international automobility regime, they became vulnerable to changes, volatilities, and fluctuations, from which they were previously shielded. This study contributes to the transition literature by highlighting how national niches sometimes depend on international regimes for support, but that the actions in these very regimes might sometimes destabilize local niches.

While the MLP has a strong temporal orientation, the spatial dimension has been less elaborated (Geels 2012; Raven et al. 2012). The complications this creates for the transportation domain are clearly visible in this analysis, since many dimensions of the automobility regime are national or international, while some are local. This results in the fact that national mobility regimes can have local variations, and local actors may also support more radical niche projects that can form the seeds for future transitions (Geels 2012).

There have been calls to elaborate further on the spatial dimension of transitions (see Bulkeley et al. 2010; Geels 2012; Raven et al. 2012). Building on this argument, it is interesting to revisit recent debates on the relationships 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 common argument in this debate is that a lack of domestic market also represents a barrier for internationalization. In light of the analysis of the Norwegian attempt to develop a technological niche market of EVs (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 we might anticipate. Later, the market niche created by comprehensive Norwegian support mechanisms for introducing EVs benefited actors in the international technological-innovation system. Meanwhile, this indicates that market demand can be actively created by active, comprehensive political nurturing, as demand factors are one of the biggest challenges for introducing a new technology. However, the role of EV users was not very significant during the 1990s, when the incentives were introduced. Environmental NGOs represented users in their battles to provide local traffic-related benefits for the few EVs on Norwegian roads.

In sum, the Norwegian EV transition was 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. However, the actual Norwegian market for EVs remained limited. The second phase (2009 to present) focused less on industry development. Today, the only way to obtain one of the few Norwegian EVs that remains is on the secondhand market, and the dream of a Norwegian EV industry resembles a distant memory. Instead, 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 and more comfortable than gas-driven cars (Ingeborgrud and Ryghaug 2017). The emergence of the Norwegian EV culture appears to have been influenced by landscape developments, primarily climate change. The pleasure related to driving green, nonpolluting cars has also been very important, sometimes more so than the economic benefits (Ryghaug and Toftaker 2014).

Norwegian EV incentives are likely to be reduced and changed in the years to come, as the number of electric cars grows. For instance, EV owners must contribute to the costs of maintaining transportation infrastructures in the long run. At the same time, it seems reasonable to expect continued technological development and design of new EV models and more shared mobility solutions, as a result of digitalization of the transportation sector and new platform solutions. Although these practices have contributed to a new discourse of sustainable mobility, Sheller (2012: 191) notes: *It still remains questionable to what extent these cultural shifts will impact on the overwhelmingly automobile-centered pattern of majority mobility.* Recent growth in car sales in Norway, and Norwegians' continued fondness for their privately owned electric cars, also contributes to such an understanding, although national policies and city municipalities are forcefully pushing for limiting the use of cars in inner cities in favor of promoting walking, cycling, and public transportation in new, reinforced ways. The Norwegian case is intriguing, as it is one of very few in which electrification of the transportation sector seems to be well underway. However, we may ask to what extent replacing ICs with EVs really transforms our mobility system. Discussions with key experts in the Norwegian mobility sector (Ryghaug and Toftaker 2016) reveal that individual car use still seems to be the dominant mode of transportation and that they see deployment of technology as first and foremost relying on techno-economic incentives. Alternative trajectories portraying more changes in mobility patterns and culture through more travel planning, mixed use of multiple transportation modes, less private car ownership, car sharing, and more investments in modal transfer and parking spaces to allow for the aligning transportation modes exist but do not seem to be underpinned by dominant imaginaries or policies. Therefore, the EV transition in Norway might not significantly affect the automobile-centered patterns of mobility. There is the risk of potentially entering an electric-automobility system if policies promoting, for example, shared and integrated transportation are not also developed quickly.

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