

Put a price on carbon to fund EV incentives – Norwegian EV policy success

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Abstract

In this paper we will look at the experiences from the Norwegian EV policies which has fostered the most advanced EV market in the world. What lessons can be learned from the Norwegian experience, and how can other countries follow in Norway's footsteps?

1 Introduction

Norway is the world's leading EV market with a 19% BEV (Battery electric vehicle) and 16% PHEV (Plug-in hybrid vehicle) market share by June 2017 (figure 1). In December 2016 the milestone of 100.000 BEVs registered was reached (figure 2). This is equivalent to about 3% of the total fleet of 3 million passenger and light commercial vehicles in Norway. In this paper we will explore the Norwegian incentive package and how other countries can learn from the Norwegian EV case.

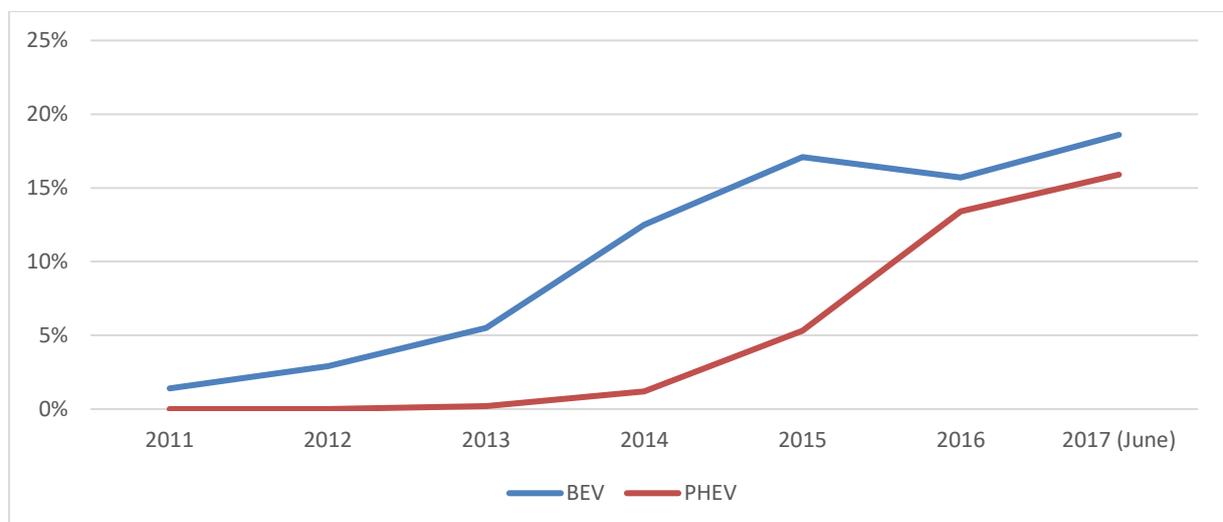


Figure 1: Norwegian EV market share development. Source OFV AS [1]

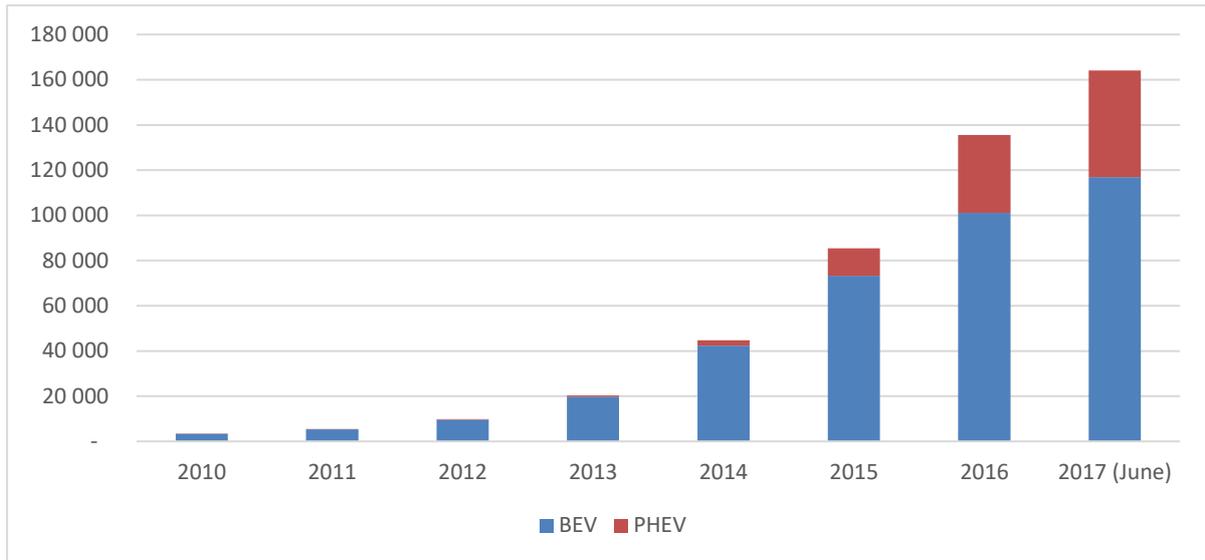


Figure 2: Norwegian EV fleet development. Source: Norwegian Public Roads Administration [2] and OFV AS [1].

Many of the Norwegian EV incentives date back to the 1990s (Table 1), but the EV market didn't really evolve before the introduction of the modern age BEVs spearheaded by the introduction of Mitsubishi i-MiEV in 2010 and Nissan LEAF in 2011. With a combined market share for BEVs and PHEVs reaching 35% by June 2017 the Norwegian market is the first market where plug-in vehicles are truly mainstream. This gives us unique user experiences, and provides the opportunity to get unrivalled experiences related to how the EV incentives are rated by real life EV users.

2 Historic development

The Norwegian EV incentives started to evolve back in the 1990s (Table 1) as a mean to foster the incumbent Norwegian EV industry. However, in recent years, the Norwegian EV industry went out of business, and the main driver for the incentives has been climate and environmentally related issues.

Incentives for zero emission cars	Year
No purchase taxes (Average 10 000 Euros for petrol and diesel cars)	1990
Low annual road tax	1996
Exemption from road toll	1997
Free municipal parking (revised in 2017, now decided locally)	1999
50 % reduced company car tax	2000
Exemption from 25% VAT on purchase/leasing	2001/2015
Access to bus lanes	2003
Free access on state ferries	2009

Table 1: Norwegian EV incentives development. Source: Norwegian EV Association [3].

3 The corner stone of the Norwegian EV revolution

As table 1 shows, Norway has a rather comprehensive EV policy package. This has without doubt been crucial to the EV market development. Different EV incentives have been introduced by shifting governments

and the EV policy have a strong support from all parties in parliament. This have made the Norwegian EV policy long term and predictable both for the market and the consumers.

But which EV polices are the most important ones from a user perspective? The Norwegian EV Associations yearly EV owners survey goes back to 2012 and gives an unrivalled insight into the minds and preferences of EV users. One of the key aspects of the survey relates to how the EV incentives are valued by the users (figure 3).

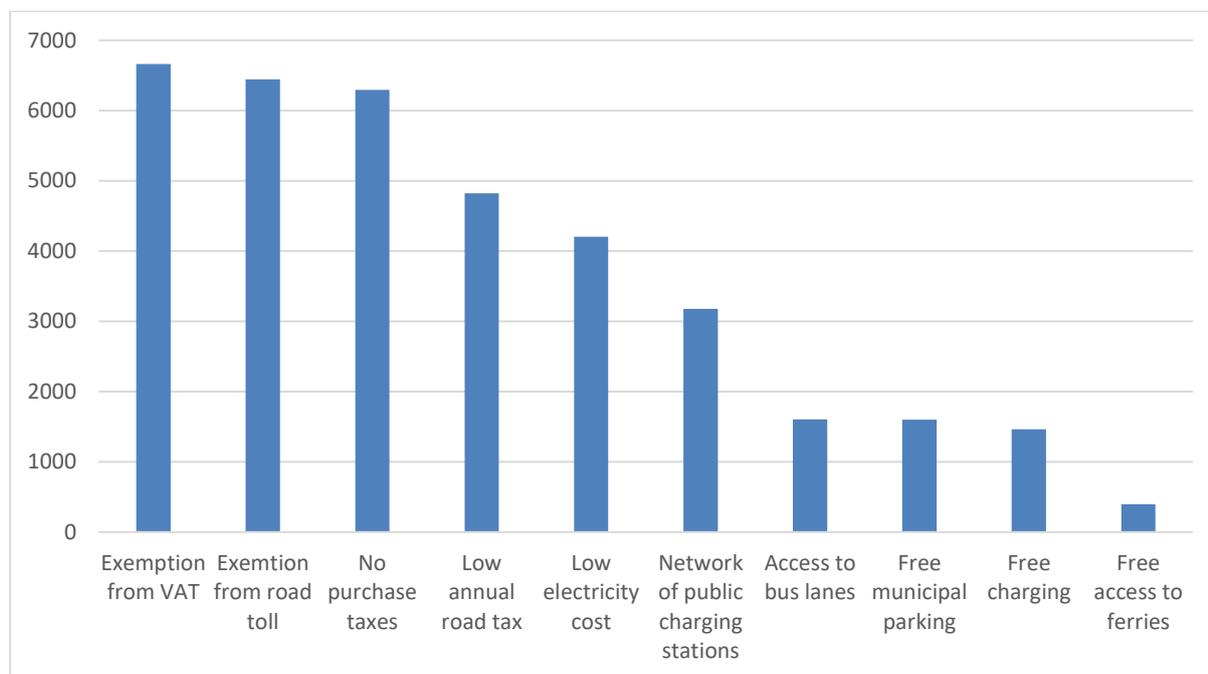


Figure 3: Most important EV incentives according to Norwegian EV owners. Question: Select the 3 most important EV incentives. Source: Norwegian EV owners survey 2017[4].

The Norwegian experience shows the most important EV incentives is the tax breaks that makes EVs price competitive at the time of buying the car. Consumers react to economic incentives, and research indicates that the upfront cost is a stronger influencing factor in the buying decision than the total cost of ownership. For instance, C. Brand et al. uses a discount rate of 30% for the private car market [5]. This corresponds to how EV owners values the incentives (Figure 3).

Through several years, the most valued incentives have been the tax breaks. This also correlates with research from the Norwegian Institute of Transport Economics that finds that *“Policies that address the purchase price of a BEV are found to be most effective in the way that they contribute significantly to BEV market shares.”* [6]. To further explain why this so we need to briefly outline the Norwegian taxation system for cars.

4 The Norwegian car tax system

The Norwegian car tax system is based on the polluter pays principle. The purchase tax for all new cars is calculated by a combination of weight, CO₂ and NO_x emissions. The tax is progressive, making big cars with high emissions very expensive. For the last years the purchase tax has been adjusted gradually to have more emphasis on emissions and less on weight.

Below we have found some examples and compared different EV models with similar petrol models to illustrate how the Norwegian tax system makes EVs competitive in the market.

	
Audi A7	Tesla Model S
2,0 TFSI 252hk quattro aut	75D 4WD
Import price: 319 464	Import price: 636 000
CO ₂ tax: 125 253 (157 g/km)	CO ₂ tax: 0
NO _x tax: 1 525 (21.5 mg/km)	NO _x tax 0
Weight tax: 109 198 (1720 kg)	Weight tax: 0 (2109 kg)
Scrapping fee: 2 400	Scrapping fee: 2 400
25% VAT: 139 460	0 VAT
Retail price: 697 300 NOK (73 017 Euro)	Retail price: 638 400 NOK (66 849 Euro)

Table 2: Norwegian price comparison between Audi A7 and Tesla Model S. Source: OFV AS [1].

	
Volkswagen Golf	Volkswagen e-Golf
1,0 TSI 110hk Businessline	Exclusive
Import price: 180 624	Import price: 259 900
CO ₂ tax: 31 827 (109 g/km)	CO ₂ tax: 0
NO _x tax: 2 263 (31.9 mg/km)	NO _x tax 0
Weight tax: 21 526 (1162 kg)	Weight tax: 0 (1510 kg)
Scrapping fee: 2 400	Scrapping fee: 2 400
25% VAT: 59 660	0 VAT
Retail price: 298 300 NOK (31 236 Euro)	Retail price: 262 300 NOK (27 466 Euro)

Table 3: Norwegian price comparison between Volkswagen Golf and e-Golf. Source: OFV AS [1].

	
Volkswagen Up!	Volkswagen e-Up
1,0 60hk BMT Beats up!	Exclusive
Import price: 103 621	Import price: 188 100
CO ₂ tax: 19 209 (96 g/km)	CO ₂ tax: 0
NO _x tax: 1 276 (18 mg/km)	NO _x tax 0
Weight tax: 13 494 (859 kg)	Weight tax: 0 (1139 kg)
Scrapping fee: 2 400	Scrapping fee: 2 400
25% VAT: 35 000	0 VAT
Retail price: 175 000 NOK (18 325 Euro)	Retail price: 190 500 NOK (19 947 Euro)

Table 4: Norwegian price comparison between Volkswagen Up! and e-Up. Source: OFV AS [1].

As you see, the progressive tax system makes most EV models cheaper to buy compared to a similar petrol model, even if the import price for EVs are much higher. This is the main reason why the Norwegian EV market is so successful compared to any other country.

The state income from the CO₂ purchase tax alone was about 3,5 billion NOK in 2016 with a total sale of 154 603 passenger cars. The cost of the tax incentives for 24 222 electric vehicles sold in Norway in 2016 is estimated to be well below the income. Even if the CO₂ tax is not directly earmarked to fund EV incentives, the total income of the tax is more than the cost of EV incentives with a 16% EV market share in 2016.

If other countries want to increase the market share for zero emission vehicles to reduce CO₂ emissions and local pollution, they could introduce a CO₂ tax on purchase similar to Norway's car tax system. Below is an illustrative example of a CO₂ tax system where you introduce a small fee based on the CO₂ emission of the car. The fee per gram CO₂ is gradually increased.

The level of tax for polluting cars and subsidy for zero emission cars can be adjusted following the market developments.

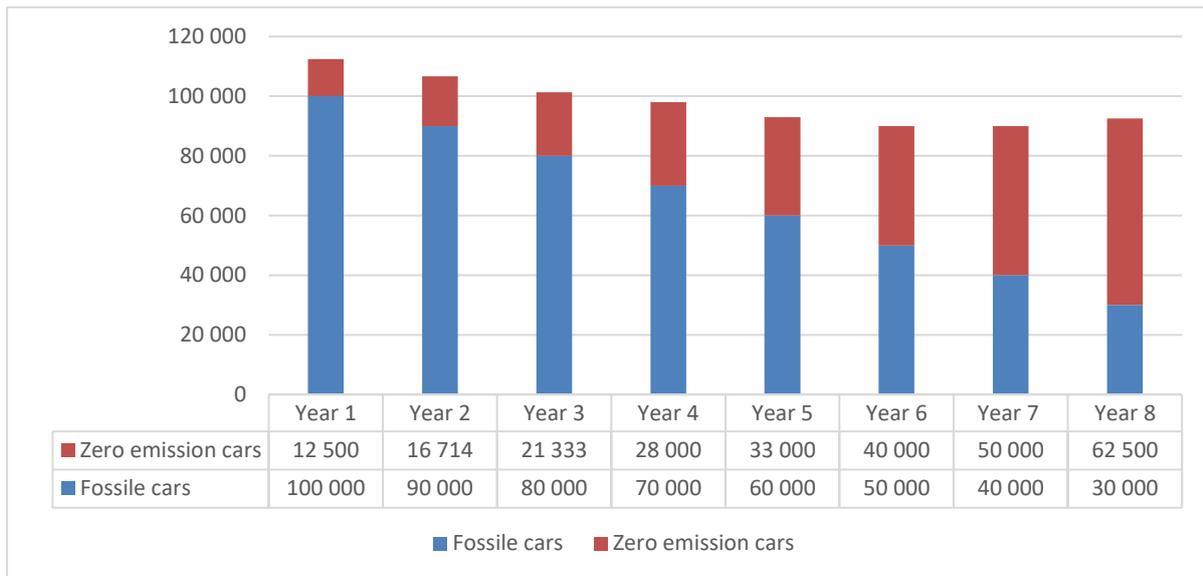


Figure 4: Illustrative example on how a CO₂ car tax system can be introduced in other countries to finance BEV tax incentives in a market introduction phase. Source: Norwegian EV Association.

In this example (figure 4) we use a car market with about 100 000 new passenger cars sold every year. This number can be scaled up or down depending on the country.

In year 1, the tax is set to 10 Euros per gram CO₂. For an average of 100 gram CO₂ per km this means a tax of 1 000 Euros per vehicle. The total tax income of 100 million Euros can finance a subsidy of 8 000 Euros per electric car, 12 500 BEVs in total that will give an 11% market share in year 1.

In year 4, the tax is increased to 20 Euros per gram CO₂. With 70 000 fossil cars sold, the total tax income is 140 million Euros. This can finance 28 000 BEVs with a subsidy of 5000 Euros each increasing the BEV market share to 29%.

In year 8, the tax is set to 25 Euros per gram CO₂. Total tax income of 75 million Euros for 30 000 fossil cars sold. A subsidy of 1 200 Euros each for 62 500 BEVs and a 68% BEV market share.

This is a simplified model where we assume an average 100 gram CO₂ per km for new fossil cars. We have not taken into account the transaction cost for the tax collection. This simple illustrative model is available for download [7].

5 Long term effect of EV policy

Only 4% of the Norwegian EV owners want to switch to a petrol or diesel car if they had to replace their EV tomorrow (figure 5). The owners are also very satisfied with their EV and this can suggest that if you have tried an EV, you will not switch back to the old technology for the rest of your life. This makes the long-term effect of the EV policy underestimated compared to classic economic theory. The EV policy in combination with a carbon tax stimulates to behavioural change with a long-term effect.

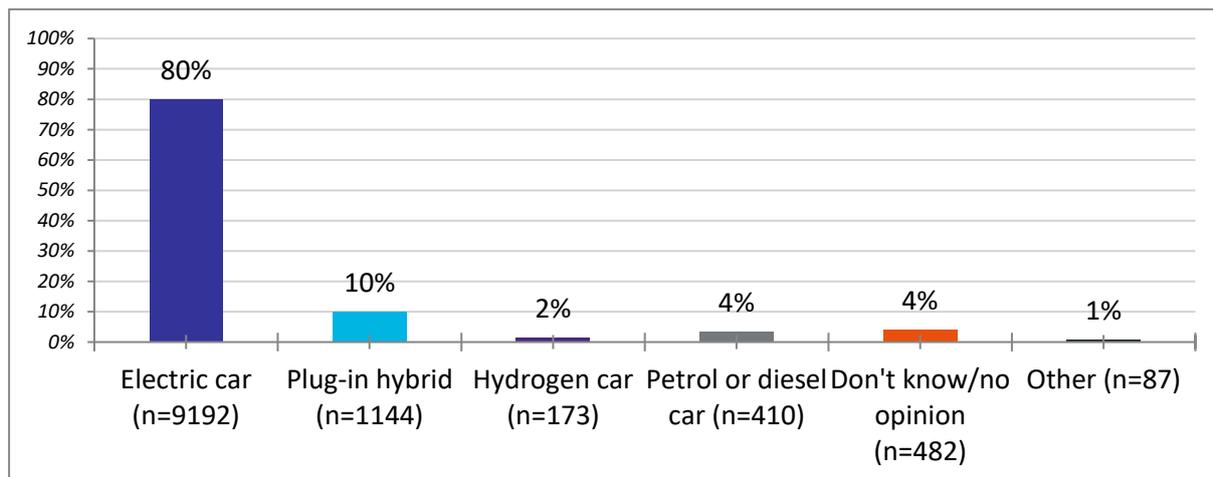


Figure 5: If you had to replace your electric car tomorrow, it would have been with a ... Source: Norwegian EV owner survey 2017 [4].

The BEV incentives must be powerful at start to have a profound effect on the car market, as the Norwegian case shows. But with a quick shift to zero emissions car market, the incentives can be phased out and the environmental effect will probably remain.

6 Local incentives on toll roads, parking and ferries

The same principle for car tax system can also be introduced for other incentives like toll roads, parking fees and ferry fees. Norway has so far had zero fees for zero emission vehicles. With a booming EV market, concerns of lost revenues, especially on local levels are growing.

The Norwegian government have decided to implement a national rule that local authorities can introduce fees also on zero emission vehicles, but the fee can never be higher than 50% of standard rates for conventional vehicles. This will give a long-term signal to potential EV buyers that it will always be economic beneficial to own a zero emissions car. If the local governments need to raise fees to increase revenues, the price difference between polluting cars and zero emissions cars can be maintained, thus keeping the incentive intact.

7 Charging infrastructure

At the current Norwegian early mass market, a national network of fast charging stations is essential. Even if home charging during the night is most common, potential new EV buyers need to be assured that they can refill the battery during the day for longer trips. Also see the paper [8] for more information about this topic.

8 Lessons learned

The taxation level for new cars in Norway is unlikely to be matched in most other markets. However, it is interesting to examine how other countries learn from the Norwegian case. According to our calculations a relatively modest carbon tax on new cars based on emissions would be sufficient to fund a support scheme for EVs that would be large enough to help the international EV market to gain the necessary momentum to reach economics of scale.

According to the Norwegian EV owners survey 2017, economic incentives are by far the most important reason to convince people to try out a new emission free technology. Once you have tried a BEV, you will not go back to a fossil car.

Research from CICERO [9] shows that there is a significantly higher acceptance for a tax if its revenues are earmarked to a specific cause. Our suggestion would be to introduce a small carbon tax on fossil cars based on emissions levels, and use the revenue to fund EV incentives until the EVs can compete without incentives. That will likely happen sooner than we think considering the battery technology development and the Norwegian EV market development.

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