



**FROM FICTION TO REALITY:
THE EVOLUTION OF
ELECTRIC VEHICLES**

2013 - 2015

November 2015

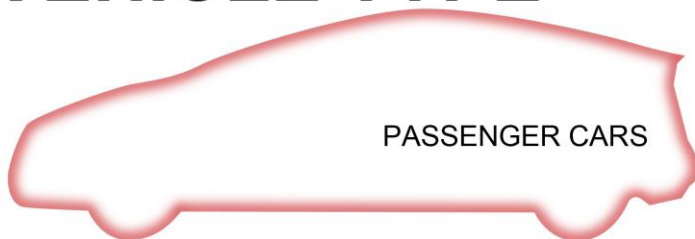
SCOPE

The figures contained in this paper include data from the different solutions of JATO Dynamics Ltd. The following definitions apply



MARKETS COVERED

VEHICLE TYPE



PASSENGER CARS

PERIOD ANALYZED

JANUARY 2013 - AUGUST 2015

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INTRODUCTION

In the face of significant population growth, finding efficient and sustainable means of transport presents a huge challenge to both developed and developing economies. The United Nations expects the global population to reach 8.5 billion by 2030 and 9.7 billion by 2050. Much of this growth will take place in Africa, and in countries with already large populations (such as India and the USA)¹, with the greatest proportion happening in urban areas. By 2030 there will be more than 40 'mega-cities' with more than 10 million inhabitants.

But more people means more consumption, more waste and a bigger impact on the environment. This is why new transport solutions must be cleaner, more efficient but still very accessible. This means reducing our reliance on the fossil fuels that currently power millions of vehicles. The continued use of oil as the primary fuel source for road transportation, and fossil fuels for many other parts of our infrastructure, poses major environmental and health problems.

Despite this, we have made slow progress in weaning ourselves off this energy source. The World Bank estimates that 83.6% of energy consumption in USA comes from fossil fuels. The number rises to 88.2% in the case of China, while in countries such as Germany and the UK the proportions are 81% and 84% respectively. In Japan, the world's third largest car market, coal, oil, petroleum and natural gas account for 94.7% of total energy consumption². In many developed economies the transport sector is the number one consumer of oil (in the USA, for example, this accounts for 70% of all consumption), so it's not surprising that policymakers and industry are increasingly looking to Electric Vehicles (EVs) as a solution.

The EV market is still in the introduction phase of the commercial life cycle. These types of vehicles face a complicated landscape comprising of conservative consumers, patchy infrastructure and regulatory hurdles.

Despite these challenges, the latest data from JATO Dynamics suggests that demand for EVs is gaining momentum. This paper examines the current state of the market and argues that current trends point to a bright future for EVs as they continue on their journey from fiction to reality.

¹ [UN DESA report, "World Population Prospects: The 2015 Revision"](#)

² [The World Bank, "Fossil fuel energy consumption \(% of total\)"](#)

EV: CHOICE AND AVAILABILITY

The uptake of Electric Vehicles may have been slowed by difficult economic conditions, but manufacturers are gradually introducing new models to encourage more consumers to take the plunge. Europe currently offers the most choice, while domestic manufacturers in the USA and China look set to shake things up.

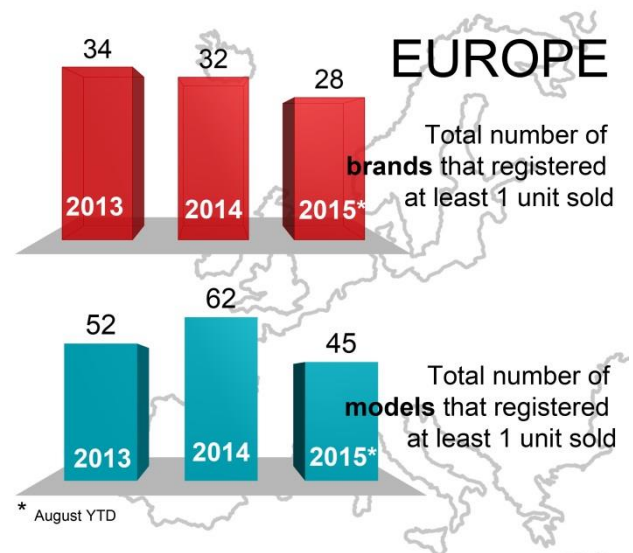
While many city-dwellers are becoming more accustomed to seeing - and travelling in - hybrid cars, it's still rare to see pure electric vehicles on the road. Thanks to the efforts of both big name car manufacturers and new players such as Tesla, consumers have a better understanding of the advantages and challenges associated with electric powered cars. Public opinion about EVs is mostly positive. For example, a recent survey by the American Energy Alliance examining voters' attitudes towards government initiatives that included support for EVs found that half of the respondents agreed that electric cars "are better for the environment than gasoline-powered cars" and that 80% think that EVs are cleaner than traditional cars³.

Despite increasing awareness and a generally positive perception of EVs, many consumers are still waiting. Macroeconomic factors and infrastructure challenges play a large part, but there is also a lack of choice. The total number of pure electric and plug-in hybrids cars available right now doesn't exceed 70. That's a low number compared to the huge variety of petrol cars on the market, but it should grow in the coming years as prices come down, more efficient batteries become available and tighter emissions regulations for the car industry take effect (especially in the EU).

At present, the majority of electric vehicle options are based on existing models, such as the Volkswagen e-Golf. Electric-only models such as the Nissan Leaf account for 40% of total EV models.

Europe Leads the Way

The European market currently offers the most choice to consumers considering the switch to an electric car. According to a survey undertaken by Deloitte in 2011, 44% of respondents in the UK said they were unlikely to consider an EV. But things have changed in recent years. In a more recent study conducted by the UK Government, 81% of young people asked about EVs said that they would consider this type of vehicle first when buying their first car⁴. Other reasons for the European surge include high fuel costs, higher levels of regulatory intervention to encourage uptake, and a highly urbanised population.



In 2013 there were 34 brands offering 52 different electric passenger car models in Europe. One year later the number of models jumped to 62, a significantly bigger range than the USA (16 brands and 23 models). This offer was composed of 45 pure electric cars and 20 plug-in hybrid electric models. One of the biggest shifts came from Asian car makers such as Mitsubishi and Kia, but European players, including the German manufacturers, also made inroads. For example, in 2014 Volkswagen introduced the plug-in hybrid and full electric versions of its popular Golf along with the Audi A3 plug-in hybrid; BMW unveiled the i8 sports car, Mercedes added the plug-in hybrid version of its flagship S-Class, and Porsche revealed the Cayenne S E-

³ [American Energy Alliance 2015 Survey](#)

⁴ [Express "The next generation of motorists want to own more electric cars"](#)

Hybrid. Meanwhile, other brands such as Chevrolet left Europe completely, with its Volt leaving the market to its twin, the Opel/Vauxhall Ampera.



As demonstrated by the range of German models above, European consumers can pick from a good variety of brands, body types and size, from city cars to MPVs, luxury sedans and sports cars. However, the SUV offering remains limited. By the end of 2014 there were only 2 in the list: the Mitsubishi Outlander and the Porsche Cayenne. This goes against the overall market trend which is seeing SUVs becoming more and more popular.

The wider range of EVs available in Europe reflects the European Union's commitment - and those of its individual member state governments - to create the best market conditions for this technology to thrive. This is being achieved by working with the private sector on a range of financial, infrastructure and R&D initiatives. By 2013 more than 10 European countries had introduced special measures targeted at EVs. Some funded tax breaks or rebates to make EVs more financially appealing. Other incentives included public funding to support the installation and construction of charging points and public awareness projects.

USA and Canada: Room for Growth?

Due to its nature and its consumer tastes, the North American car market (excluding Mexico) continues to be dominated by larger vehicles and SUVs. As a result, there is a smaller range of EVs currently available as many of the most successful models in Europe and Asia are compacts that aren't as well suited to the longer distance travel often required in the more expansive North American countries. In fact, range is one of the biggest challenges facing pure electric cars in the USA and Canada.

Another is (comparatively) cheap fuel, which is helping sustain demand for bigger cars (see Figure 1). The recent drop in world oil prices has had a

further negative impact on the nascent EV market in the region.

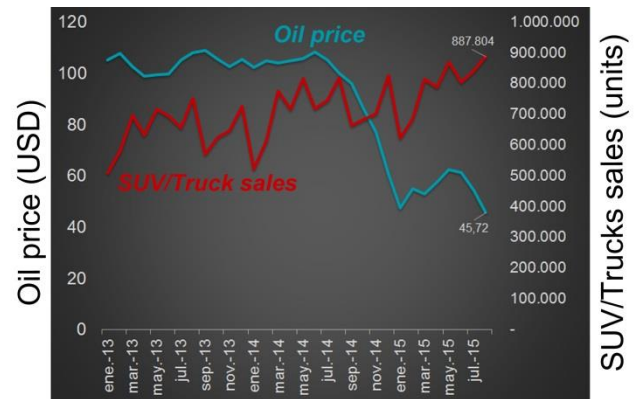
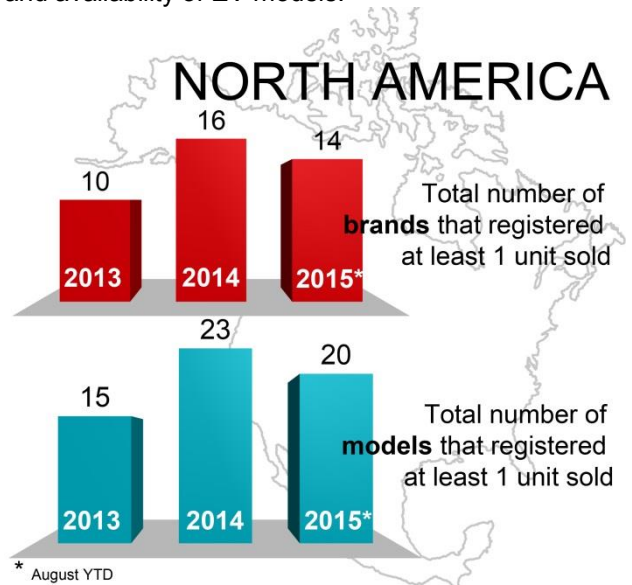


Figure 1: USA SUV & Trucks sales and oil price by month (US Dollars per barrel). Source: JATO Dynamics & World Bank

With less financial incentive, it's no surprise that consumer habits have been slow to change. Big SUVs and trucks powered by gasoline engines are still among the best-selling vehicles in USA and Canada and this has a knock-on effect on the range and availability of EV models.



In 2013, there were only 15 different models powered by electric engines and plug-in hybrids on the market. The number grew to 22 the year after, and has since declined to 20 as of September 2015. The decrease is in line with total sales performance, which suffered due to the increasing popularity of traditional SUVs and trucks. This is clear when looking at the availability of SUVs and trucks with alternate drive trains – none of GM, Ford, Toyota and Fiat Chrysler feature either an electric SUV or truck in their line-ups. This is particularly significant given that the USA is the world's largest market for these types vehicles.

Until EVs can crack these segments, market penetration will stay low.

However, North America is also home to some of the most innovative technology companies that are determined to change the status quo. Amongst these is Tesla, which looks set to shake things up with the launch of its Model X crossover next year. With prices expected to start at \$136,500, it is unlikely to become a mass-market product, but it could nonetheless create the room for other manufacturers to follow its lead.

China to Drive EV Take-Up in Asia

China's huge domestic brands want to join the EV party too. According to JATO Dynamics volumes data, there were just 12 different models on sale in 2013. As of August 2015, the total had risen to 19, of which 11 belonged to Chinese brands. However, the overall offer remains limited considering the size of the Chinese market. Volkswagen, the country's leading brand, offers only 2 models from its huge range of cars, while other big players are yet to launch an EV model.

The situation in Japan isn't too different. As you might expect, the EV market is dominated by local brands, but again the range of options available to consumers are limited – as few as 14 different models. This is also the case in South Korea (with Kia and Samsung on the list) and in Australia, where the options are limited to a number of European or Japanese-made cars. EV adoption in other large markets such as India and Thailand is yet to take off.

Total number of models that registered at least 1 unit sold in China, Japan, Australia and India:

CURRENT EV MODELS OFFER



EV SALES: HUGE GROWTH, SMALL BASE

Electric car sales are outperforming the rest of the market by a large margin. This is to be expected from a new entrant – the challenge is for EVs to sustain this momentum and gain further market share from their petrol-based competitors.

Passenger Car Market Overview

To fully understand the performance of EVs we must first consider the current state of the wider market. As Figure 2 shows, the majority of markets we studied have seen year-on-year growth compared to last year, reflecting the general improvement in global economic conditions since the financial crisis.

Growth in the majority of the biggest markets has been steady rather than spectacular, with none of the top five markets reaching the 10% mark. Much of the double-digit growth was seen in South and Central Europe, while developing economies such as Mexico and Turkey also saw a surge in demand.

This progress is offset by the slowdown seen in a trio of larger markets - Japan (-11%), Brazil (-19%) and Russia (-34%). The consequence of these mixed results is a modest 4% average growth in new passenger car registrations across all markets studied in 2014. This is mainly due to the good economic conditions seen in the developed economies.

EVs Face a Battle for Market Share

Electric passenger car sales totalled 280,000 units in 2014, representing growth of 43% compared with 2013. While this represents stellar growth compared to the overall market, in terms of volume, 84,000 additional units in a global market that sold more than 72 million passenger cars looks like a drop in the ocean. It also explains why electric cars are still a rare sight on our roads.

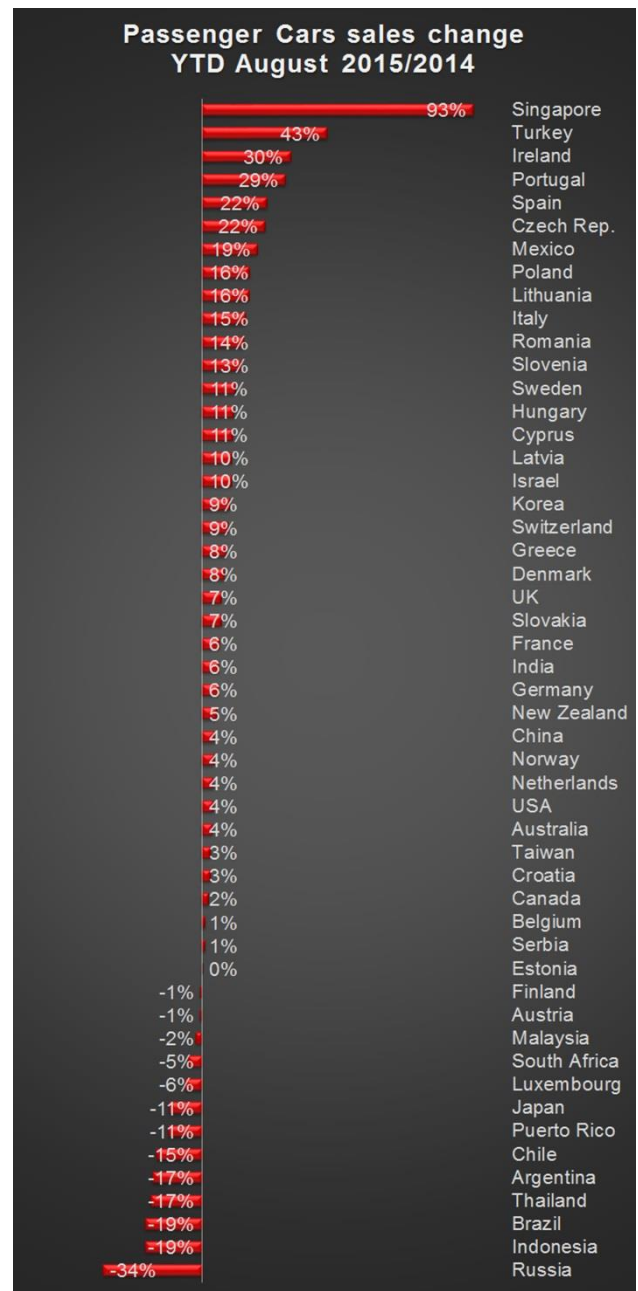
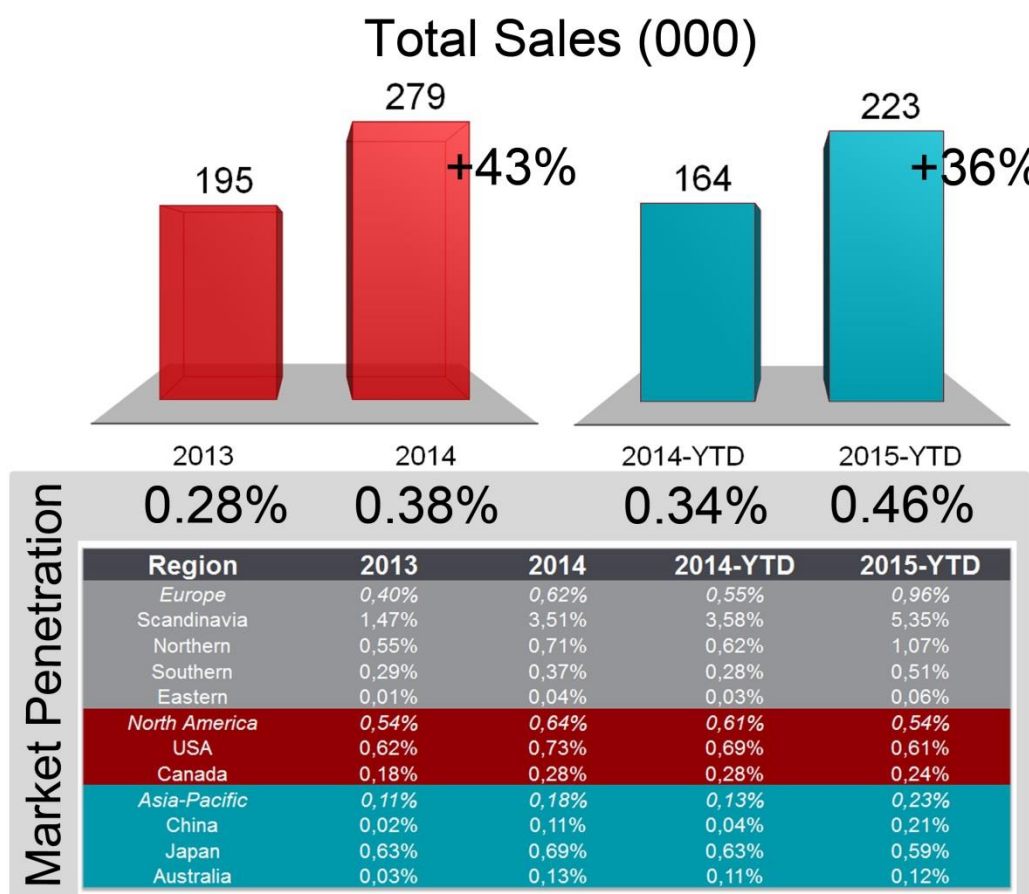


Figure 2: Note: USA variation includes light trucks (SUV & Pickups). Source: JATO Dynamics Ltd

In the slow-growing overall market, the biggest challenge for EVs is to take market share from traditional segments and fuel types. As we have already discussed in relation to the North American market, economic factors such as the fall in global oil prices will continue to have the greatest influence on purchasing decisions, to the detriment of EVs.

EVs SALES/MARKET SHARE



There are other threats too. In September 2015 the new government of Denmark decided to introduce a levy on zero-emission vehicles as a response to the country's increasing budget deficit, arguing that the measures will create jobs. This means extending the country's 180% levy to all cars, including EVs. By the year 2020, when the levy will take place, it will add €60 million in revenue annually. Denmark is not alone. Norway, the world's largest EV market by market share, is also planning to reduce its package of support for electric cars. In May 2015 it was agreed that EV owners will have to pay half the full rate of road tax from 2018 and the full amount from 2020. The current 100% VAT exemption will be replaced by a subsidy. Other benefits such as the free tolls and parking or the use of bus lanes will also come under review.

In 2013 EVs accounted for 5.7% of Norway's total passenger cars sales – the highest share seen anywhere in the world - thanks to the country's generous incentive schemes. With the exception of the Netherlands (5.4%), no other market we studied achieved even 1%. One year later the share in Norway jumped to 13.6%, and Estonia, Sweden and Latvia's shares rose above 1%.

The latest figures for 2015 so far (up until the end of August) show that EVs continue to gain market share despite the slow market. According to our data, EV sales have risen in 39 out of the 52 countries studied. Norway leads the way with an impressive EV market share of 21.5%, a proportion almost four times greater than was seen at the end of 2013. The Netherlands (5.52%) remains in second place, followed by Sweden (2.0%).

Perhaps more significantly, two of the world's largest car markets have seen their EV shares reach 1% for the first time. September 2015 YTD numbers indicate that EVs accounted for 1.1% of all new sales in France and 1.0% in the UK. In the UK this was thanks to a 203% jump in sales during the first 9 months of this year, outselling Japan, the Netherlands and Germany.

These figures place both countries in the top ten for EV sales as a proportion of total sales. All ten countries are within Europe. The USA is in 11th place with a 0.60% share and Japan is just behind with 0.59%. China recorded the highest growth of the high volume markets. EV sales increased by 443% year-on-year to over 29,000 units, the second highest volume after the USA.

Battle of the EV Brands

The manufacturer landscape has evolved over the last few years. Japan had led the way in EVs, but as of the end of August 2015 European car brands are now outselling their Japanese and American

EV volumes are up 107%. Ford and Chevrolet saw their market shares narrowed to 6% and 5% due to trends in their home market. Toyota is in 12th position - the new Mirai is yet to take off and its electric RAV4 is expected to hit American dealers by the end of this year.

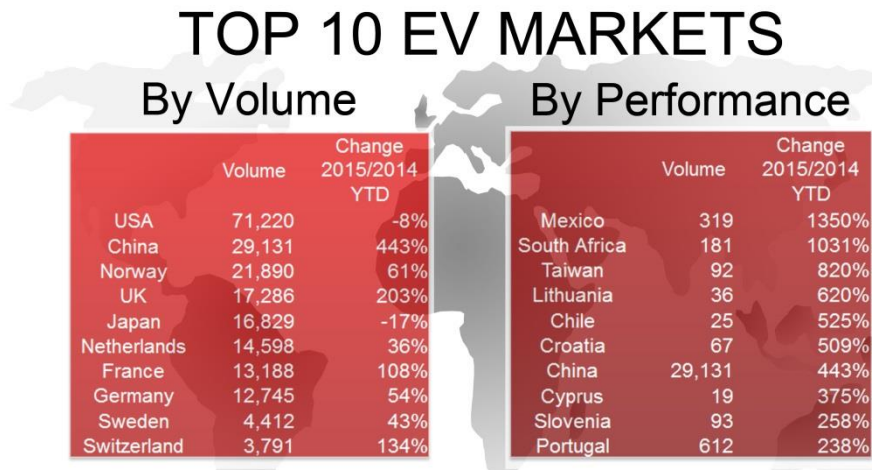


Figure 3: Top 10 markets for EVs by volume and sales growth for August 2015 YTD. Source: JATO Dynamics Ltd

Amongst the premium brands, BMW has a clear advantage over its competitors Audi and Mercedes. The success of the i-series has allowed the Munich-based company to position itself as a real alternative for consumers looking for a premium EV. However, both Audi and Mercedes posted impressive sales increases, taking their

respective market shares from 0.2% to 3.3% and from 0.1% to 1.8%.

competitors. European manufacturers' share of the EV market stood at 35% while the Japanese makers' share fell to 28%. American brands counted for 23% of the total. The Chinese EV sales boom has helped its domestic brands to increase their share from 7.5% to almost 13%.

Despite this shift, Nissan is still the world's best-selling brand when it comes to EVs. The Japanese car maker has been the global market leader since 2013 thanks to its Leaf model, albeit with a decreasing market share. By the end of 2013 Nissan sales accounted for 24% of the total. One year later this number fell to 22%, and by the end of August 2015, Nissan's share had plunged to 14%.

While Nissan's EV share has been falling, other players have gained market share. Volkswagen reported a 286% surge and is now the world's 4th best-selling EV brand thanks to the outstanding results of the e-Golf. Tesla is ahead of Volkswagen, with sales climbing 64%, but still behind Mitsubishi, the second best-selling brand, thanks to the sales performance of its Outlander.

Other brands in the ranking include BMW (+93% in August 2015 YTD), Chinese brand Zotye in 7th position with 5% market share, and Renault, whose



Figure 4: EV top 10 best-selling brands in August 2015 YTD. Source: JATO Dynamics Ltd



EVs' Top Models

Analysis of the best performing models shows that getting your electric car right as a manufacturer is the key to your market standing. As such, the leading EV brand in Nissan makes the world's leading EV model - the Leaf. This model alone is responsible for 97% of Nissan's EV sales. A similar trend can be seen with Mitsubishi's Outlander (95%) and Volkswagen's electric Golf (90%). Along with Tesla's Model S, these four cars are at the top of the global sales table, followed by the BMW i3, Renault ZOE, Chevrolet Volt, Baic E-Series, Audi A3 and Ford Fusion. The sales volumes and year on year growth for all these models can be seen in Figure 5.

The BAIC E-Series/Senova, enters the top ten after becoming the best-selling Chinese electric vehicle. By the end of August 2015, this compact MPV controlled more than 25% of the Chinese EV market, outselling 2014's top-seller, the Zotye Zhidou E20, in the process. Another city car, the Zotye YUN100, sits in second place.

Increasing Choice of Body Types, but where are the SUVs?

As demonstrated by the top 10 above, there is an expanding range of different body types and styles of EV. It's possible to find city-cars, subcompact and compact cars, mid-size, large and luxury sedans and even MPVs and sports cars.

There is one exception – there appears to be less choice when it comes to SUVs. This is strange given the strong consumer demand we are currently seeing for this segment. The small and compact SUVs that are getting very popular in Europe, South America, India, and even the USA, are still lacking real electric versions. The Toyota RAV4 was pulled from the American market after poor 2013 and 2014 sales. The discontinuation of this compact SUV means that there are only two real electric SUV options currently on the market. However, these will soon be joined by a new entry: the Tesla Model X. It's considered the



world's first fully electric luxury SUV and though already launched will not be seen on US streets until next year.

As of August 2015, compact cars such as the Nissan Leaf accounted for 35% of the total EV market. However, one year before compacts represented 44% of sales, and the year before that it was more than half (52%). This fall in share coincides with the rise in popularity electric city-cars, which have seen their market share jump from 7.7% in 2013 to 11.9% for 2015 so far. The MPV segment has also seen significant growth. Mid-size sedans have lost the most market share, driven in part by changes in the American market.

SALES BY SEGMENT

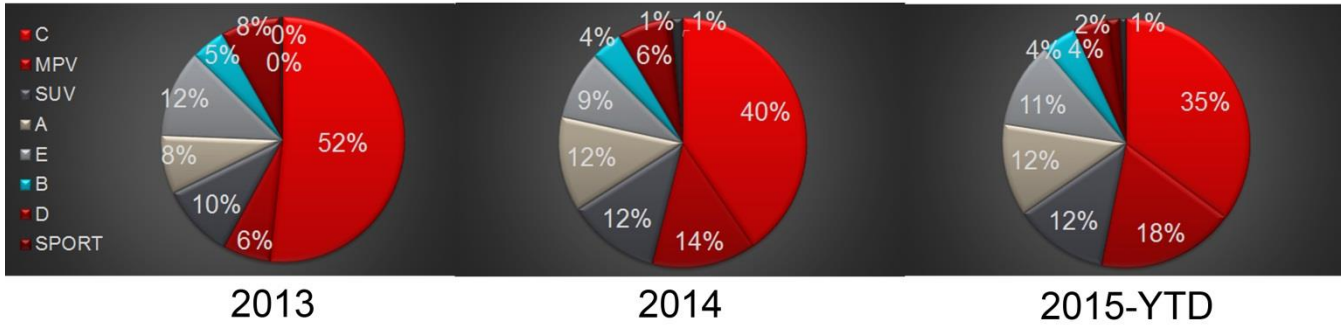


Figure 5: EV global sales by segments. A: City-cars; B: Subcompacts; C: Compacts; D: Mid-size; E: Large; F: Luxury. Charts don't include other minor segments. Source: JATO Dynamics Ltd

Sports cars have also received the EV treatment. Since 2013 consumers around the globe have bought 7 different BEV, PHEV or EREV compact, mid-size or supersports cars that include the Mercedes SLS AMG Electric Drive, the BMW i8, Porsche 918 and the VW XL1. Of these, BMW, thanks to its strong brand and marketing, has been the most successful so far. Last year its sales jumped to 1,851 units (from 127 in 2013) and as of August 2015, BMW had sold 3,590 units worldwide. 32% of sales were in the USA, 19% in the UK, and 9% in Germany. Not bad for a niche car priced at \$136,500 in USA and €130,000 in Europe!

A BRIGHT FUTURE

2016 COULD BE A RECORD YEAR FOR THE EV MARKET

According to our forecasting partner LMC Automotive, both the short and long term outlooks for EVs are positive. Sales are expected to hit record levels from next year, driven by massive growth in China and Europe through to 2025.

The future looks bright for electric vehicles. Based on LMC Automotive's forecasts, the global market is expected to reach sales in excess of 700,000 units next year thanks to strong growth in China, Europe and the USA.

Annual EV sales in Europe are predicted to hit 500,000 units by 2019. By 2022 the Chinese market is expected to account for half of global sales - almost 1.5 million units a year.

The forecast for 2025 sees more than 5.5 million electric vehicles being sold worldwide. However, the main sources of demand will be unchanged, with China (2.9 million), Europe (1.7 million) and the USA (800,000) still responsible for the vast majority of sales. Japan (85,000), South Korea with (35,000) and India (19,000) will lag some distance behind as growth in these markets is expected to be steady rather than explosive.

LMC Automotive also estimates that the biggest winners will be PHEVs, with sales jumping 195% from 2016 to 2019 before reaching 3.3 million units annually by 2025. As a result PHEVs will represent around 60% of combined global sales for PHEVs, BEVs and EREVs. Pure electric (BEV) volumes are predicted to rise from 350,000 units in 2016 to 2.2 million nine years later.

EV SALES FORECAST

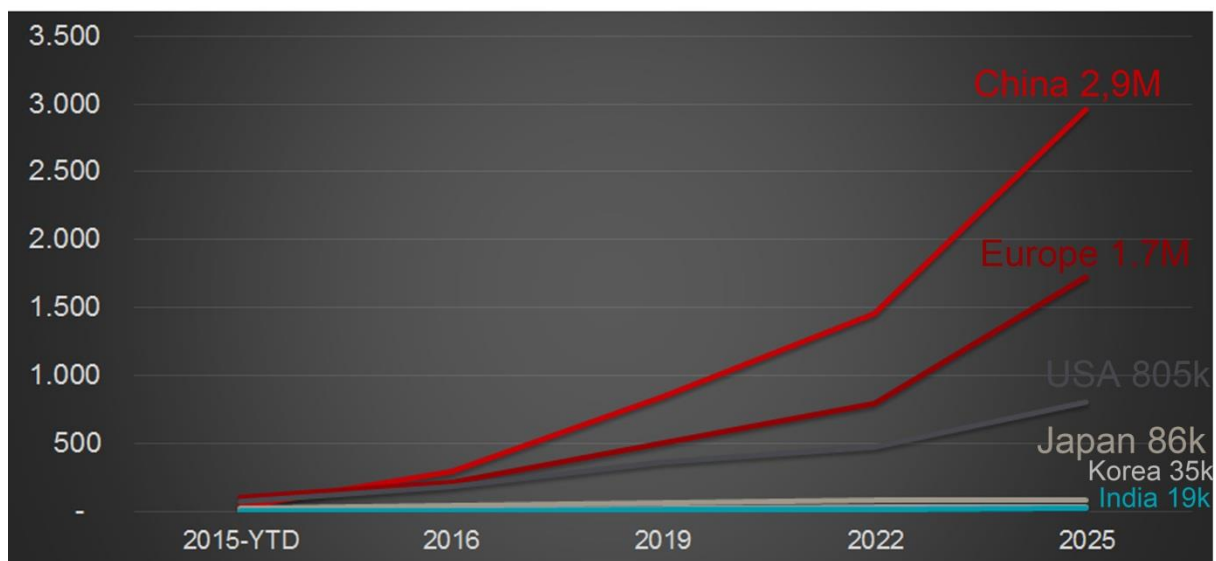


Figure 6: Expected EV sales volume in 2016, 2019, 2022, 2025. 2015-YTD actual. Source: LMC Automotive

CONCLUSION

The success of the car industry relies heavily on anticipating and responding to changing consumer behaviours and new external challenges. This has resulted in wave upon wave of innovation as manufacturers look to stay ahead of the game and gain an edge in an incredibly competitive marketplace. Electric power is one of the industry's many innovative ideas and has now evolved to become a viable means of reducing our dependence on fossil fuels.

Though growing at a rapid rate, electric vehicles are still a niche rather than a mainstream product. We are seeing limited demand for a relatively limited offer. Numerous challenges stand in the way of a flourishing EV market. Many of these are the result of macroeconomic conditions which not only have a profound effect on purchasing habits but also on the ability of governments to offer financial incentives and support investment in the necessary infrastructure. Where they exist, negative consumer perceptions must also be tackled.

Nevertheless, there's a growing consensus around the benefits of EVs. They can contribute to the reduction of CO² emissions and can make us less dependent on oil. The environmental case has helped the industry to introduce EVs to consumers and give them a foothold in the market. The next step is to make electric cars a mass-market proposition.

The industry, consumers and governments must all play an important role if this goal is to be achieved. Manufacturers must continue to work to develop the technologies that will make the next generation of EVs even more attractive to consumers both in terms of price and capability. Governments and regulators must help to create the conditions that allow EVs to better compete with petrol cars. Consumers must be willing to be patient while the technology evolves and keep an open mind.

The first step has been taken - electric cars are no longer part of science fiction. But the biggest change is still to come – all stakeholders need to work towards a world where electric comes as standard.

ABOUT JATO

HOW CAN WE SUPPORT YOU

The information contained in this report is sourced from data researched and analysed by JATO Dynamics Limited.

JATO Dynamics is the world's leading provider of automotive intelligence and offers several tools to assist in the analysis of vehicle specifications, volumes, news, historic data and trends for the automotive, retail, agricultural and finance/leasing sectors. JATO's strategic intent is to help customers create significant competitive advantage by constantly leading in connected data, information and knowledge provision, ultimately improving work processes, informed decision making and business results for customers.

JATO's dedication to quality is recognised by some of the largest organisations in the sectors we serve, across Manufacturing, Retail, Leasing, Component Suppliers and Agriculture.



ACCURACY

Ensuring up-to-date and precise market information



TIMELINESS

Responding promptly to market events



COMPLETENESS

Acquiring and presenting all the information customers require

Whether customers are looking to compare vehicle specifications, optimise a total cost of ownership position in the market, or recommend a balanced incentive strategy, JATO can provide a solution to help answer these challenges and many more... JATO solutions include:

- **JATO Volumes:** keeping up-to-date with a complex and constantly changing industry
- **JATO Specifications:** providing the latest, current vehicle specifications for single/multiple country analysis
- **JATO Analysis & Reporting:** focussing on the individual and bespoke needs of the customer
- **JATO Carspecs:** training sales people and informing customers through comparison and configuration tools
- **JATO News:** providing bulletins on changes in the automotive sector
- **JATO-LMC Automotive Global Light Vehicle Sales Forecast:** powering product and business planning processes
- **JATO Incentives:** providing a comprehensive view of the incentive landscape
- **JATO Total Cost of Ownership:** comparing product and aftersales TCO positioning
- **JATO eGuide:** digitally sharing vehicle comparisons with end customers
- **JATO Datafeed:** delivering timely, accurate and complete automotive intelligence
- **JATO Event-Driven learning:** keeping sales people up-to-date on all changes in local markets
- **JATO Net:** provides the macro overview required to make informed decisions



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