

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. A list of policies that needs to be in place before one could expect a BEV take-off in a given country is also presented.

In total there were 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. In August 2013, BEVs alone accounted for over 6% of new car sales. If this trend continues, there could be more than 50.000 electric cars in Norway by the end of 2016. So how did this EV- revolution in Norway come about?

The paper looks at policy measure, infrastructure developments and technology drivers which can help explain the rapid development seen in the Norwegian marketplace. This paper also examines 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.

Keywords: *Electric vehicles, modal shift, supporting policy measures, EV infrastructure, EV technology development.*

1. 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 – it was sold 4.359 new BEVs and PHEVs in Norway through the 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 monthly sale of BEVs reached the all time high of 5.2 % of the total sale of new cars in (585 cars).

OEM	2012 sales
Nissan	2487
Mitsubishi	672
Citroen	560
Peugeot	447
Toyota	171
Opel	141
Tesla	38
Ford	34
Renault	26
Buddy Electric	24
Fiat	24
Think	22
Tazzari	10
Mia	9
Fisker	6
Ikke oppgitt	4
Chevrolet US	3
Piaggio	1
SUM	4679

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. The figure below 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 sale figures are also special in a Scandinavian context. In Denmark, as of per 1. June 2012, there are only a total of 1160 registered electrical vehicles, broken down this means 975 passenger cars, 9 vans, 165 trucks and 11 buses (Dansk elbil komite, 2012).

As of June 2012 there were about 500 BEVs in Sweden. In Sweden it was sold 266 electric passenger cars in 2012. This is doubling of the sales compared to 2011.

Figure 1: EV sales statistics for Norway in 2012 (HEVs not included):

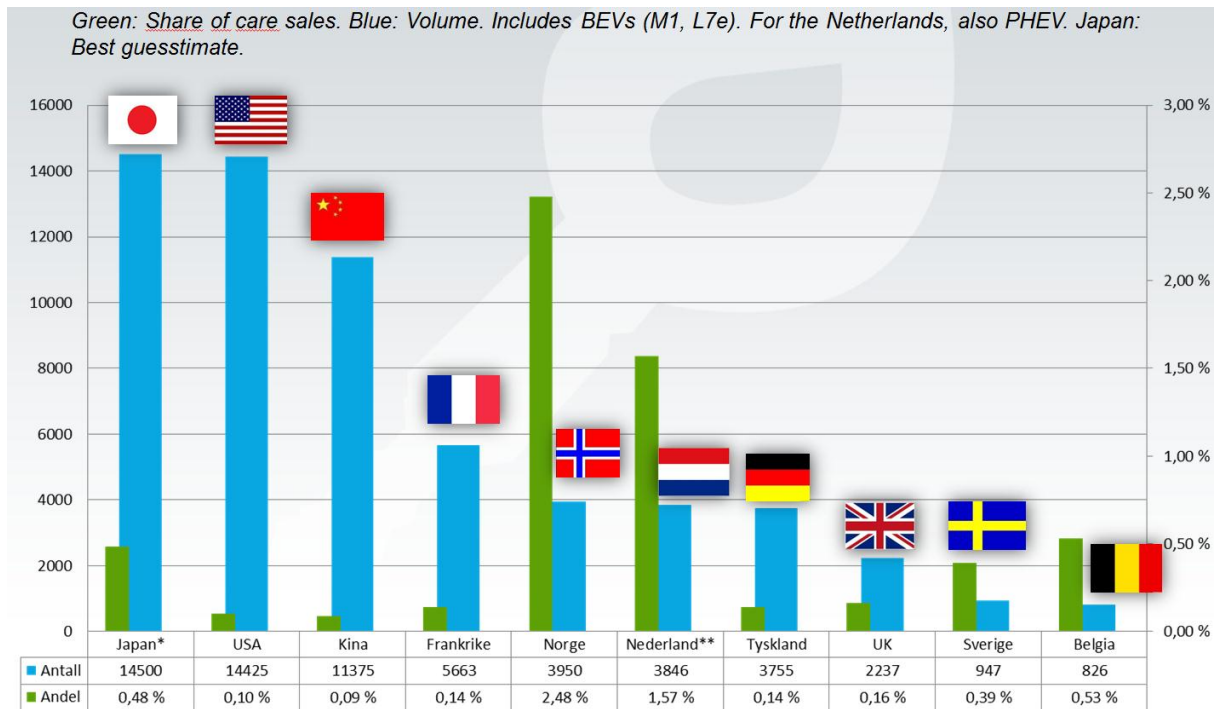


Figure 2: Global EV sales 2012, top 10 countries

2. 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 in place 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 Norwegian Ministry of Transport and Communication established in 2008 a resource group led by Energi Norge in order to draw up an action plan for electrification of road transport. The Resource group recommends that you have an ambition that the proportion of rechargeable cars will make up 10 percent in 2020. The Government has so far not to set a number of goals attached electric cars. But the 10 percent vision can be viewed as similar to 200,000 BEVs and PHEVs by 2020.

Central to understanding the Norwegian BEV incentive model is the fact that regular ICE cars are taxed heavily in Norway, compared to most other European countries. Upon import, cars are taxed according to their weight, CO₂ 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 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 charging points in Norway.

Swedish EV incentives

The Swedish government has established the goal 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 electric vehicles includes investment support of 25% of additional cost maximum of 100 000 SEK for the first sold 75 vehicles and 25% of additional cost maximum of 50 000 SEK for 1000 sold vehicles. This is only for public and private entities.

Other incentives for alternative vehicles, except ethanol vehicles, also exist in Sweden. Fringe benefits, for electric and hybrid vehicles, the taxable value of the car for the purposes of company car taxation are 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 40 000 SEK. There is a limited amount of vehicles for the super bonus; 5000 vehicles are supported. Hybrid vehicles with CO₂ 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 60 SEK 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 80 SEK/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 (Lewald, 2011; Swedish Transport Agency, 2011).

Danish EV incentives

In Denmark there are also some measures in place to promote electric vehicles. Since 1984 the introduction of EVs has been supported 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 or weight fee 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 1 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 2400 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 technologies 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. Subsequently, they will pay a tax amounting to 11.25 Euro (up to 2,000 kg), 12.02 Euro (up to 3,000 kg) or 12.78 Euro (up to 3,500 kg) per 200 kg of weight or part thereof.

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 CO2 emission level. Pure electric vehicles are exempted from the IUC. Since 2009, an income tax reduction of 30% up to 796 EUR is provided as an incentive for the purchasing electric vehicles or passenger cars exclusively using RES as fuel.

During 2008 to 2010 purchasers of a new vehicle emitting a maximum 130 g/km CO2 receive an incentive of 1,000 EUR, if they have a car which is 10 years old or more scrapped simultaneously (1,250 EUR if the car is more than 15 years old). In 2010 the tax incentive was reduced to 750 EUR for a 10 year old car and 1,000 EUR for an 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 5,000 EUR 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).

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

Figure 3: Sum-up of EV incentives in countries studied

3. 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.

It should be mentioned that Norway has had its own production of electric vehicles from 1990. However, the production of the [Th!nk 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.

Another key difference that may explain differences in taxation policies is the availability of local resources. There is a higher interest for BEVs and FCEVs in countries which have a large source of renewable electric power like Norway, but higher for bio-fuels in countries like Sweden that have large bio resources.

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 these 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 so that such incentives become 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.

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.

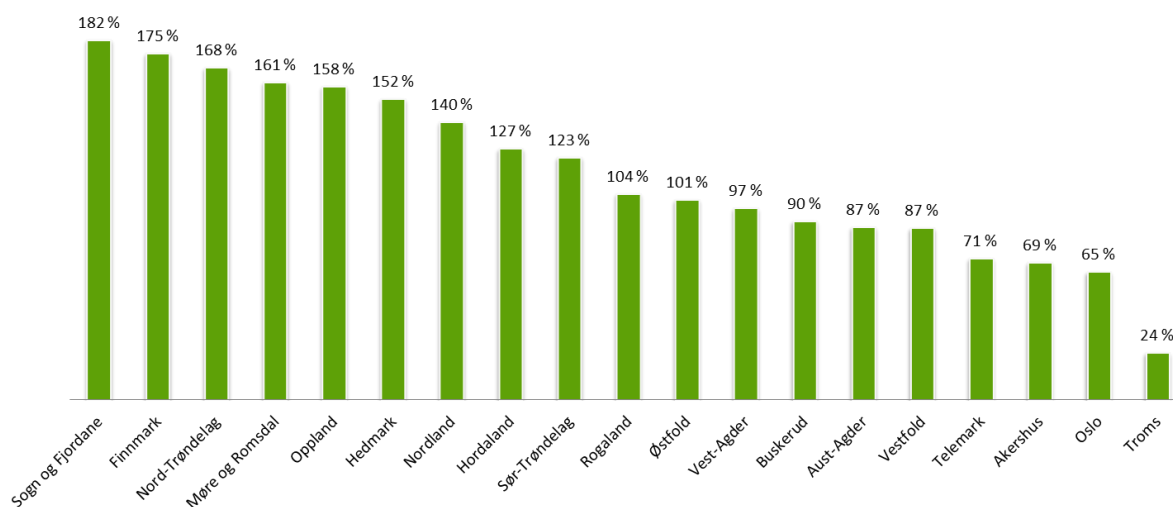


Figure 4: EV growth per region in Norway in 2012

The graph 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.

One tends to believe that the EV is the household's second car. Especially this has been the case in Norway. But a survey by NTNU (Ecar/sintef) shows that this is not the case. Given that approximately 42 % of Norwegian households have two cars (TØI 2011), the EV serves as the everyday car (NTNU 2011).

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 market 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 producers and importers 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 course the record selling Nissan LEAF. An EV that also come 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 suddenly your friends, neighbors and colleagues buy an EV – and this is when you realize that you need one too.

... and increased supply of EVs is bringing the costs down...

EV incentives help automakers to help cover the costs of the initial state so that they can more quickly achieve profitability by producing them. When automakers launch EVs, electricity and production volumes increase, there will be competition in the market, and the cost goes down. And the prices of EVs have been dropping quite much over the recent years.

In the Norwegian market 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 electric cars 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:

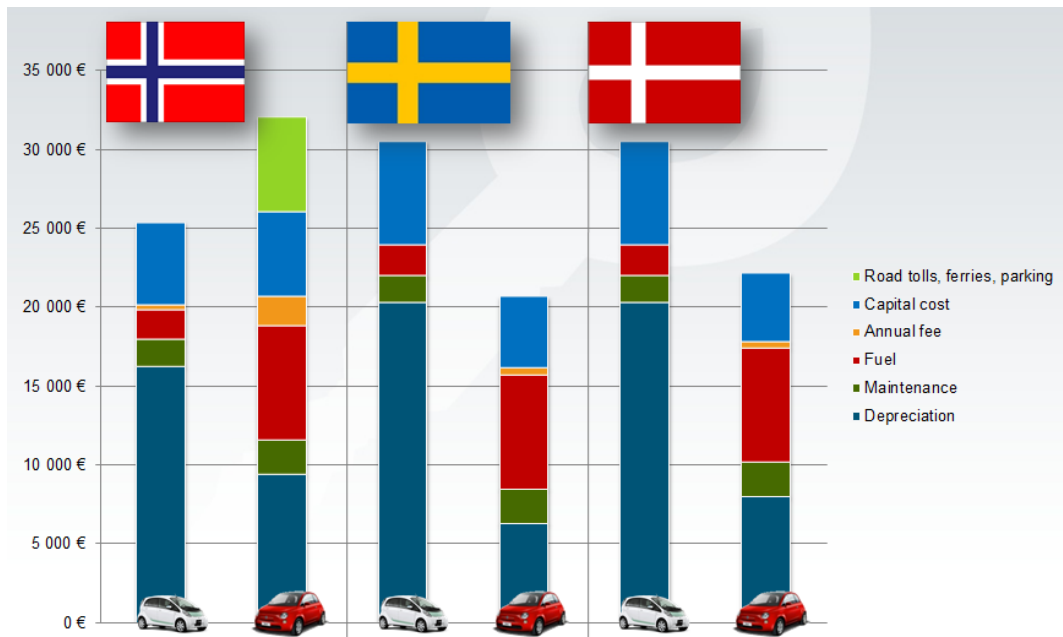


Figure 5: TCO for Mitsubishi i-MiEV vs Fiat 500. 2012 pricing. 5 years of ownership, 15.000 km / year. Estimates only

The figure 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 above 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 the fastest in Norway.

Has improved battery technology played any role?

The battery technology is indeed the EVs Achilles' heel. Compared to gasoline, batteries have a low energy density and weigh a lot more, and if this was not enough – they requires far more space 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 came the nickel-metal hydride (NiMh) that was less dangerous. 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).

The lithium battery technology is far from perfect, but in the short term is assumed to be the best option for electric vehicles. 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.

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 manage 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 (picture below).



Figure 6: 10 new 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, but because they feel secure knowing that they are to be found – just in case.

4. Future outlook for EVs

Global markets are vital for rechargeable cars to grow further

Even though Norway is an important early market, we are 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 Chinese people over time are beginning 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 the political-strategic reasons, because this will lead to increased oil imports, increased dependence on oil-producing states, and less political room for maneuver.

The auto industry focused primarily on markets in Western countries when new, relatively expensive car technology will be developed and sold. The European Union and the United States, 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 developmental pattern assumes payment determination and political will to pursue such cars in the West in the short and medium term. In addition to the air quality gains from such cars, they are also defended with industrial arguments. An early position in the market for EVs can provide competitive advantages for the domestic auto industry that leads to wealth creation and jobs, and thus are a good investment. It is also a strategic point in making them less dependent on oil imports before oil prices are painfully high at some point in the future.

There is a lot of evidence pointing to that several of these early markets are heading into a recession, which could be detrimental to the introductory rate for EVs. If countries consider betting on such cars as an industrial investment, it's probably better odds for betting continued, and possibly even strengthened, than if the bet is considered to be solely a climate change commitment (Green car strategy 2011).

Outlook for the Norwegian EV market in 2013

The Norwegian electric car Association has made the following conjecture for 2013: The expectation is that increased sales continues and that we will see a 25% growth in 2013 and that the total sales of rechargeable cars and used imported cars will reach 5,500. The wild cards that might blow up this number are public procurement deals, and particularly the sales of Tesla Model S (Norsk elbilforening 2013).

Already in 2012 between 800 and 1,000 Norwegians have booked for a Tesla Model S, even if the first car will be delivered in March/April 2013. Already at the beginning of 2013, there is a chance that Tesla can sell between 1,500 and 2,000 Model S in Norway in 2013 (Grønn bil 2012).

During the 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 the following outlook on Norwegian BEV / PHEV sales towards 2020. The prognosis is updated to reflect policy changes made in 2012.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total car sales	128000	138000	140000	140000	140000	140000	140000	140000	140000	140000	140000
Total BEV / PHEV share	1,00 %	2,00 %	3,40 %	5,00 %	8,00 %	12,00 %	17,00 %	20,00 %	23,00 %	26,00 %	30,00 %
BEV	1,0 %	2,0 %	3,2 %	4,3 %	6,7 %	8,0 %	12,0 %	13,0 %	10,0 %	11,0 %	12,0 %
PHEV	0,0 %	0,0 %	0,2 %	0,7 %	1,3 %	4,0 %	5,0 %	7,0 %	13,0 %	15,0 %	18,0 %
Total BEV / PHEV sale	1280	2760	4760	7000	11200	16800	23800	28000	32200	36400	42000
BEVs	1280	2747	4505	6020	9380	11200	16800	18200	14000	15400	16800
PHEVs	0	13	255	980	1820	5600	7000	9800	18200	21000	25200
Scrapped BEVs/PHEVs	100	150	200	250	300	350	350	400	450	500	550
BEV	100	150	200	250	300	350	350	400	450	500	550
PHEV	0	0	0	0	0	0	0	0	0	0	0
BEVs/PHEVs by year-end	3400	6010	10570	17320	28220	44670	68120	95720	127470	163370	204820
BEV	3400	5997	10303	16073	25153	36003	52453	70253	83803	98703	114953
PHEV	0	13	267	1247	3067	8667	15667	25467	43667	64667	89867

Number of BEVs and PHEVs

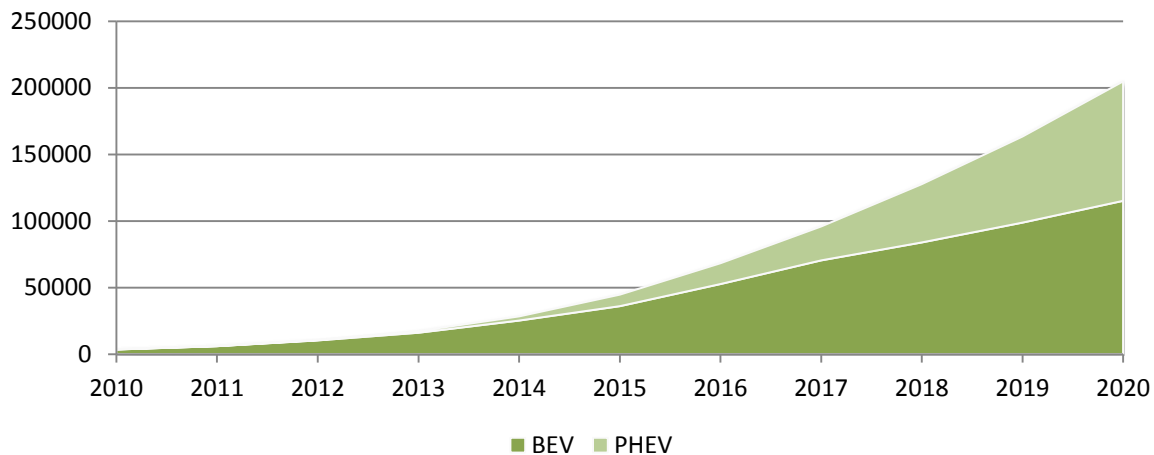


Figure 7: Norwegian EV prognosis for 2020

5. Conclusions

Looking at the current policy measures and ambitions in the Nordic countries 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 it's when you both have push and pull factors within your incentive schemes – success will come. This has been the case in Norway and has definitely impacted the success of electrical vehicles. In other countries the incentives are mostly connected to free parking and free charging on one side or financial incentives on the other.

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 - 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 is 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. Until that time, any government wishing 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.

Below you will find a traffic light with some lessons learned-suggestion on how a country can get from market immaturity to mass market introduction to finally a mature market.

1: Market immaturity

- EV technology is sub-par, presents significant usability sacrifices in terms of range and comfort relative to ICE cars
- TCO for EVs relative to ICE cars is poor
- EV infrastructure is poor
- Heavy government incentives needed to make EVs attractive
- Norwegian example: Access to buslanes and significant economical incentives made BEVs attractive to suburban commuters around Oslo, mainly due to significant time savings

2: Mass market introduction

- EV technology improves, users no longer have to compromise on comfort and safety. Range remains an issue, but is good enough for daily commutes
- EV TCO reduction means EVs are competitive with ICE cars in certain segments
- Larger market potential means improved EV infrastructure.
- Private / public joint venture needed to speed up commercial development of infrastructure. Government incentives still needed to ensure EV competitiveness. Stability and predictability is key
- Norwegian example: All incentives from phase 1 upheld. Financial incentives guaranteed through 2017. EVs become commonplace in urban areas, EV sales exceed 3% of total car sales in 2012. EV adoption in rural areas begin, purely motivated by cost savings

3: Mature market

- EVs are an established niche in the car market, and are sold through regular dealerships on regular conditions. An EV is "just another car". EVs still have limited range, but compensates by being a good daily driver.
- EV TCO is competitive with ICE in several segments, large enough to sustain a viable EV market
- EV infrastructure is being built commercially as demand grows
- Incentives can be gradually reduced or removed, as OEM technology improvements and price reductions ensures EV competitiveness

References

- Grønn bil 2013: <http://www.gronnbil.no/nyheter/over-10-000-ladbare-biler-paa-norske-veier-article311-239.html>
- Nordisk energiforskning 2012 - INTELLECT – End of Project Report <http://www.orkusetur.is/doc/34147?download=false>
- TØI 2011 - TØIs reisevaneundersøkelse 2009 <https://www.toi.no/getfile.php/Publikasjoner/T%D8I%20rapporter/2011/1130-2011/1130-2011-el.pdf>
- Spørreundersøkelse fra Volvo, 2012: 8 av 10 ønsker å kjøpe ladbar bil. <http://www.gronnbil.no/nyheter/volvo-8-av-10-oensker-aa-kjoepe-ladbar-bil-article294-239.html>
- INTELLECT 2012: Rapport om rammevilkår i de nordiske landene. <http://www.gronnbil.no/nyheter/intelect-hva-betyr-nordiske-rammevilkaar-for-elbil-i-praksis-article289-239.html>
- Dansk elbilalliance: <http://www.danskelbilalliance.dk/>
- Elbil er bil nummer én (SINTEFs Ecar – prosjekt): <http://www.tu.no/energi/2011/06/28/avliver-mytte--elbil-brukes-som-nummer-1-bil>
- SEAI 2012: http://www.seai.ie/Grants/Electric_Vehicle_Grant_Scheme/I_am_a_consumer/Benefits_of_Buying_an_Electric_Vehicle/
- Clean Vehicle EU: <http://www.cleanvehicle.eu/info-per-country-and-eu-policy/member-states/ireland/national-level/>
- Dansk elbilkomite 2012: http://www.danskelbilkomite.dk/elbiler_og_lovgivningen.htm
- Albrecht et al 2013: Albrecht, M., Nilsson, M., & Åkerman, J. (2013). Electrification of vehicles – policy drivers and impacts in two scenarios. *Grid Integration of Electric Vehicles in Open Electricity Markets*. Wiley.
- EV city casebook 2012: http://www.cleanenergyministerial.org/Portals/2/pdfs/EV_City_Casebook_LR.pdf
- <http://www.cleanvehicle.eu/info-per-country-and-eu-policy/member-states/ireland/national-level/>
- NTNU 2011: <http://www.sintef.no/Projectweb/ECar/>
- Figenbaum/ Nørbech 2012: Erik Figenbaum, TØI/Tom E. Nørbech, Transnova December 2012: <http://elbil.no/elbilfakta/politikk/878-elbilpolitikken-virker-etter-hensikten>
- Green car strategy 2011: Grønn Bils strateginotat 2011
- Norsk elbilforening 2013: <http://www.elbil.no/mennesker/882-hva-forventer-vi-av-elbilaret-2013>
- Grønn bil 2012: <http://www.gronnbil.no/nyheter/tesla-model-s-priset-i-norge-article309-239.html>
- McKinsey 2012: http://www.mckinseyquarterly.com/Battery_technology_charges_ahead_2997
- Elbil.no 2010: <http://www.elbil.no/elbilfakta/teknologi/171-fart-og-spenning-om-batterier>
- Lewald, 2011; Swedish Transport Agency, 2011
- MOBILE 2012: <http://www.mobie.pt/en/postos-de-carregamento>
- ESB 2012: <http://www.esb.ie/electric-cars/index.jsp>
- Uviklingen for ladbare biler i Norge på kort og mellomlang sikt: <http://www.gronnbil.no/nyheter/utviklingen-for-ladbare-biler-og-infrastruktur-i-norge-paa-kort-og-mellomlang-sikt-article222-239.html>