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# **Norway, the most successful market for Electric Vehicles**

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## **Abstract**

In recent years there has been a dramatic increase in the number of vehicles on roads worldwide. According to more and more studies this growing number of cars will have a significant impact on urban air quality and will also create higher oil dependency for the majority of western countries. Many countries all over the world have already implemented incentives to promote the adoption of electric mobility as one of the key solutions to the problems of oil dependence and air quality. However, none of them has been as successful as Norway. Oslo is the city with the highest number of electric vehicles per inhabitant in the world, and Norway is the only country where a 100% electric car has been one of the top 10 most sold cars in 2012 and in 2013—the Nissan LEAF. This paper will describe the reasons why the Norwegian market has become the centre of the EV world.

*Keywords: Electric Vehicle Incentives, Policy Framework, Norway*

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## **1 Introduction**

One of the most promising technology options to decarbonise road transport is the full electrification of vehicles. After three years of early commercialization—first mass produced cars commercialised in 2010—, the EV and the necessary recharging infrastructure technology are today mature enough to prepare the move towards a wide adoption in Europe.

Taking into account sales until December 2012, the United States have the largest fleet of electric and plug-in hybrid vehicles, reaching the 75,000 units. However, in terms of market penetration, Norway, with a population of 5 million, is the clear benchmark with more than 10,000 EVs on the road, with a market penetration of more than 3% and also being the first market in the world with a 100% EV in the top 10 sales.

In Europe, some of the Member States have already in place a strong political support for electric mobility—passenger vehicles and light commercial vehicles. However, none of the policy packages today in place has been as successful as the one of Norway. With the objective of setting up best practices for the industry and the public authorities, this paper is exploring the reasons why the Norwegian EV adoption has been so fast.

## **2 Background**

The challenges faced by some of the largest economies in the world regarding oil dependency, air quality in cities, uptake of renewable energy sources and industrial competitiveness have been pushing governments in the past years to develop roadmaps for long term decarbonisation of transport and to implement demand incentives for zero-emission vehicles despite the global economic crisis.

Table 1 shows a comparison between the largest EV markets and some of its relevant economic data, total car industry volume, and sales of EVs in 2012.

	Population * (million)	GDP per capita PPP ** (Intl. \$)	EV incentives launched	Industry Volume in 2012 *** (units)	EV Sales 2012 (units)	EV Market Share (%)
USA	315.6	49,922	2010	14,492,398	14,251	0.10%
Japan	127.4	36,226	1998	5,369,720	15,000	0.28%
France	65.6	35,548	2008	1,898,760	5,638	0.30%
Germany	82.0	39,028	N/A	3,082,504	2,312	0.08%
UK	63.2	36,941	2010	2,044,609	1,265	0.06%
Netherlands	16.8	42,194	2008	502,544	941	0.19%
Norway	5.1	55,009	1991	137,967	3,967	2.88%
Spain	47.3	30,557	2011	699,589	435	0.06%
Italy	60.7	30,136	2013	1,402,089	517	0.04%

\* Estimated population in 2013

\*\* Source International Monetary Fund (data in International Dollars)

\*\*\* Source OICA

Table 1: Key indicators in major markets

In general the top four markets regarding electric vehicle uptake are Norway (2.88%), France (0.30%), Japan (0.28%) and the Netherlands (0.19%). All the other markets have a penetration rate of 0.1% or below.

The market today is mainly driven by the economic impact of the current crisis in national economies, the effects of having or not nationally manufactured electric vehicles, environmentally conscious consumers, oil prices and demand incentives. However, because of the low availability of full electric vehicle models it is very difficult to identify the real market potential for the long term adoption.

A recent report from the European Climate Foundation has shown the potential macro-economic benefits of the decarbonisation of the transport. Europe could improve its growth prospects and create between 500,000 to 1.1million additional jobs by 2030 through a wider adoption of more sustainable vehicles. Further improvements in decarbonising transport could allow the EU to reduce its dependence on foreign oil and save between €8 and €3 billion a year by 2030. The adoption of zero emissions vehicles will have a triple positive impact, reducing impact in climate change, improving urban air quality and an economic stimulus.

Some of the world leading countries have reacted to those potential benefits associated to the zero emissions mobility and have already in place a number of zero-emission vehicle demand incentives. To name only a few examples, in the United States an incentive of 7,500 USD is available, in the UK since 2011 the amount is 5,000 GBP and in France is 7,000 EUR.

The social, environmental and economic stakes of decarbonising transport are so important that despite the economic turbulence since 2008, governments have not reduced the investments necessary for the introduction of zero emission transport.

As a summary, in the case of Norway we could observe that the combination of a very high GDP per capita, high consumer awareness (incentives in place since 1991) and consumers' willingness to pay a premium for environmental friendly products is making the difference compared to the other world markets.

### 3 Early market

After several attempts to enter the market, EVs reached the maturity to become a mass market product late in the 2000's.

The first 100% EVs intended for mass market were the Tesla Roadster in 2008, the Mitsubishi i-MiEV in July 2009 and the Nissan LEAF in December 2010. These pioneer models paved the way for the start of a wider adoption of zero-emission mobility. Since 2008 and the launch of the Tesla Roadster more than 150,000 electric vehicles have been sold worldwide, with the Nissan LEAF leading the market with more than 70,000 units sold.

Even if the first mass production electric passenger cars came from Japan and the United States, in Norway since the early 1990's there has been significant technology awareness for the consumers as two local manufacturers of electric vehicles were present in the market—Pivco, later developed into Think and Kewet, now named "Buddy".

Today the two local brands represent about 18% of the total fleet

In 2006 there were about 1,600 EVs in Norway, mainly dominated by the local brands with 60% market share. In June 2013, the zero emissions fleet reached the 13,000 units, Nissan LEAF being the market leader with 34% of the total volume.

## 4 Policy packages

The early phase of the zero-emission vehicles commercialisation has been characterised by a heterogeneous market response. In particular due to the facts that the vehicle retail prices are higher than their equivalent with internal combustion engines, the recharging infrastructure is not sufficiently deployed and consumers are not informed enough about the electric powertrain and why this technology is now in the market.

The political response of the different countries all over the world has led to a diversity of measures, not all of them equally efficient. Therefore, there is a need to analyse the policies and measures implemented in the country with the highest EV market penetration, Norway.

The tremendous success of the zero-emission mobility in Norway is the result of the combination of three key factors:

- *Demand Incentives:* A comprehensive incentive package, backed by a political consensus that provides commitment until 2018,
- *Recharging Infrastructure:* More than 4,200 charging points already available, 65 of which are CHAdeMO-compliant DC fast chargers, and
- *Citizens' zero-emission awareness:* Having local EV manufacturers and having a long term political commitment—in place since 1990—has given citizens the time to understand the benefits of zero-emission mobility.

### 4.1. Demand Incentives

The first signal that the public authorities send when there is a need for the society to adopt a new technology is the introduction of incentives. Traditionally, this action could take the form of a cash bonus at the moment of the purchase, a reduction of the taxation or a fiscal incentive.

As the socio-economic and environmental benefits of the introduction of the zero-emission mobility are so important, some countries introduced additional incentives like the use of bus lanes, low emissions urban zones, free motorway tolls, free parking, etc. The key success factor of the proposed incentive package is the matching with the consumers' needs that are specific to every country. Therefore, it is observed that the same incentive does not lead to the same market reaction.

In the case of Norway, the current incentive policy is the result of more than 20 years of experience in adapting the measures to the reaction of the population. The list below shows current incentives and the year when they were implemented.

- 1990's: Free parking—annual savings up to 3,800 EUR.
- 1996: Road toll exemption—3 to 27 EUR.
- 2001: VAT exemption—25%.
- 2003: Registration fee exemption—ranging from 6,600 EUR to 20,000 EUR.
- 2004: Use of lanes for bus and taxi.
- Free travel on ferries.
- Reduced annual road tax—on average 325 EUR savings per year.
- 50% reduction of company car tax for employees—aprox. 2,600 EUR.
- Free electricity from slow and quick chargers

The incentive package is largely supported by the major political parties in Norway. In June 2012, the current government guaranteed the above measures at least until the next elections in 2018. This long-term commitment is also a major step as it gives the industry enough visibility to develop a stable market for the coming years.

## 4.2. Recharging Infrastructure

There are over 4,200 publicly-accessible charging outputs already installed in Norway, of which more than 65 are 50kW CHAdeMO-compliant DC quick chargers. Even if this number seems very high the fact today is that the recharging stations in Oslo are overcrowded as the current fleet of more than 13,000 electric vehicles requires a higher number of publicly accessible recharging points.

Back in 2011 the Norwegian Government Agency, Transnova, spent more than 9 million NOK in grants for quick charging infrastructure, grants that had a dramatic contribution in the achievement of the 65 CHAdeMO units today in operation in the country. The vast majority of these 65 units were installed and commissioned during 2012, installations that had a direct impact on the number of CHAdeMO-equipped passenger EVs registered in that same year: 3,883 cars, an all-time highest.



Figure 1

In the first half of 2013 Transnova granted almost 7 million NOK to several charging infrastructure operators, grants that will translate into more than 30 new quick and semi-quick charging locations before the end of 2013, all of them with at least one CHAdeMO-compliant output. It is expected that thanks to this new boost in the installation of charging stations, the number of CHAdeMO-equipped passenger EV registrations will beat a new record high in

2013. As to AC slow charge, in the city of Oslo there are more than 970 outputs available to the public, and local authorities are committed to maintain a rate of 100 new chargers per year.

## 4.3 Zero-Emission Awareness

In the large majority of markets, the technical complexity and the lack of consumers' knowledge of the electric powertrain and the batteries is leading to the idea that the risk of purchasing an electric vehicle is significantly higher than that for its internal combustion engine equivalent.

Indeed, one of the major remaining barriers for zero-emission vehicles adoption is the fact that a significant part of the consumers still believe in a number of technology myths and perceived risks.

In Norway, the fact that incentives and awareness actions were launched as early as in the 1990's has given enough time for the population to understand that the zero-emission vehicles should be considered as assets for the society, as they dramatically reduce noise and increase air quality in cities. In particular, as almost the entire electricity production in Norway comes from renewable sources, the move to EVs is essential to reach a zero-emission society.

## 5 Market reactions to mass-commercialized EVs

Since the market launch of the first mass production models in 2010, there has been a significant acceleration in the adoption of EVs in Norway.

As shown on Figure 2, the fleet grew from about 3,000 units in 2009 to more than 10,000 units in 2012. Following the current trend it can be estimated that the sales volume in 2013 will exceed the 6,000 units and bring the overall fleet to more than 16,000 vehicles.

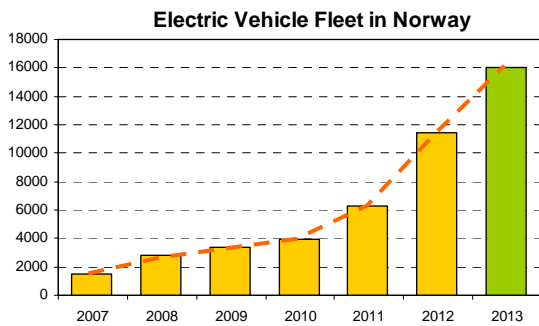


Figure 2

Given the fact that new EVs in the light commercial van and premium segments will be commercialised, it is expected that the growth trend will remain significant.

The market entry in 2013-2014 of full electric vehicles like the Volkswagen eUP or the eGolf, the BMW i3, the Tesla S, the Renault ZOE or the Nissan eNV200 with significantly expand the current model range. As a result, the market penetration of electric vehicles in Norway could exceed 10% by the end of 2014.

## 6 Integration of Electric Vehicles and Smart Grids

The Norwegian electricity sector will face important challenges in the coming years. In particular, they will be associated to the full implementation of smart meters before 2019 and the deployment of other smart grids technologies.

The integration of the electric vehicle fleet (remote control of charging/ discharging) in the electricity grid management will open the door to increasing efficiency of the grid and potential operating costs reduction for utilities.

Even if the large share of pumped storage hydro electricity in Norway creates a relatively stable grid, the availability of electric vehicles makes Norway an interesting area to study the potential effects of smart charging and vehicle-to-grid.

In the mid term we could imagine a Norwegian society in which the electric vehicle battery charging and discharging will

be remotely managed by the electricity supplier according to the national electricity market needs. In return, the vehicle owner could have access to specific benefits including the possibility of having free electricity from the home wall-box.

## 7 Conclusions

The study made about the effectiveness of the policy measures promoting zero-emission mobility shows that the package of incentives is specific for each country and that it has to be combined with a progressive but ambitious roadmap to deploy recharging infrastructure and raise consumer awareness.

In Norway, the right combination of the above three factors has been in place for more than 20 years. This long term commitment has given society the time to understand the value and the benefits of moving towards electric mobility. The result today has been a rapid adoption of the electric vehicle technology by the customers leading to a market share over 3% in less than three years and in a national automotive market just recovering from the global economic crisis (the total automotive sales in 2012 are at the same level as in 2007). In that context the current electric vehicle market penetration in Norway could be considered as a success story.

Currently, the market adoption is still growing and with the arrival of new models from different brands and covering different segments the market share is expected to increase significantly in 2013 and 2014.

Given the global economic crisis, the political and economic benefits of sustainability—creation of “green tech” jobs, reduction of oil imports and improvement of air quality in cities—will be the base for a better and stronger economy. This message is well understood by major world economies and therefore a number of EV promotion actions are already in place. The data and the conclusions of this study could be useful for policy makers as it shows the strategy followed by the most successful country in moving towards a 100% electric mobility.

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