Institute of Transport Economics
Norwegian Centre for Transport Research

Summary:

Pathways to electromobility - perspectives based on Norwegian experiences

TØI Report 1420/2015
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Oslo 2015, 65 pages English language

Electric propulsion is much more energy-efficient than internal combustion engines (ICEs), and electric vehicles (EVs) emit no local pollutants and greenhouse gases. Norwegian authorities have introduced a number of incentives for EV diffusion, in order to support a transition to more environmentally friendly transport. Norway is at the moment a leading EV country where 20% of the new vehicle market were EVs in the 1st quarter of 2015 and EVs constituted 2% of the total fleet of passenger vehicles. The report is a part of the Electromobility+ project COMPETT, which should answer the main question: "How can EVs come to use to a greater degree?" The report provides some insights by presenting two analyses of the Norwegian EV story. The first one uses a multi-level perspective (MLP) to look at the interaction of events and actors at the niche, regime and landscape levels. The second one looks at user adoption from a socio-technical perspective using the theory of diffusion of innovations.

Introduction

Norway has had incentives for EVs since 1990. In the beginning these incentives were put in place to allow testing and experimenting with EVs. From about the year 2000 focus shifted to support a potential growing Norwegian EV industry, whereas from 2010 and onwards the policies have been linked to the policies for reducing climate gas emissions in Norway. Purchase incentives reduce the purchase cost of EVs. EVs are exempted from the Value added tax (25%) as well as the registration tax imposed on other vehicles being registered for the first time in Norway. The result is that small EVs cost about the same as comparable gasoline and diesel vehicles in Norway whereas compact and larger EVs are cheaper. In addition EVs have access to bus lanes and free parking, they do not pay on toll roads and have reduced rates on main road ferries crossing the Norwegian fjords. Annual tax is also reduced.

Part I: A multi-level perspective on EVs in Norway

The multilevel perspective framework developed by Geels (2003) and others, centres around the concept of interaction between niche activities in the market, regimes that consist of automotive actors, stakeholders, established practises of vehicle usage and the landscape being external factors originating internationally or nationally such as oil prices and the climate policies. Niche activities may according to this framework breakthrough as a result of windows of opportunity opening up the established regime often as a result of pressure from the landscape.

The success of EVs in Norway seems to be a result of the long-term stable political framework built up piece by piece by many actors and stakeholders. Heavy vehicle

taxes have given room for tax relief incentives rather than direct subsidies. There has not been much criticism of these policies. The introduction of long-term EV policies and incentives, addressing the various weaknesses of EVs, have allowed businesses to recognize and seize opportunities. The policies and incentives have been so successful that in April of 2015, Norway had 50 000 EVs, this being 2% of the total fleet of passenger vehicles in the country. Thus, Norway has become the forerunning country within electro mobility.

The framing of the policies has evolved from first allowed testing of EVs, then support to industrial development, and finally the EV policy framed as a climate mitigation measure, leading to greater acceptance of the policies. These policies gave the traditional vehicle manufacturers a head start in the Norwegian market as they established a new EV regime within the ICE regime. This new regime could utilize the effects of all the achievements and incentives built up by the independent EV regime over a period of two decades. Other countries can take inspiration from the Norwegian policies, but may need to follow other paths as different windows of opportunity may open up for them.

The EV diffusion seems to be on a *transformational path* of transformation internationally where moderate pressure on the ICE regime is leading to a gradual establishment of an EV regime. The EV regime grew out of the old regime through a reorientation of the powering of automobiles while keeping other basic vehicle features unchanged. In Norway, the policies and pressure from the landscape have been much larger, leading towards an incentive driven "*technology substitution path*".

Being a country at the forefront of electro mobility could cost more money and strain public budgets more than Norwegian politicians originally anticipated. Globally electro mobility develops more slowly compared to the rapid changes seen in Norway. This will lead to the cost of vehicles remaining higher for longer, as the total volume of EVs produced will increase at a slower rate, than if all countries had progressed at Norway's rate. It could also lead to a narrower selection of models as the automakers may delay the introduction of new models. The risk of international setbacks in EV development is, thus, the main uncertainty for electro mobility in Norway. The other major uncertainty, the revision of the incentives, will also have an inevitable impact on sales.

Part II: Diffusion of EVs in Norway

The technology itself, its characteristics and ability to meet user needs, and the ability to change the technology during the process to avoid possible weaknesses, is the key element of diffusion. The rate of diffusion (Rogers 1995) is influenced by the perception of technology with respect to:

- *Relative advantages* of the innovation related to other technologies can be financial, practical, environmental and personal, giving social status or satisfaction. Examples are economic profitability, low initial cost, improved comfort, saving time or effort, immediacy of reward.
- *Compatibility* with the users' needs, basic values and norms in the social system. The more radical and disruptive technology, the less it is compatible with existing practises, norms and values, the slower its rate of adoption.
- *Complexity* conceives how easy it is to understand and put the technology to use, and its ability and flexibility to accommodate more opportunities. The more complex the innovation, the lower the adoption rate is.

- *Trialability* applies to the opportunity for trial. Innovations that can be tried out on a small scale are perceived as less uncertain and easier to implement than those that require full implementation immediately. Trialability is more important for early than for later adopters. The latter will be helped by information from adopting peers.
- *Observability/visibility* for new users can increase the speed of implementation. This factor stresses the importance of network communication and the strategy for launching the product.

Incentives to speed up EV adoption should address these factors, especially the first one, Relative advantage, which is the most influential in the diffusion process. The improved technology and reduced costs combined with the incentives have resulted in Norwegian EV buyers noticing that EVs have many relative advantages over ICE vehicles. The limited range is not a hindrance to adoption. Drivers learn to manage range limits. The reward is immediate as the EVs cost the same or less than ICEs, and their operative costs are much lower due to their energy efficiency and low cost energy carrier. Hence, one may claim that EVs are both climate friendly and low variable cost vehicles suitable for daily travel needs.

The diffusion process started in larger urban regions of Norway but now covers smaller cities and rural areas as well. To get the diffusion of EVs started, cities should be targeted. However, they should not be targeted when there is concern regarding an increase in traffic. Although this is a dilemma, the diffusion pattern shows that EVs spread to rural areas from the cities, suggesting that the issue is temporal.

There is potential for future growth supported by diffusion through interpersonal networks, i.e. friends, families and colleagues and the anticipated availability of new longer-range models attracting new customer groups. Technology that gives longer range at lower prices, should make it easier for other countries to support the introduction of EVs by choosing between the many incentives tested in Norway and developing their own packages.

The diffusion of EVs in Norway resembles what is expected from diffusion theory. An achievement of the EV policy is that national, regional and local governments, businesses and NGOs have been motivated to move in the same direction. The actual rate of diffusion will be heavily influenced by possible modifications to the societal and economic framework and cooperation. The Norwegian EV market is, however, dependent on the other automotive markets. If diffusion does not catch on globally or in Europe, the diffusion of EVs in Norway may slow down.

Part III: Learnings from Norway based on part I and II

The two perspectives in this report complement each other and provide a good understanding of how the EV policies in Norway came to being and how they have influenced the market actors and the vehicle buyers.

The EV policy has consistently been pro EV in Norway, indicating to users that the technology is compatible with societal needs, although the reasoning has changed. Other competing options such as biofuels have been more debated. The positive EV communication in Norway might have inspired a greater share of the general vehicle owners to consider buying an EV compared to the general vehicle owners in other countries were the communication is more ambivalent.

From the experience of EVs in Norway it is evident that incentives are needed to speed up diffusion whilst EVs are more expensive than ICEs. These incentives came about through a series of unique events where stakeholders took advantage of windows of opportunity. Other countries will need to find their own way of supporting EVs as other windows of opportunity may appear and they will have their own framework of vehicle policies to start from.

Incentives that address and improve on the perceived relative advantage of EVs as seen by the potential buyers will be the most effective in speeding up the adoption of EVs. In Norway it has been seen that purchase incentives have been particularly effective in speeding up adoption in combination with user incentives that give EVs a relative advantage that is not available to others.

When the price is right and vehicle buyers are aware of and see the advantages of EVs, the diffusion pattern will be similar to that of other innovations.