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# The Road Ahead for Electric Vehicles: National Targets, Manufacturing Plans, Costs, and the Role for International Collaboration

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## Abstract

The International Energy Agency (IEA) simulates scenarios for future energy supply which underline the need for low emission vehicles (LEVs) such as plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs), among various LEVs. By 2020, cumulative national targets for electric vehicle sales (both PHEV and BEV) (with assumed growth rates) add up to seven million worldwide. If achieved, this would almost reach 10 percent of total vehicle sales in 2020, yet the resulting 20 million EVs on the road would only be equal to two percent of the global car stock in that year. But it would be a position from which EVs could play a much bigger role in the following 10 years and beyond. This paper explores the near-term intersection of supply and demand for EVs to better understand market developments thus far. Questions answered in this paper include: were 2011 EV sales in line with expectations? Are EV sales on track to help meet climate mitigation goals? What can be expected between now and 2020? Will 2012 will be a perfect storm of supply and demand? And what will reaching the 2020 targets cost? The IEA here presents its findings on projected supply and demand trajectories of EVs based on national targets, city plans, and announced original equipment manufacturer (OEM) and battery manufacturer capacity. The 2011 sales of 40,000 EVs are encouraging but this number must grow exponentially in the years to come to reach the targets – a challenging prospect. The IEA analysis demonstrates the urgency for international collaboration on data and planning so as to effectively propel the widespread deployment of EVs.

*Keywords: BEV, EV, PHEV, market, policy*

## 1 Introduction

Transport accounted for about one fifth of global primary energy use and a quarter of all energy-related $CO_2$ emissions in 2009 and a nearly half of them originated from passenger vehicles [1]. In the Baseline scenario of IEA's Energy Technology Perspectives 2012, which assumes no strong energy and climate policies are introduced, it is expected that vehicle stocks and their fuel consumption rise steadily, reaching more than double by 2050. This would cause global warming and would lead to a high oil demand, driving oil prices upwards unless adequate supply of oil and alternative fuels becomes available.

IEA has proposed an "Improve" scenario to reduce $CO_2$ emissions and oil dependence by introducing low emission vehicles (LEVs), such as Battery Electric Vehicles (BEVs), Plug-in Hybrid Electric Vehicles (PHEVs) and Fuel Cell Vehicles (FCVs). In this Improve scenario, 27 million EVs (PHEVs and BEVs) are expected to be sold by 2020 and over 1 billion by 2050, as shown in Figure 1 so as to reduce $CO_2$ emissions by 10 gigatons (Gts) by 2050 along with strong fuel economy improvements of conventional internal combustion engines. In the short term (2010-2030), PHEVs with short electric range (20-30 kilometers) are assumed to have a higher penetration in the market, but long electric range PHEVs (PHEV-120) dominate in the long term (after 2030), in anticipation of battery performance improvements in the same period.

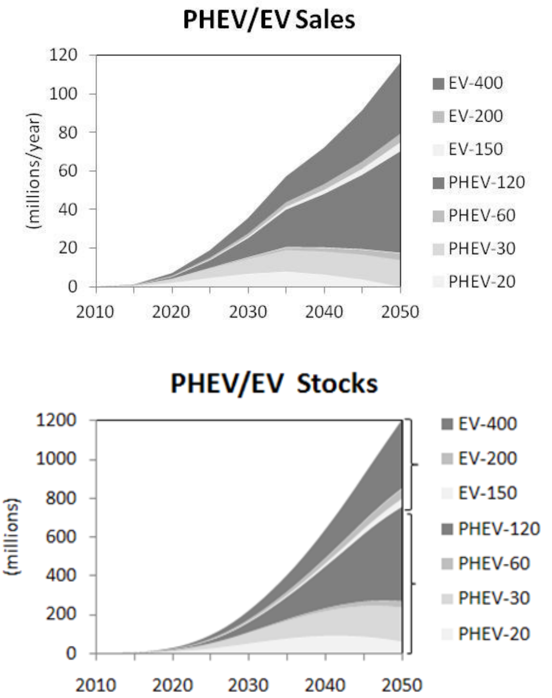



Figure1: Expected vehicle sales and stocks, by type and electric range in kilometers [2]

In the near term, 2011 represents what can be called the first year of the *Third Age of EVs*. The first age took place in the early 20$^{th}$ century, when EVs were relatively popular until the internal combustion engine displaced them. The second age happened during the 1990s, when interest was renewed in France through the French Agency for Environment and Energy Management (ADEME) and in California through its Zero Emissions Vehicle (ZEV) mandate, which spurred sales of some EVs, but never lived up to its billing (though ZEV has recently been revised and relaunched).

Last year witnessed the mass launch of two major electric vehicle models: Nissan's LEAF, a full battery electric vehicle, and Chevrolet's Volt, a plug-in hybrid electric vehicle. The first data points of this third age of EVs are the focal point of this paper, and the results are arguably impressive.

About 40,000 EVs were sold in 2011, the most in any year in history (outselling the previous historical vehicle stock peak at the turn of the 20$^{th}$ century of approximately 30,000) and more than the sale of hybrid electric vehicles (HEVs), such as the Prius, during the first six years of sales combined (1997-2003).

Since the nascent market is still developing, with more new models being launched each month, it is clear that 2012 auto sales will be crucial in determining the road ahead for electric vehicles.

EVs are a new – or revived, depending on your perspective – technology, and as such must pass through several stages of market development, optimization and scale-up.

## 1.1 Motivation

Today's EVs are far better than models sold a decade ago, but the costs are still high and infrastructure is still being developed. In the next year or two, EVs should pass the 100,000 cumulative sales mark worldwide, though this will still represent a tiny share of the more than 100 million cars that will be sold over this period. But this period will help cities establish infrastructure and help consumers get to know the technology and potentially allow for a much bigger expansion of markets towards the middle of the decade.

By 2015, a global target of 1-2 million EVs on the road seems reasonable, and by 2020 - by which time there is a good chance that EVs will be cost-competitive (or nearly so) with conventional internal combustion vehicles (ICEs) - a goal of 20 million EVs on the road is envisioned by major economies around the world and is consistent with the IEA Improve scenario, as part of a longer term plan to meet climate mitigation goals.

While this goal is very ambitious, reaching 20 million would represent only about 2 percent of the world's cars; but reaching this level will set the stage for EVs to play an increasingly important role after 2020. With on-going rapid sales growth, the IEA projects that EVs could account for 15 percent of the global vehicle fleet by 2030.

Though other types of new technology vehicles besides EVs should continue to be developed, it will be hard to beat the potential of electric vehicles for cutting oil use and $CO_2$ on a per-kilometer basis. With a moderately clean electric grid, EVs should be able to hit 50 grams of $CO_2$ per kilometer, well below today's vehicles. Today's efficient cars emit between 100 and 150 grams of $CO_2$ kilometer; even HEVs have trouble going below 90 grams per kilometer.

# 2 Methods

Three primary sources of information are used in this paper: official national data, city-level data and industry data. The first two have been collected primarily via the Electric Vehicles Initiative (EVI) (see Section 2.2); the third through industry contacts and commercial vendors. Using multiple sources also provides an opportunity to cross-check the quality and validity of data. For example, some official national statistics include golf carts as EVs and thus over-report the amount of EV vehicle stock. Industry production provides a useful cross check in this regard. Similarly, city data often provides details missing at the national level, such as the number of recharging points installed. In sum, the IEA data set provides a broad, up-to-date picture of the sales and stock of EVs worldwide.

## 2.1 IEA and MoMo

Besides database development, the IEA also updated its Electric and Plug-in Hybrid Electric Vehicle Roadmap, originally published in 2009, in June 2011 with the latest analysis on achieving the Agency's Improve (then called "BLUE Map") scenario, which outlines pathways to halving global energy-related $CO_2$ emissions by 2050 compared with 2005 levels [3]. That scenario envisions more than 1 billion EVs on the road by 2050, representing more than half of the global car fleet then.

IEA scenarios for future energy supplies underline the need for low-emission vehicles such as PHEVs and BEVs. Consistent with the targets set by countries, the Agency is calling for a ramp-up to 50 percent sales of electric, plug-in and hybrid vehicles by 2050, passing through a 10 percent sales share point at about 2020.

Using IEA's Mobility Model (MoMo), the world vehicle sales and stock have been analyzed to determine the context of PHEVs and BEVs and related infrastructure and mitigation costs for meeting IEA scenario results for increased EV market share.

MoMo contains historical data and projections to 2050 and includes all transport modes and most vehicle types, including two (including electric two-wheelers, especially prevalent in China) and three-wheelers, passenger cars, light trucks, medium and heavy freight trucks, buses and non-road modes (rail, air and shipping) [4].

MoMo covers travel around the world, broken into 22 countries and regions. It contains substantial technology-oriented detail, including underlying IEA analyses on fuel economy potentials, alternative fuels, and cost estimates for most major vehicle and fuel technologies, with projections of future technology cost reductions via RD&D and learning via cumulative production. It therefore allows fairly detailed bottom-up "what-if" modeling, especially for passenger light duty vehicles (LDVs).

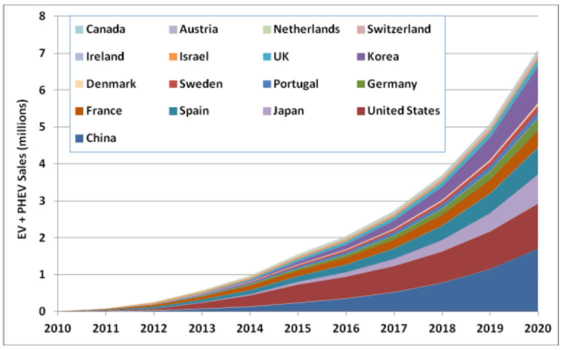
Energy use is estimated using an adapted version of the "ASIF" (tracking travel **A**ctivity, model **S**tructure, energy **I**ntensity, and **F**uel types) methodology, which works to ensure consistency between activity (passenger and freight distances travelled), structure (load factors per vehicle), energy intensity (fuel economies of different vehicles) and fuel factors [4].

## 2.2 Electric Vehicles Initiative

The IEA is spearheading the Electric Vehicles Initiative, a coalition of IEA member countries and other major economies that have set combined targets of more than 20 million EVs on the road by 2020, as shown in Figure 2. To get there, EVI partner countries are sharing information about research and development efforts; facilitating city-to-city interaction on best practices; and enhancing common data collection and analysis efforts using projected supply and demand trajectories of PHEVs and BEVs based on national targets, city plans and announced manufacturing plans by auto makers and battery companies.

EVI was announced at the Clean Energy Ministerial in 2010 and has since held several meetings in Paris, Shanghai and Barcelona with over 40 city representatives along with the initiative's 14 member countries: China, Denmark, Finland, France, Germany, India, Japan, the Netherlands, Portugal, South Africa, Spain, Sweden, the United Kingdom, and the United States. Together, these countries account for about 63 percent of the world's vehicle demand and 83 percent of projected EV sales between 2010 and 2020.

Over the past two years of EVI's work, cities have echoed one message over and over: where are the cars? There are a variety of factors embedded in this question, but the end results is that cities and fleets are currently enduring long wait times for cars to be delivered and anecdotal signs point to pent-up demand. EVI will meet again to discuss this and related issues at the 26th Electric Vehicle Symposium (EVS-26) in Los Angeles on May 6th-9th, 2012.



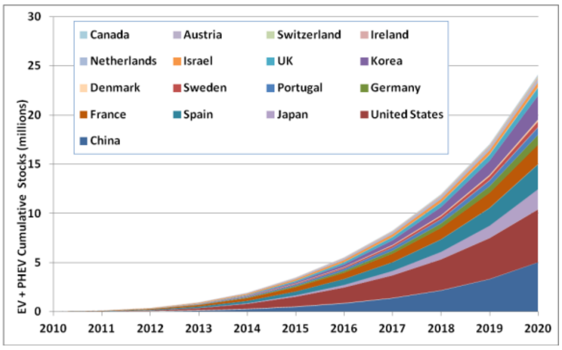




Figure2: Projected vehicle sales and stocks based on national targets with assumed growth rates, by country, 2010-2020 [5]

### 2.3 MarkLines

Finally, the third source of data besides EVI and IEA is the MarkLines Automotive Information Platform database, which is a subscription-only database [6]. MarkLines provides HEV, PHEV and EV sales on a monthly basis, by country and model.

Cumulatively, IEA is able to crosscheck this sales data against official national and city-level stock data to see if the sold cars are getting to the streets of the cities and countries involved and how this stacks up. This also allows for analysis of sales data growth numbers to understand how EV sales are progressing. There is no stock data from MarkLines and some smaller manufacturers may be missing, but overall the data points are considered representative of how EVs are thus far progressing in terms of market development.

Finally, fleet data is one crucial data point that is sometimes missing, and perhaps understandably so since city, municipal and government fleet purchases are not tracked through dealerships so they are harder to follow. Similarly, there are electric car sharing fleets being launched around the world, such as the *Autolib* program in Paris, and these cars often do not always appear in sales data tracking.

## 3 2011 EV Sales

If 2011 is considered as the first year of the "third age" of EVs (defined by the use of Li-ion batteries and featuring other new technologies, such as hybrid systems, regenerative breaking, etc.) then the results for this first year are impressive when compared to other major technology introductions in transport.

Over 40,000 PHEVs and BEVs were sold worldwide, which is especially impressive considering three main factors at play: first, a fluctuating oil price; second, the Fukushima disaster in Japan that created a supply bottleneck of auto parts for HEVs, PHEVs, and BEVs; third, the economic recession which has dampened general consumer demand, particularly for higher-end goods such as EVs.

However, if one compares the manufacturers' announced capacity as stated in 2010 for 2011 with today's actual sales, the result was 43 percent lower than the potential. Manufacturers may not have expected to fully utilize the new capacity during the year, but this does suggest that manufacturers believed there would be more sales in 2011. On the other hand, many cities complained of a shortage of vehicles during much of the year. Again, in a nascent market early predictions are particularly prone to error, and matching supplies to demands may be challenging.

### 3.1 Geographical Distribution

Figure 3 below delineates PHEV and BEV sales by country from January 2010 to January 2012. The US, Japan and China appear to be the top markets for EVs, with US and Japan accounting for 77 percent of sales alone. For PHEVs specifically, the US is the top market with an 89 percent market share. This fits into the commonly held understanding that the US automotive market opts for larger vehicles.

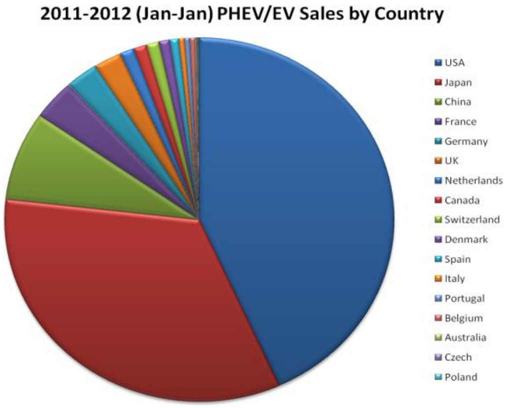



Figure3: World PHEV and BEV Sales 2010-2012, by Country [6]

In Figure 4 below regional groupings of PHEV and BEV sales worldwide are outlined. As a region, Europe beats out China, but it is clear as Figure 3 shows, that the US, Japan, and China are the biggest markets to date. Of more interest is that besides these four main markets, there are relatively few sales elsewhere, which points to the propensity of auto companies to begin launching this new product in established markets, both in terms of sales, but also in regards to manufacturing lines.

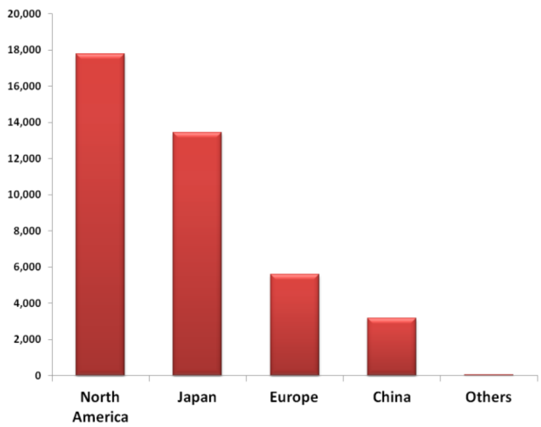



Figure4: World PHEV and BEV Sales 2010-2012, by Region [6]

## 3.2 The Fukushima Disaster and Supply Bottlenecks

The tsunami that hit Japan's Fukushima Prefecture on March 11th, 2011 was an unmitigated human disaster with far-ranging consequences including the so-called Fukushima Daiichi nuclear disaster, as well as causing repercussions in the supply chain of HEVs, PHEVs, and BEVs.

The point is not to statistically prove a correlation, but merely to suggest that 2011 sales of HEVs and EVs may not be entirely representative of what is to come.

Looking at Figure 5 below, one can see a steep, dramatic drop of HEV sales at the time of the disaster. This is made more convincing since sales continue to increase after May and have since grown continuously.

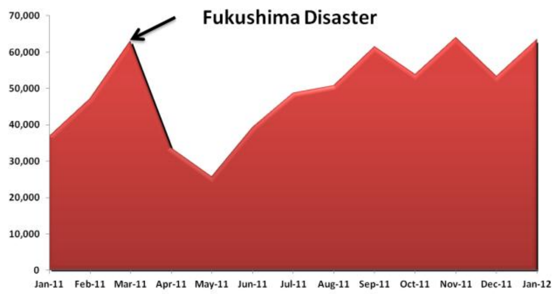



Figure5: World HEV Sales 2011-2012 [6]

Similarly, in Figure 6 we see a drop in sales of EVs around the time of the Fukushima disaster. Arguably, it appears to begin sometime before, but it does suggest a parallel finding compared to the HEV sales drop.

During the rest of the year, one can see a second drop, which is hard to explain, though oil price could be a factor, as seen in Figure 7.

Of historical significance, the cumulative EV stock surpassed the 1912 world peak of 30,000 around November of 2011. December sales were around 6,000 which finished 2011 off at a higher sales rate compared to the rest of the year. Should this sales rate continue, 2012 sales would be about 72,000, close to a doubling of 2011 sales and roughly in line with the growth profile needed to reach the 2020 targets, though it is still very early in this period.

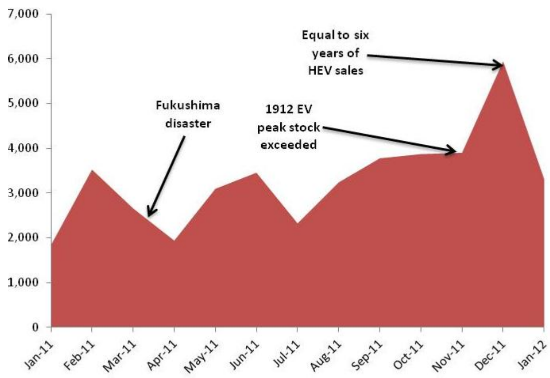



Figure6: World PHEV and BEV Sales 2011-2012 [6]

## 3.3 EV Sales and Oil Price

The sales of HEVs and EVs dip twice in 2011, rather dramatically, and beg the question: why?

The Fukushima disaster and subsequent supply bottlenecks as well as the oil price may suggest part of the answer, but in an early market it is hard to say much with certainty.

As Figure 7 below indicates, the oil price, both Brent and West Texas Intermediate (WTI), escalates into 2011 with two peaks, corresponding to the two sales dips of HEVs and EVs. This could be suggestive of a correlation, but again, is unclear.

On the other hand, it is perhaps more interesting that despite relatively fluctuating oil prices in 2011, as seen in the two peaks, consumers still went out and bought EVs, and even continued to do so at an increasing rate throughout 2011.

The data implies certain sensitivity to oil price and also a dearth of supply due to a hereto centralized supply chain, but once manufacturing of EVs starts spreading, such as Nissan’s planned LEAF capacity in Smyrna, Tennessee, US, this may dissipate.

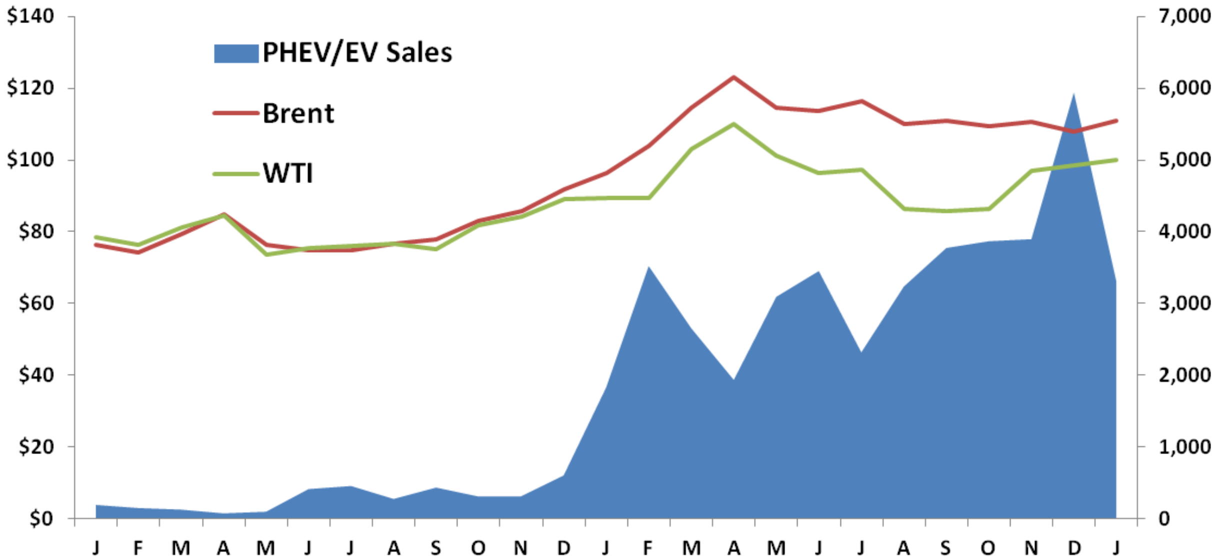



Figure7: World PHEV/EV Sales 2010-2012, including oil price trends, both Brent and West Texas Intermediate prices [5][6]

# 4 Lessons from Hybrids

Hybrid electric vehicles began in earnest with the launch of the Toyota Prius in 1997, as well as the Honda Civic launched in early 2001. Though 2011 sales of EVs may appear to be low, it took six years for HEVs to achieve the same level of sales as it took EVs in one year, namely, 2011 (Figure 8).

This may be due to better visibility of BEVs and PHEVs than hybrids in the late 1990s, stronger marketing efforts, and more models available. It could also reflect improved public awareness: that the advanced technology that HEVs represent has now been understood by the general populous and are therefore more accepting of EVs as a next logical step in the technological evolution and electrification of the vehicle fleet.

On the other hand, one could argue that EVs should have taken a longer time to reach the level of sales that HEVs achieved since EVs are after all more of a change than what moving from ICE to HEV represents, primarily due to driving range anxiety and general charging infrastructure needs.

Thus EV sales in 2011 can be read as a success story when compared to HEV sales, but it also holds a warning: HEVs were launched in 1997, and though they represent a relatively important, cost-effective technology, with good customer perception, they have only captured a global sales market share of about one percent today, 14 years later.

It should be noted however that hybrids are not struggling everywhere; Figure 8 below shows flat sales of hybrids across most regions, yet hybrids took off after 2008 in Japan and now capture a 10 percent sales share.

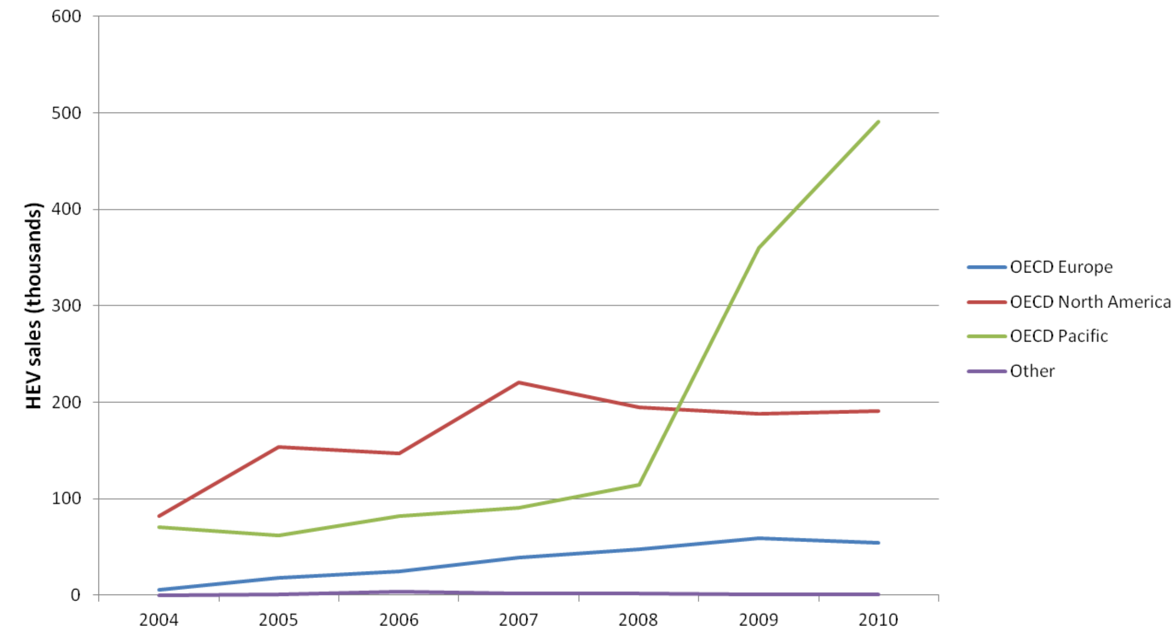
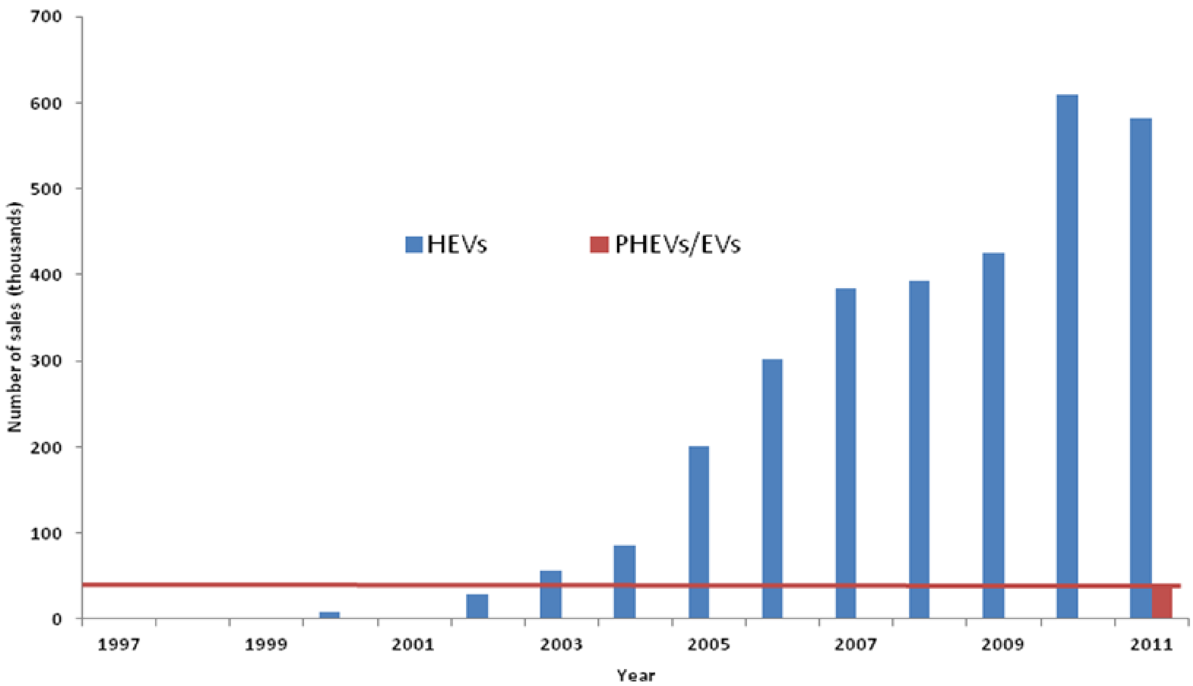


Figure8: Hybrid sales by region (2004-2010) [5]

If 14 years is any indication of how long it takes to get a new technology from market introduction to significant market share, then plans for BEV introduction and targets for 2020 will be very challenging to reach (Figure 9).
But how good a guide to BEV success is the experience of hybrids likely to be? There are a number of considerations in making a comparison. Indications that BEVs may actually be better positioned include:

- Manufacturers and national governments appear broadly enthusiastic. Many countries and car manufacturers have shown a big interest in a fast introduction of BEVs hoping this breakthrough technology might go from market newcomer to market mainstay in a shorter period of time than it took the HEV.
- HEVs may have created an impetus for manufacturers to expand their production lines beyond traditional engine and fuel options, with expanded consumer choice.
- Patented hybrid technologies appear to have slowed down the wide adoption of the technology by a large number of car manufacturers, thus limiting hybrid models available.
- Sustainability goals and fuel economy standards will put additional pressure on manufacturers and consumers to lower the $CO_2$ emissions per gram of a given vehicle,



which will come to include low-$CO_2$ vehicles after a certain point (in order to achieve <100 grams/$CO_2$)

(above) Figure9: HEV vs. PHEV/BEV sales by region (1997-2011) [6]

- Potentially higher oil prices may lead consumers to shift away from fossil-fuel based vehicles to other energy sources with potentially more stable fuel prices and/or a lower reliance on energy through better efficiency

On the other hand, several factors might slow the introduction of BEVs compared to HEVs, as BEVs have specific characteristics that make them quite different from the traditional ICE-powered vehicle:

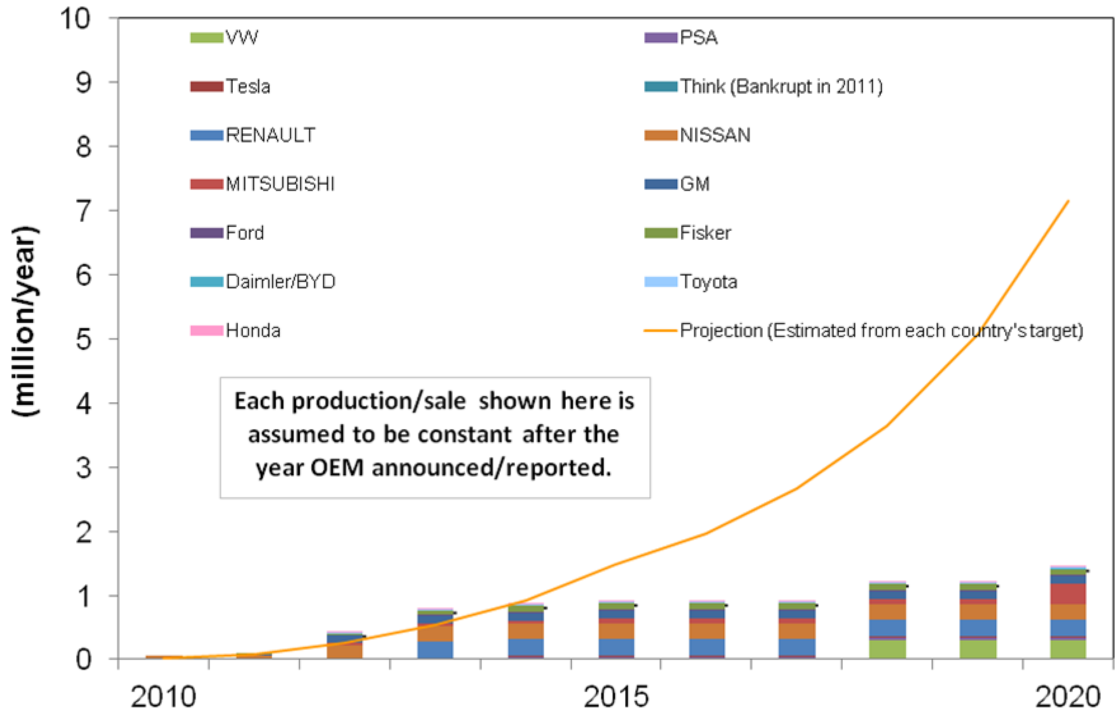
- BEV needs a dedicated infrastructure, and in the foreseeable future, the recharging time is much longer than we the vehicle owner is used to.
- The range of the vehicle is limited; though many transport surveys highlight that current BEV range is more than enough for daily commute, but it is still questionable whether car buyers will be willing to pay for a vehicle capable of doing 150 km.
- The cost of the vehicle and battery is still high: even though strong cost reductions are expected via economies of scale and technology learning, the early adopters should not expect cost savings by buying a BEV.

## 5 What to expect in 2012

Besides models from major automakers such as the Volt (GM) and the LEAF (Nissan), there are also models expected from Renault, Ford, PSA/Mitsubishi, and the increased availability of Tesla's Model S and Fisker's Karma. And several new models are entering the market this year, including the moderately priced Mitsubishi i-MiEV, which is already on sale in Japan and is expected to hit the US market in June.

Also entering the world auto market this year is Toyota with a plug-in variety of its best-selling Prius model, and BMW is expected to release two EV models in 2014. The increase of models could have a profound effect on the market as pent-up demand is addressed, giving a better understanding of the market size, potential and geography. The Ford Focus EV may also represent a change-up in the US market as GM and Tesla Motors get an additional EV competitor.

In a strict sense, with close to a doubling of global sales needed each year through 2020 to reach the targets, sales of EVs in 2012 would have to reach about 80,000, not necessarily an easy accomplishment, but the increased number of models and expected increases in production per model, along with fully functioning supply chains (e.g., full recovery from the Fukushima disaster), should help (Figure 10). There should also be increased supply through more plants and more manufacturing capacity in several regions, including Nissan's new plant in the US dedicated to producing the EV LEAF model.



(above) Figure10: Government Targets and PHEV/BEV production and sales as reported by OEMs [2][5]

# 6 2010-2020: The Road Ahead

The next 8 years will be crucial in the road ahead for EVs. On the one hand, reaching the 2 percent stock target in 2020 may not appear to equal success for EVs, but this requires a rapid build-up that, once completed, would put EVs in a position to go for much bigger scales in the following decade. But achieving a near doubling of sales for 10 consecutive years is likely to be extremely challenging.

Looking at Figure 10 above, the announced manufacturing capacity of EVs is put next to our best understanding of manufacturers' announced plans for model introduction and production capacity levels (Note that the announced manufacturing capacity is kept constant once a target has been set. In other words, if a company says they will have x millions in capacity of a vehicle in year 2016, then that number was kept constant after 2016 to keep estimates conservative).

It is of course likely that in a robust market, capacities will increase over time, and new announcements will be forthcoming. But for now at least, the figure demonstrates that companies have not yet announced enough manufacturing capacity after 2014 to keep up with targeted growth. It is natural that auto companies are especially cautious in their roll-out of such a new and different product, but it is important to keep track of investment plans to avoid future supply bottlenecks.

However, it is also quite clear that EV demand growth along the target line is not by any means a foregone conclusion, and the current picture on supply commitments reflects the fact that there is not yet enough confidence in market growth for manufacturers to invest in capacity beyond that shown in the figure. This is prudent, but the next two-three years will be critical to better establish where the market is going, and to ensure that manufacturers keep up if the market starts to grow rapidly.

# 7 How much will EVs cost governments (and consumers) to establish?

Given the ambition of the targets and the current relatively high costs of EVs, support programs will be critical to build demand in the rapid way desired. As mentioned, over the next 8 years (through 2020), in order for EVs to be fully established, it is estimated that around 20 million must be sold, with accompanying infrastructure. Considered from the sheer cost of infrastructure and vehicles, the price tag for this appears high. And much of the infrastructure and vehicle incremental cost may need to be covered by governments.

This section provides a summary of IEA estimates of these costs, and also compares these to the expected cost of all cars around the world during this time frame to add some context.

Most of the details and assumptions regarding the IEA cost estimates are beyond the scope of this paper and will be made available in a separate forthcoming working paper. But key assumptions are results for infrastructure and vehicles are:

- Infrastructure: one recharging unit per EV for home recharging, and one public charge station (by 2020) for every 50 cars. Costs are $600 per recharging unit for home recharging and $6,300-$31,000 per public recharger. Overall this cost comes to about $300 per car (assuming a 15-year of amortization rate). Cumulative charger costs (2010 to 2020) equal around $8 billion.
- Vehicle incremental costs: currently battery costs are high, making the incremental cost of EVs high. Starting in 2011, the IEA estimates an approximate cost of $500 per kWh for a vehicle with 27 kWh, or total battery cost of $13,500 per vehicle; subtracting out savings from replacing the ICE engine with an electric motor (about $2,800 per vehicle), the net increase in vehicle cost is on the order of $12,000. Fuel savings from EVs will help, but an estimated $4,000 (slightly discounted) over vehicle life still leaves a net cost increase of about $8,000.
- Cost declines: if battery costs do not decline over time, this net incremental cost would be prohibitive – if consumers demand that all of this be covered by government subsidies in order to buy large numbers of vehicles, the subsidy cost would come to $160 billion over the eight year period, eight times more than the recharging infrastructure cost of 20 billion. However, based on estimates of a best achievable battery cost of about $260, production of 20 million should be enough to reach this target (based on a learning rate of 10% per doubling of cumulative production).

If so, then the incremental cost of EVs would drop to under $4,000 (Figure 11).

With the cost reductions from learning, the subsidy required per vehicle declines over time and just about reaches zero by 2020 (Figure 12), suggesting that EVs would achieve commercialization with no further subsidies needed. Further, the reduction in subsidy cost happens as the annual volume rises, and the overall cost of subsidies is therefore far lower than in the constant EV cost case. By the time cumulative sales reach 2 million in about 2016, the per-vehicle subsidy is down to $3,000 and dropping fast.
In this case, over the 10 year time frame, the annual subsidy cost (globally) never rises above $5 billion per year and the total over the 10 year period is about $25 billion, rather than $160 billion in a no cost-reduction case.
Overall, if governments spend $20 billion on infrastructure and $25 billion on vehicle incentives, and another $5 billion on other EV related efforts (e.g., RD&D, information campaigns, etc.), the cost will be $50 billion or about $5 billion per year over 10 years. This will represent about 0.1% of the about $30-40 trillion that will be spent on all conventional cars and fuel around the world over this time period. To put it differently, if each conventional car sold in the next 10 years (around 1 billion cars) were taxed at about $50, this would pay for the entire EV rollout over the coming decade.

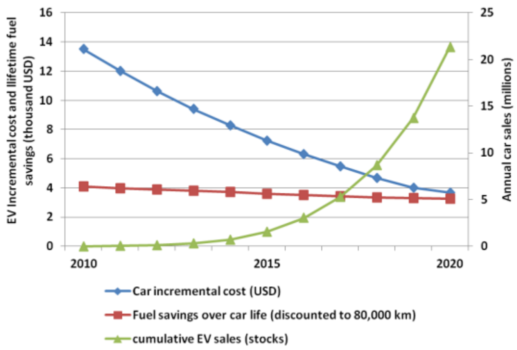



Figure11: EV sales projections and incremental car costs and fuel savings [2]

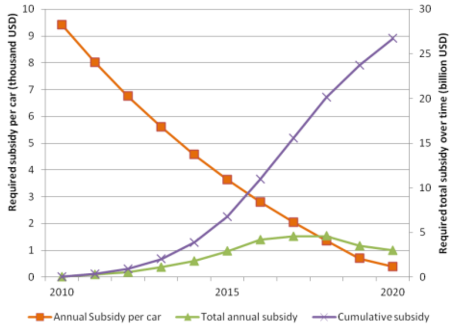



Figure12: EV required subsidy per vehicle and total per year, and cumulatively to 2020 [2]

# 8 Conclusions

2011 EV sales were not an entirely representative year for a nascent market due to the Fukushima disaster and the economic recession, but considered in the context of some other new technology introductions, the total sales of 40,000 can be considered impressive. If sales double to 80,000 in 2012, then the first many doublings of annual sales toward national targets in 2020 will be achieved; each succeeding doubling may get harder but if governments help pave the way via supportive policies and car makers keep up in terms of production, the 2020 targets appear achievable. And we would be well on the road to achieving bigger transport CO2 reduction goals by 2050.
In any case, 2012 will be a crucial year in the road ahead for vehicle electrification.

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