The future is electric! The EV revolution in Norway – explanations and lessons learned

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Abstract

The paper presents an analysis of the ongoing battery electric vehicles (BEV) revolution in Norway focusing on the measures that have been introduced to support a modal shift away from the classical motor car. Different policy measures, BEV infrastructure and EV technology developments and their coherence are examined. The paper also looks into the situation for BEV in some other European countries before lessons learned are drawn.

In total there are now more than 9,500 BEVs and 330 Plug-in Hybrid Electric Vehicles (PHEV) driving on Norwegian roads by the end of 2012 – an increase of 4,679 in 2012 alone. BEVs and PHEVs amounted to about 3.1 percent of sales of new passenger cars. The corresponding figure for 2011 was 1.6 percent. If this trend continues, there could be more than 50,000 electric cars in Norway by the end of 2017. So how did this EV-revolution in Norway come about?

The following policy measures are in use in Norway today to promote EVs: BEVs and fuel cell electric vehicles are completely exempt from import tax and VAT; Free parking in publicly owned parking spaces; No road toll; Access to bus lanes; Free admission on national road ferries for the car; Increased mileage allowance for usage in the public sector and 50 % taxable benefit if used as a company car.

Infrastructure for charging is also important. By the end of 2012 there are 3,700 charging points installed in Norway – and the number is steadily increasing. Most of them are free of charge and placed on public grounds. In addition there are 57 fast charging stations installed. The paper also examines technology developments when it comes to EVs, as this also might have something to do with the increasing number of sales. The growing number of EV automakers, the increasing comfort in new cars and the price competition between different EV manufacturers will also be looked into.

The paper looks at the market penetration and the main differences in BEV policies in Sweden, Denmark, Germany, Portugal and Ireland. In the end a 3-step lesson to be learned for other countries are presented – with the Norwegian example as the starting point.

Introduction

The paper presents an analysis of the ongoing battery electric vehicles (BEV) revolution in Norway focusing on the measures that have been introduced to support a modal shift away from the classical motor car. Different policy measures, BEV infrastructure and EV technology developments and their coherence are examined. The paper also looks into the situation for BEV in some other European countries before lessons learned are drawn. A 3-step list of what needs to be in place before one could expect a BEV take-off in a given country is also presented.

EV sales in facts and figures

In 2011 a total of 2,240 electric vehicles were sold in Norway, leading to a total of around 5,500 BEVs on Norwegian roads by the year-end. In 2012 the sales numbers exceeded all expectations – 4,359 new BEVs and PHEVs were sold in Norway

Table 1. EV sales statistics for Norway in 2012 (HEVs not included).

OEM	Import	National sales	SUM
Nissan	189	2298	2487
Mitsubishi	7	665	672
Citroen	47	513	560
Peugeot	40	407	447
Toyota		171	171
Opel		141	141
Tesla	6	32	38
Ford	3	31	34
Renault	2	24	26
Buddy Electric	2	22	24
Micro-Vett	15	9	24
Think	5	17	22
Tazzari	1	9	10
Mia		9	9
Fisker		6	6
Unknown	1	3	4
Chevrolet US	2	1	3
Piaggio		1	1
SUM	**320**	**4359**	**4679**

through official channels. If personal imports are added, a total of 4,679 new electric cars were sold last year. Corresponding total figure for 2011 was 2,242. BEVs and PHEVs amounted to about 3.1 percent of sales of new passenger cars. The corresponding figure for 2011 was 1.6 percent. In September 2012 the sale of BEVs reached all time high of 5.2 % of the total monthly sale of new cars in (585).

The total number of BEVs and PHEVs that were registered in the end of 2012 Norwegian is estimated to be 10,005 (Grønn bil 2013). Nissan LEAF was the superb sales winner in 2012 with total 2,487 cars sold; of which 189 were used car imports. It is quite fascinating that Nissan LEAF alone sold more cars in 2012 than the total sale of EVs in 2011. The next three on the list are the smaller cars Mitsubishi i-MiEV, Citroën C-ZERO and Peugeot iOn. On the plug-in hybrids side, Toyota Prius wins with 171 sold cars, in front of the Opel Ampera with 141 new registrations.

The sale of electric vehicles in Norway is a rather special story. In Norway sales of BEVs are sold in numbers that are comparable to the sales of big countries like Germany, France and the UK. This is quite impressive in a country with only 5 million inhabitants. Figure 1 clearly shows why it could be important for other countries to learn some lessons from Norway when it comes to EV deployment.

The Norwegian EV percentage of total sales is far beyond all other countries (the green columns). But in total EVs sold, France has the highest share. It is also interesting to notice that EV sales in 2012 were higher in Norway than in Germany. EV sales in Sweden and Denmark are increasing, but they are still quite far behind the Norwegian figures.

Figure 2 shows the development in the total sales of BEVs in the private market in 2011 and 2012 in some selected European countries. We clearly see that several countries are in the beginning of a take off, but we also see some countries that are struggling e.g. Portugal and Ireland.

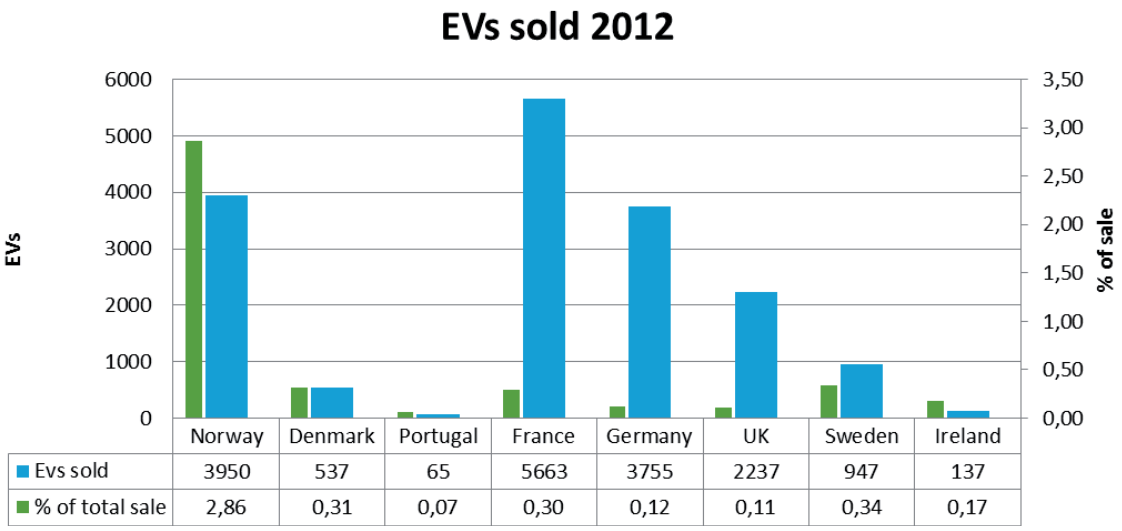
Incentives for EV

NORWEGIAN EV INCENTIVES

Norway introduced its current BEV incentive scheme gradually during the late 1990's and early 2000. The goal of the incentive scheme has been to bring BEVs up to or beyond par with similar conventional (ICE) vehicles in Norway, both from an economical and a functional point of view.

The incentive scheme did not show its full potential until 2011. This was mainly due to supply constraints: Up until 2010, the main suppliers of BEVs in Norway were Think, Buddy Electric, and to some extent used imports from France. None of these supply sources were able to deliver a mass-market combination of price, availability, quality and quantity. In 2011, with the introduction of Mitsubishi i-MiEV in Norway, the supply side was finally able to deliver a BEV in an attractive price range, with competitive performance and equipment, and in sufficient volumes, to make a major impact in the marketplace. The effects of this are clearly visible in the sales figures for Norway, shown in Figure 3.

The Norwegian Ministry of Transport and Communication established in 2008 a resource group led by Energy Norway in order to draw up an action plan for electrification of road transport. The Resource group recommends that the ambition is that the proportion of rechargeable cars will make up 10 percent of the Norwegian car fleet in 2020. The Government has yet to commit to a quantitative goal for EVs in Norway, but have



	Norway	Denmark	Portugal	France	Germany	UK	Sweden	Ireland
Evs sold	3950	537	65	5663	3755	2237	947	137
% of total sale	2,86	0,31	0,07	0,30	0,12	0,11	0,34	0,17

Figure 1. EV deployment in the studied countries. Number of sold vehicles and percentage of total sale.

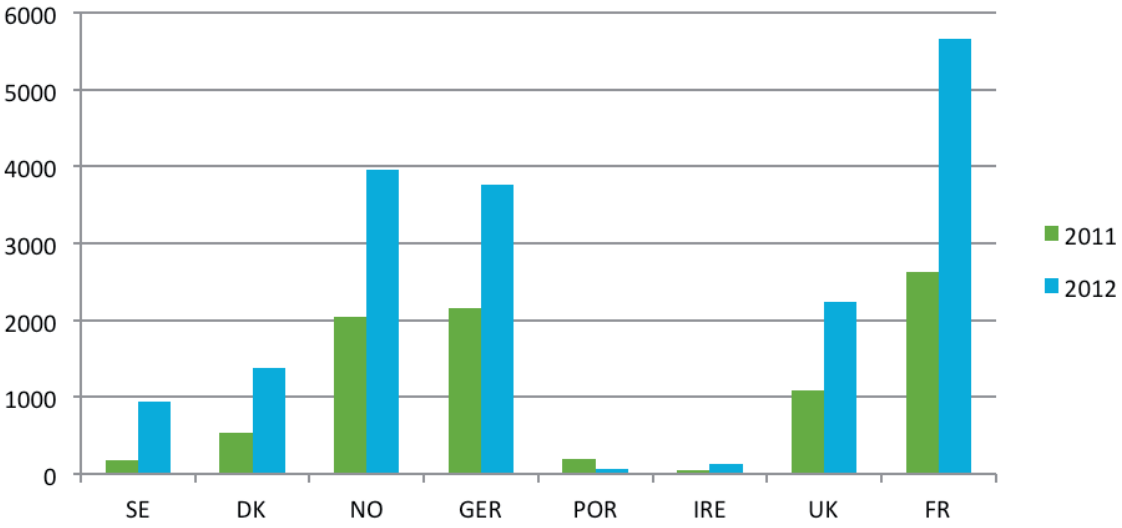


Figure 2. EV deployment in the private market in 2011 and 2012.

stated that average emissions from new cars in 2020 should be no more than 85 gram CO_2 per km. The 10 percent vision can be viewed as similar to approximately 260,000 BEVs and PHEVs by 2020.

Central to understanding the Norwegian BEV incentive model is the fact that regular ICE cars are taxed heavily, compared to most other European countries. Upon import, cars are taxed according to their weight, CO_2 emissions and motor effect – as well as NO_x emissions (from 1 January 2012). On top of this, cars are taxed with 25 % VAT.

BEVs and fuel cell electric vehicles, FCEVs, are completely exempt from import tax and VAT. In addition, EV operating costs are significantly lower than for a similar ICE vehicle. The result is that the Total Cost of Ownership (TCO) for BEVs compares favorably with ICE cars, even more so with increased yearly driving distance. The current tax benefits for the purchase and use of zero-emission cars clean is in the next parliament period (ending autumn 2017), as long

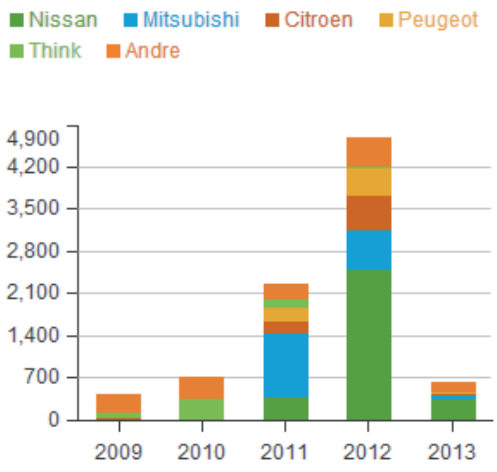


Figure 3. Number of sold EVs of different brands. Norway 2009–2013.

Figure 4. Geographical distribution of charging points.

as the number of pure zero-emission vehicles does not exceed 50,000.

Another incentive has been the decision to let BEVs and FCEVs utilize excess capacity in bus-lanes and being exempted for road toll on Norwegian roads. The use of bus lanes is convenient, especially during rush hours, along certain corridors outside main cities and not paying road toll before entering the biggest cities in Norway is also of course beneficial. This combined incentive saves BEV commuters money and significant amounts of time, while reducing noise and local pollution to the benefit of the public at large. Additionally, this incentive has no direct economic cost for the municipality.

But the incentives for BEVs and FCEVs are not restricted to the main cities. They have free admission on national road ferries (for the car – not the driver). To create an economical incentive to use more BEVs in the public sector, the mileage allowance is increased from NOK 3.50 per km to NOK 4.0 per km. Further, BEVs have a 50 % taxable benefit if used as a company car.

Another important usage-related incentive is access to free parking in all publicly owned parking spaces, as well as a significant number of reserved EV-parking spaces (some equipped with charging possibilities). Furthermore, the Government granted around €6.5 million in 2009 to accelerate the construction of charging points. Due to a "low tech, low cost" approach, this grant money resulted in close to 2,000 new charging posts across Norway. As of January 2013, there are around 3,700 public charging points in Norway. The geographical distribution of these is shown in Figure 4. It should also be noted that a significant number of Norwegians have access to a private garage with a 16A circuit breaker. For this customer group, charging an EV is currently simply a matter of plugging the car in to an existing wall outlet.

SWEDISH EV INCENTIVES

The goal of the Swedish government is that the transport system should be "fossil fuel independent" by 2030, but has no precise target for PHEV/BEV penetration (Albrecht et al 2013). Sweden has a couple of special incentives in place to secure increase sales of electric vehicles. Procurement policies for BEV includes investment support of 25 % of additional cost maximum of SEK 100,000 for the first sold 75 vehicles and 25 % of additional cost maximum of SEK 50,000 for 1,000 sold vehicles. This is only for public and private entities.

Other incentives include fringe benefits – for PHEV/BEV the taxable value of a company car is reduced by 40 % compared with the corresponding or comparable petrol or diesel car. The maximum reduction of the taxable value is SEK 16,000 per year, and a "super bonus" for low emitting vehicles (in force from January 2012) with investment support up to SEK 40,000. There is a limited amount of vehicles for the super bonus; 5,000 vehicles are supported. Hybrid vehicles with CO_2 emissions of 120 g/km or less and electric cars with an energy consumption of 37 kWh per 100 km or less are exempt from the annual circulation tax for a period of five years from the date of their first registration.

There are also some more regional initiatives to promote EV. In Stockholm "alternative vehicles", including EVs, registered before 2008 has a congestion toll road exemption (max SEK 60 per day). For electric or plug-in vehicles there is free charging at about 70 sites in the city. For electric or plug-in vehicles there is also free parking at Arlanda (about SEK 80/h). In Gothenburg EVs could be parked for free in certain areas of the city.

Regulatory changes are also made to enable EV introductions. Since February 2011 municipalities can reserve parking spots in public spaces for EVs (Albrecht et al 2013).

DANISH EV INCENTIVES

In Denmark the introduction of EVs has been supported since 1984 through a time limited exemption from the Danish vehicle registration tax. The current tax exemption is now prolonged until 2015 (through the tax reform agreed in the Danish Parliament in September 2012). This exemption does not however apply to hybrid vehicles (Danish elbilkomitee 2012). Furthermore, the time-limited exemptions for fuel consumption tax are also prolonged until the end of 2015. This so-called "green owner tax" works as follows: This fee is based on the more gasoline (diesel) a car uses to run a kilometer, the higher the tax. Because an electric vehicle uses 0 milliliters of petrol to run a kilometer the fee will obviously be 0 kroner (Danish elbilkomitee 2012).

Denmark has also public charging stations with free electricity in some municipalities: Further, some municipalities offer free parking for EVs (Odense and Frederiksberg). However, it should be remarked that after December 2011 owners of EVs again have to pay for public parking in Copenhagen (Danish elbilkomitee 2012).

The Danish Transport Agency has been assigned to administrate a fund for research activities and demonstration projects on energy efficient transport. The largest single grant of first round was given to the project 'Test-an-EV' where 300 electric vehicles are tested for daily use by 2,400 families in turn (testenelbil.dk 2012). The test is expected to reveal driving and charging patterns and user experiences with electric vehicles.

GERMAN EV INCENTIVES

Germany has set an official goal of 1 million EV on the roads by 2020 and EUR 2 billion are set aside to support the introduction of EVs. Included in this package are research in battery technologies, support for the development of improved tech-

nologies for electric cars, support for standardization project, support for research and development of intelligent supply networks (Dansk elbilalliance).

In Germany electric vehicles are exempted from the annual circulation tax for a period of five years from the date of the first registration of the car. (ACEA, 2012)

In some cities in Germany there are special incentives to promote the use of EVs. Like the state of Berlin who supports implementing alternative drives in its fleets and has begun converting its state-run vehicle fleet to electric and plug-in hybrid vehicles. Various projects with e-fleets and e-car sharing are underway or are planned, for example: the Initiative 120 project, a concept for testing alternative drive systems in patrol cars at the Berlin police department (EV city casebook 2012).

PORTUGUESE EV INCENTIVES

For the purchase of all kind of vehicles there is a Value Added Tax of 20 % in Portugal. Since 2007, the policy for car taxation is to transfer tax burden from tax on acquisition (Imposte sobre Veiculos, ISV) to the annual tax on ownership/circulation tax (Imposto Unico de Circulacao, IUC). Both are calculated on basis of cylinder capacity and CO_2 emission level. Pure electric vehicles are exempted from both registration tax and annual circulation tax. Hybrid vehicles benefit from a 50 % reduction of the registration tax. (ACEA, 2012)

During 2008 to 2010 purchasers of a new vehicle emitting a maximum 130 g/km CO_2 received an incentive of EUR 1,000, if they had a car which is 10 years old or more scrapped simultaneously (EUR 1,250 if the car is more than 15 years old). In 2010 the tax incentive was reduced to EUR 750 for a 10 year old car and EUR 1,000 for a 15 year old car respectively (Article 106 of Law no. 3-B/2010). For the purchase of an electric vehicles when scrapping an old vehicles, for individuals there is an incentive of EUR 5,000 and for companies a deduction of 50 % in Corporate Income Tax related to the purchasing price.

Portugal has invested heavily in charging infrastructure, partly due to an early deal with the Renault-Nissan alliance that would make Portugal a frontrunner in EV adaptation based on clean wind energy. As part of this arrangement, Portugal created MOBI.E, a national EV infrastructure developer. As of January 2013, the MOBI.E network consists of 1,300 charging points all over Portugal, all accessible to anyone with a MOBI.E card (MOBI.E 2012).

IRISH EV INCENTIVES

Ireland's target is to achieve 10 % electric vehicle usage by 2020 which is equivalent to having 230,000 vehicles on the road by then. The Government is providing a grant towards the purchase of the first 6,000 EVs in order to encourage Irish Consumers to consider switching their vehicle type to electric.

The grant is provided to an approved Electric Vehicle Dealer who then provides a discount to the vehicle purchaser. This method is used in order to reduce the loan amount required by the Consumer in order to purchase the vehicle. In addition to the grant amount for the vehicle, the Consumer will also benefit from a zero rate of Vehicle Registration Tax (VRT) for BEVs and up to €2,500 rebate on VRT paid for a PHEV. Each of these benefits will be captured during the Grant Application Process and monitored by SEAI to ensure that the Consumer is duly benefiting from the Scheme (SEAi 2012).

On 31 October 2012 it was announced that the milestone of 1,000 installed EV charge points in Ireland including domestic, commercial and public was reached. This means that all Irish counties and 85 % of major cities and towns have now access to EV charging infrastructure. Ireland is also progressing on fast charging points; until September 2014, a total of 46 EV fast charge-points will be installed along the key inter-urban routes as well as transport hubs such as airports and ports across the island of Ireland (ESB 2012).

Sum-up of EV incentives in countries studied

All the countries have implemented a set of incentives for EVs, but still we see that the expansion of EVs differs drastically in the selected countries. But it seems infrastructure alone is not enough to get a break through for EVs. Only when the sum of incentives makes it profitable to buy EVs, do the incentives pay off.

Which Norwegian incentives have been working – how and when?

TAXATION POLICIES – THE MAIN DRIVER?

The Norwegian tax system for cars is something that deserves some more comments and reflections. Cars in Norway have always been expensive compared to almost all other countries. This can partly be explained by that Norway has not had a car industry of importance; the same applies to Denmark and Finland. These three countries are at the very top in Europe when it comes to the level of car one-time fee. Another difference might be the availability of local energy resources. Norway has large source of renewable electric power and has taken interest for building as market for BEVs and FCEVs, while Sweden have large bio resources and has developed a market for bio-fuels.

Table 2. EU incentives in countries studied.

	Norway	Sweden	Denmark	Germany	Portugal	Ireland
Financial incentives	Yes	Yes	Yes	Yes	Yes	Yes
Access to bus lane	Yes	Limited				
Free parking and no road toll	Yes	Limited	Some	Some		
Charging infrastructure	Yes	Some	Yes		Yes	Yes

It should be mentioned that Norway has had its own production of electric vehicles from 1990. However, the production of Think City, the most known Norwegian EV brand, was stopped in March 2011 and the company filed for bankruptcy on June 22, 2011. This is actually a part of the explanation on why EVs quite early in Norway (1989) got tax exemptions and later also other market push incentives. Again – promoting a home grown car industry – it's a rather strong driver.

Still, in most of the Nordic states taxation on fuel and vehicles are a vital income source for their governments. When providing incentives such high taxation can though make things simpler. Revoking taxes (specifically temporarily) is usually a simpler process for governments than providing direct funding or subsidies. Therefore, it is "easier" (that is provides less financial risk) to reduce taxation and, in that way, reduce the cost difference between conventional technologies and new (developing) technologies.

Many of the incentives can be of high value for the customer. Incentives leading to time saving, e.g. driving on bus lanes, priority down-town parking (free) could offset the extra vehicle cost. Non-financial incentives can therefore be of higher value than financial incentives, but to be effective it is important to have good cooperation between municipal and national government as some of the incentives touch on both authorities.

FROM AN URBAN PHENOMENA TO A COUNTRYSIDE MUST?

Some of the incentives for BEVs, such as parking, access to the public fields and no road toll, are fitting commuters in urban areas very well. This is particularly evident in the western corridor outside Oslo in the direction of Asker. Along this highway, public transportation is relatively poor (meaning that most people don't live close to the highway or the train stations) and there are therefore long queues, especially in the morning rush hours (Green car strategy paper of November 2011).

During 2012 we have seen the same phenomena outside other Norwegian cities like Stavanger and Trondheim. In terms of electric car sales per capita, the small island Finnøy outside Stavanger top the EV sales list of 2012. During 2012 it was sold one BEV per 100 inhabitants. The main reason for the good sales is likely to be the new toll road tunnel connecting the island to Stavanger (Grønn bil 2013). This toll road also happens to top the list of being the most costly toll road in Norway in 2012 – if you chose to drive a classical car.

EV growth per region in Norway in 2012

Figure 5 shows EV growth per region in Norway from March to September 2012. Although the volume is still higher in urban areas than rural areas, the trend clearly shows a significantly higher growth rate in rural areas than in urban areas for this period. This marks a clear change from previous years, where both the growth rate and the volume were higher in the cities than in the rest of the country.

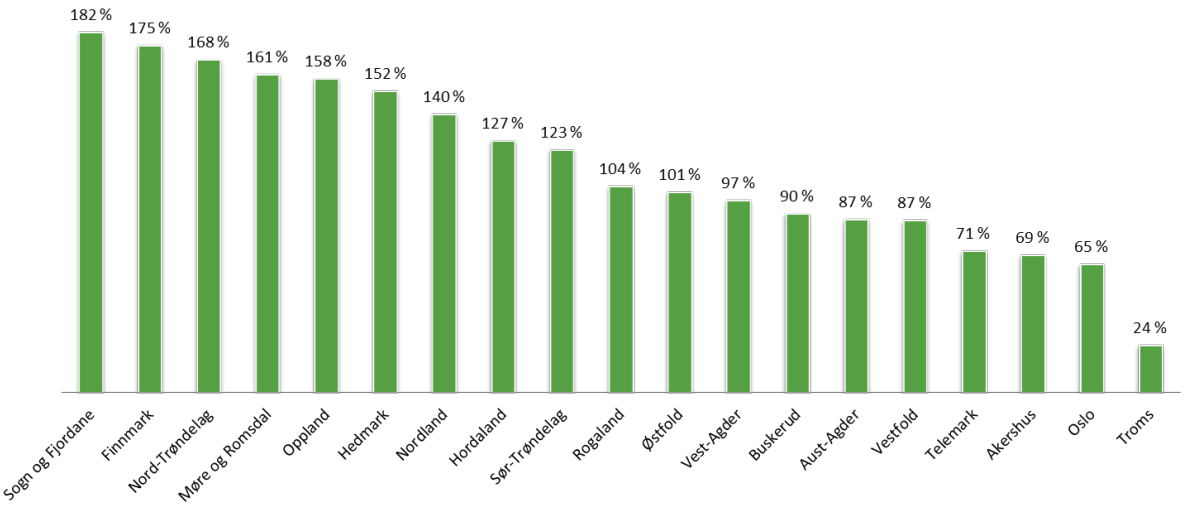
But this trend is also interesting from another point of view. Slowly, EVs are becoming relevant alternatives for those living outside urban areas. If you drive the same distances every day e.g. to get to work and back home again, then a BEV might exactly be the car that you need.

One tends to believe that the EV is the household's second car. But a survey by NTNU (Ecar/sintef) shows that this is not necessarily the case. Given that approximately 42 % of Norwegian households have two cars (TØI 2011), the EV also serves as the everyday car for many (NTNU 2011). However, this also means that many use the BEVs mainly for commuting and the classical car for longer trips – in this way households are getting around the range limitations of BEVs.

WHERE THERE IS DEMAND, THERE WILL BE SUPPLY …

EVs in Norway were until 2009 largely purchased to save time and money – free parking and no toll road fees. Comfort, performance and status were traded for other benefits. The rapidly growing marked for EVs in Norway has clearly been driven by private demand. Until recently, one of the main barriers in the market was supply-side issues: The demand was there, but a small number of available EV's meant limited choice and distribution.

From 2010/2011, more normal cars were introduced such as Mitsubishi i-MiEV, Citroën C-ZERO, Peugeot iOn and of



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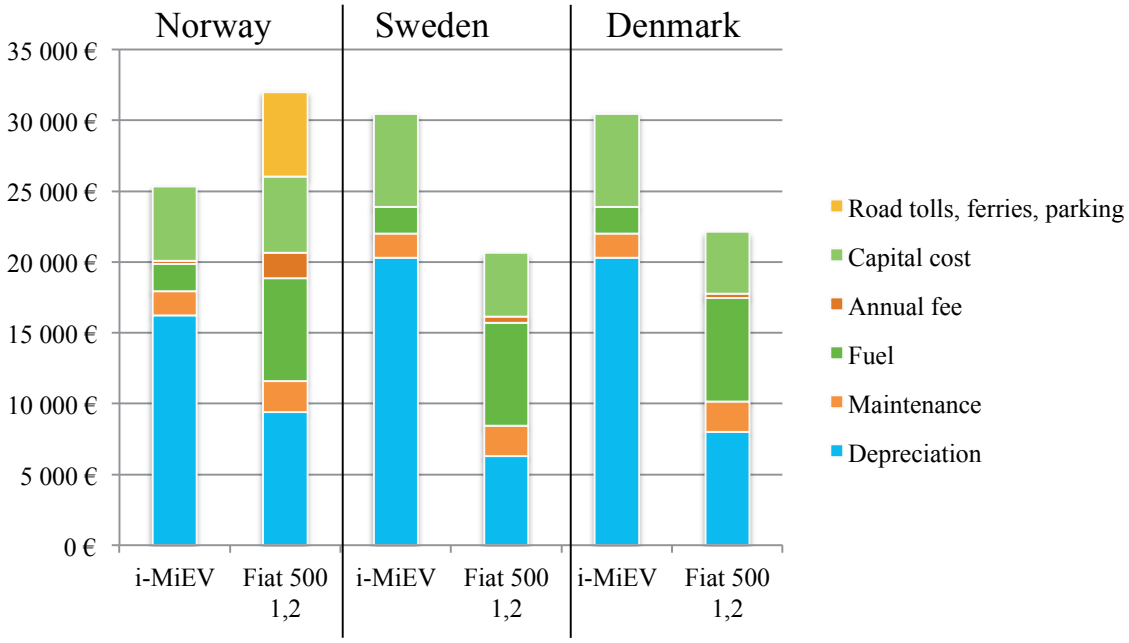

Figure 6. Total cost of ownership for a Mitsubishi i-MiEV vs. a similar Fiat 500 1.2 gasoline car.

course the record selling Nissan LEAF. An EV that also comes with back seats and air condition made EVs interesting for a new group of purchasers. These new and better equipped cars have now started to display their true potential – and they are also offered at a cost competitive level. And when suddenly your friends, neighbors and colleagues buy an EV – this is when you realise that you need one too.

… AND INCREASED SUPPLY OF EVS IS BRINGING THE COSTS DOWN …

EV incentives help automakers to cover the costs of the initial phase so that they can more quickly come to a profitable level. When production volumes increase, there will be competition in the market, and the cost goes further down. And the prices of EVs have been dropping quite much over the recent years.

In the Norwegian market one has been able to observe a large price reduction after the major automakers introduced electric cars. In 2009, one could buy a two-seat Think City electric car for NOK 290,000 including winter tires. In 2012, one can buy a Peugeot iOn with 4 seats, better comfort, better guarantees and security for the car buyer for NOK 190,000 ready to drive with snow tires included *(Figenbaum/Nørbech 2012)*.

All suppliers of EVs compete on identical terms according to normal, commercial rules. As a result, increased competition and higher market volumes have led to lower pricing. As of January 2012, the three quasi-identical cars iOn, C-ZERO and i-MiEV all cost around €24.000, down from around €30.000 on introduction a year earlier. The competition between the leading manufacturers has continued throughout 2012. The cost of EVs is expected to decline further in the coming years, making EVs even more cost effective compared to ICE cars.

… BUT THE OWNERSHIP COST OF AN EV IS STILL A QUESTION OF POLICIES

But a compatible purchase price is one thing; another factor that comes into play is the ownership cost of a car. How has this been developing in Norway? The Norwegian experience is that the more you drive, the more profitable the EV compared to a traditional car – even if one expects a bigger loss in the electric car value. A Nissan LEAF, owned for 5 years and drives 15,000 miles per year was assumed to be competitive in costs compared to a VW Golf already in 2011, even without full use of incentives such as access to bus lanes, free parking etc (Green car strategy paper 2011). If we compare Norway with Sweden and Denmark, we can see some interesting differences:

Figure 6 shows the Total Cost of Ownership for Mitsubishi i-MiEV vs a similar Fiat 500 1.2 gasoline car, based on 5 years of ownership and 15,000 kilometers driven per year, for Norway, Sweden and Denmark. The Mitsubishi i-MiEV comes out much better for the owner in Norway than in Sweden and Denmark. Especially the road tolling and parking fees makes the difference between owning an EV and a conventional car. This also supports the findings described earlier where people especially living in or just outside big towns like Oslo, Bergen, Trondheim and Stavanger – towns which also happens to have toll road systems – are also the areas where the number of EVs has been and are growing most in Norway.

EVOLUTION OF BATTERY TECHNOLOGY

The battery technology is indeed the EVs Achilles' heel. Compared to gasoline, batteries have a low energy density and weigh a lot more than a gasoline tank. Following from this there will be concerns about expectations for how far you can drive before recharging – especially during the Norwegian winter season.

The battery technology first accelerated towards the end of the 1990's; first for cells and small batteries, then for larger units. We got the nickel-cadmium batteries for electric cars, but these disappeared quickly because cadmium is too toxic to use. Then the nickel-metal hydride (NiMh) that was less dangerous was introduced. Saline batteries (Zebra) were promising and came in small volumes of electric cars e.g. used in the Norwegian brand Think. Before finally various types of lithium-batteries has taken over most of the market (Elbil.no 2010).

As it looks now; up to 2020 it will be all about improving the control systems that provide reasonable mileage and further extending the lifetime of lithium batteries. The new Tesla Model S is in this respect a new leap forward – promising that you can drive up to 500 km (at 88 km/h) if you go for the high-end 85 kW-version.

The introduction of Li-Ion batteries in EVs have several advantages: It is maintenance free, has a higher energy density than previous chemistries used, is able to withstand most charging and discharging patterns with less degradation or need for deep-cycling than previous chemistries, as well as enabling commercial fast charging. In sum, this battery technology created a huge leap forwards in terms of usability and user-friendliness, which has been integral to the success of the current generation of BEVs in Norway.

But the future might be even brighter: A new report by the international consulting firm McKinsey predicts that the prices of batteries (that could be used) for electric vehicles will be reduced by 70 percent by 2025. The price reduction is due to larger production volume, lower component prices and technology development that will increase the energy density of batteries (McKinsey 2012).

THE DEVELOPMENT OF CHARGING POINTS

BEV's and charging points is the classical chicken or the egg-dilemma. In Norway the state agency Transnova has together with several municipalities managed to deploy charging stations to serve an increasing number of EV's. But after a big boost in 2009 and 2010 the charging infrastructure in Norway has evolved a bit more slowly in 2011 and 2012. At the end of 2012, there were 3,700 of what we can call normal charging points (Figure 7).

10 charging points installed at Frognerseteren, in the hills outside Oslo

There were also added quite some fast charging points in Norway in 2012 bringing the total to 58 to be found at 53 locations. If this continues it will soon be possible to drive an EV in Norway for longer distances – if you don't mind to stop for a burger or a coffee on your way.

But one should also remember that most people in Norway charge their car at home. Many also have this possibility at work. But still new charging station will be crucial in the years to come. Maybe not because people actually need them, bet because they feel secure knowing that they are to be found – just in case.

Figure 7. Normal charging points.

Future outlook for EVs

GLOBAL MARKETS ARE VITAL FOR RECHARGEABLE CARS TO GROW FURTHER

Even though Norway is an important early market, it is far too small to be able to drive a market large enough to be profitable for the big automakers. The main assumption behind to invest in the development of new automotive technology is the expectation that it will demand such cars in ever-greater volume globally. In particular, emerging economies such as China and India is important. It is not sustainable, for example, that the Chinese over time begin to use the car like we do in the western world today, both because of the emission problems this would create locally and globally, but also for political-strategic reasons. Increased oil imports, increased dependence on oil-producing states, will mean less political room for maneuver.

The auto industry focused primarily on markets in Western countries where new, relatively expensive car technology can be developed and sold. The EU and the US, along with Japan, will be the most important markets for EVs in the short and medium term, until markets in China, India and other countries will evolve. This development pattern assumes willingness to pay and political will to pursue such cars in the West in the short and medium term. In addition to the air quality gains CO_2 emissions reductions, there are also industrial arguments. An early position in the market for EVs can provide competitive advantages for a domestic auto industry which again leads to jobs and wealth creation.

However, several of the potential early markets, especially in Europe, are now in a recession. This might have an impact on the future introductory rate for EVs. But if countries sees EVs as more of an industrial investment, and do not only pursue them because of climate change targets, the odds might be better (Green car strategy 2011).

OUTLOOK FOR THE NORWEGIAN EV MARKET IN 2013

The Norwegian electric car Association is expecting that increased sales will continue and that we will see a 25 % growth in 2013 bringing the number of sold EVs to 5,500. The wild cards that might increase this number are public procurement deals, and particularly the sales of Tesla Model S (Norsk elbilforening 2013). Already by the end of 2012 app. 1,000 Norwegians had booked a Model S, even if the first car will be delivered during the summer of 2013. Tesla might sell between 1,500 and 2,000 Model S in Norway in 2013 (Grønn bil 2012).

During 2013–2014, most major automakers offer at least one model in the European car market that can use electricity charged from the power grid. Among the most exciting news will be the new models offered by the German car makers BMW and VW. And maybe the French Renault ZOE will offer a surprise?

Grønn Bil has made an outlook of Norwegian BEV/PHEV sales towards 2020. The prognosis is updated to reflect policy changes made during 2012.

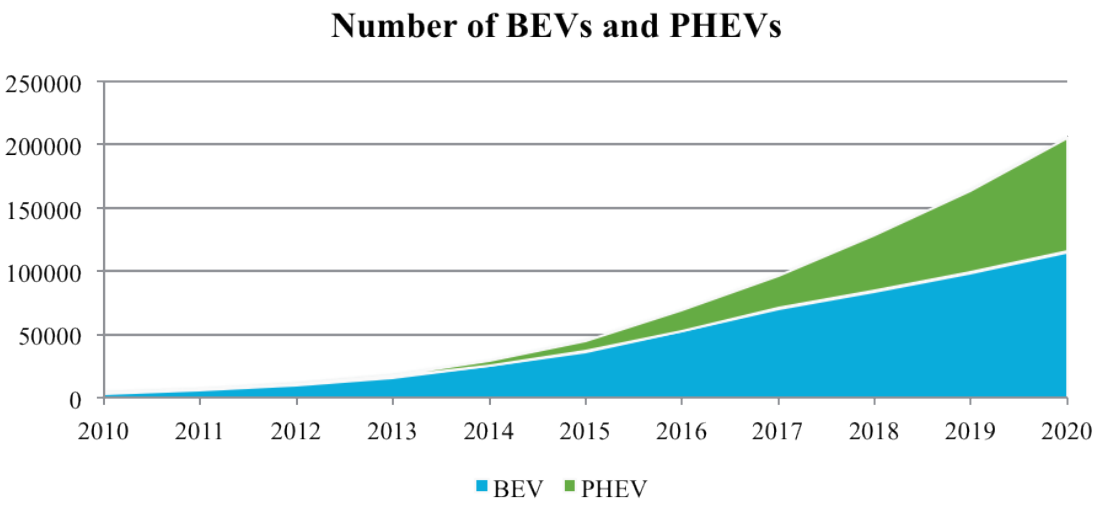

Figure 8. Prognosis of BEVs and PHEVs sales until 2020.

It will be interesting to see if other countries in Europe can pull Norway down from the throne as being the country with the highest BEV sales as a percentage of total car sales. The future will tell.

Conclusions

Looking at the current policy measures and ambitions in Europe, it is interesting to acknowledge that it has not been Sweden or Germany – countries with a large automotive industry – that have engaged most aggressively with Electric Vehicles. Instead, it is Norway that is leading the rest of the pack, both when it comes to having most policy incentives in place, and when it comes to having more EVs on the road than any other country, compared to its total car park.

The Norwegian lesson is that you need both push and pull factors within your incentive schemes – success will not come otherwise. A policy mix which contains financial incentives, access to bus lanes, free parking/no toll road and charging infrastructure – is indeed a receipt for BEV success.

But the special car taxing system in Norway is of course also an important explanatory factor. The possibility to buy a rather cheap car that is also cheap to drive – and you escape the toll road fee and you also could use the bus lanes to get to your job – that is a winning combination. When it comes to the 2011/12 take off for EVs in Norway – new models that look like an ordinary car has also played its role. The further build out of fast charging stations could be an important key to continued success.

The key learning points from the Norwegian EV experience seem to be fairly straightforward. If EVs are competitive in terms of usability and TCO, today's EV technology is good enough for users to be quite happy with their cars, and recommend them to their neighbors. As technology improves and prices come down, EVs will be competitive in more and more segments, and sales will increase further. Until that time, any government that wish to speed up EV introduction will have to provide incentives that are strong enough to give EVs a competitive edge in a market segment large enough to attract suppliers. Each country will have to find the right domestic tools to make this happen, but in general tax reductions and usage incentives seem to be better measures than direct subsidies. As EV prices come down and EV technology improves, incentives can gradually be reduced and removed, as long as EV competitiveness is upheld in the market.

Figure 9 is a summary of lessons learned, as a suggestion on how a country can get from market immaturity to mass market introduction to finally a mature market.

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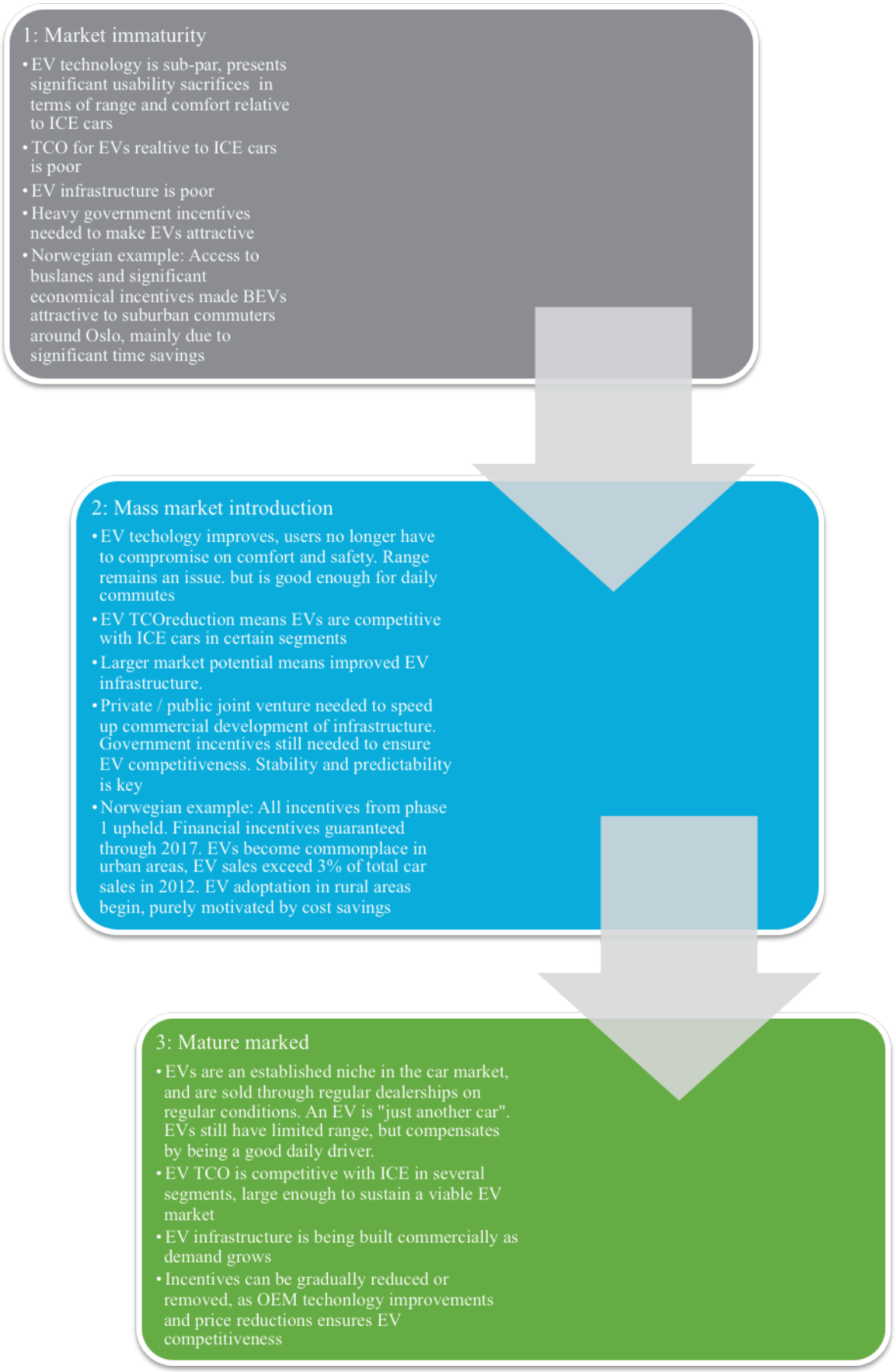

Figure 9. Summary of lessons learned, as a suggestion on how a country can get from market immaturity to mass market introduction to finally a mature market.

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