



ELECTRIC VEHICLE – DISRUPTOR OF THE AUTOMOTIVE ECOSYSTEM

Abstract

In 2003, the California Air Resources Board ended its Zero Emission Vehicles Initiative, following litigation by automakers. Thereafter, General Motors along with Toyota and other automakers ceased production of electric vehicles citing limited demand and sluggish battery technology development. Meanwhile, in Silicon Valley, Tesla was born. Despite several hiccups, the Lotus Elise-based, lithium-ion battery-powered Tesla Roadster went on sale in 2008. In 2009, Tesla and several other companies received millions of dollars in

funding from the US Department of Energy. Tesla used the loan to develop the Model S and acquire Toyota's shuttered plant in Fremont, California. It reignited the electric vehicle movement.

Electric vehicles are by no means a new concept – they have been existing in some form or the other since the 19th century. But in 1912, electric cars lost their most compelling advantage when Cadillac introduced the Cadillac Touring Edition with an electric starter, replacing the hand crank. By 1920, prohibitive

costs, combined with limited range and cheap oil contributed to a sharp decline in electric car sales. In 1996, General Motors began leasing the EV1, the first modern electric car with a battery range of 70 to 100 miles. An upgraded version with nickel metal hydride batteries went on sale three years later with a 100 to 140 mile range. GM produced about 1,000 vehicles. Subsequently, the company stopped manufacturing citing viability reasons. Elon Musk deserves credit for renewing interest in electric vehicles.

Rise of the EV

2015-2025 will be an exciting period for the auto industry as the electric car segment will attract several entrants. Automobile manufacturers will make significant investments to capitalize on the growth of electric vehicles.

Electric vehicles will disrupt the automobile industry in the next 5 to 10 years

The Electric Vehicle Initiative seeks to facilitate the global deployment of at least 20 million passenger car EVs, including plug-in hybrid and fuel cell electric vehicles, by 2020.

EVs - both hybrid and pure electric cars - will make up more than one-quarter of the global car market within just 10 years, their numbers growing from around 1 million today to around 25 million in 2025.

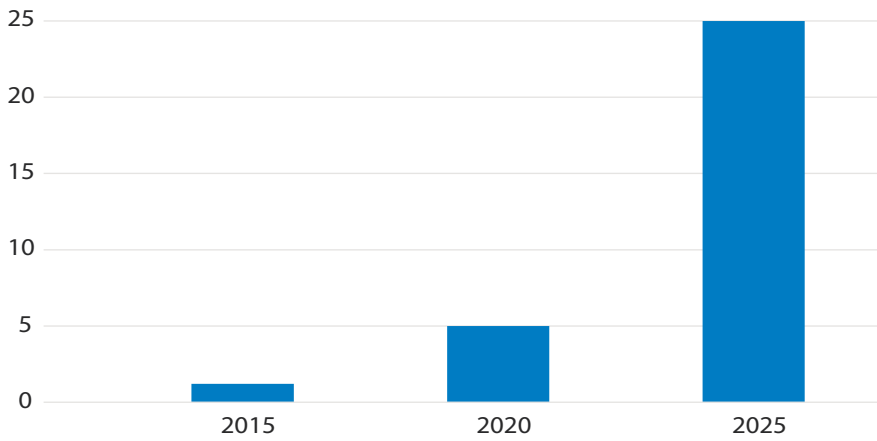
Plug-in electric vehicle sales are forecasted to reach 400,073 in annual sales in the US market and 107,146 in Canada by 2020.

The PricewaterhouseCoopers Autofacts team estimates sales of pure electric, plug-in mild and full hybrids will grow 433% to 2.2 million units by 2021, driven by a number of factors, including regulatory pressure.

Navigant Research has forecasted that the annual plug-in electric vehicles sales will exceed 860,000 in 2024

Figure 1 : Key Statistics

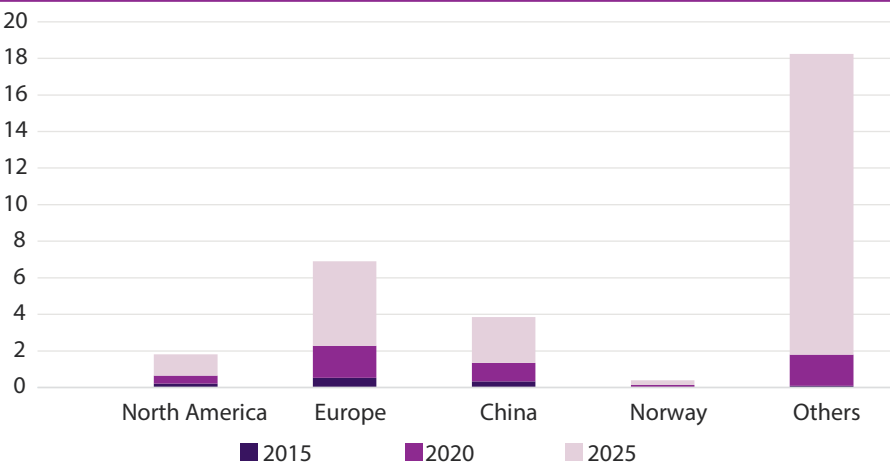




Electric vehicles sales forecast - Global (in Millions)

Source: Goldman Sachs low carbon economy reports, Korea herald.com

Global electric vehicle industry sales are surging significantly and are expected to grow from ~1.2 million in 2015 to ~25 million in 2025. Decreasing battery costs (expected to drop by half from the current US\$ 200 per Kwh), combined with a host of technological features, will contribute towards rising electric vehicle sales. Also, increasing regulatory pressure on emissions will force governments to continue subsidies for electric vehicles, making them more affordable and attractive for the car buyer.



Electric vehicles sales forecast - Key Regions (in Millions)

Source: Navigant Research, Goldman Sachs, Ev volumes, Norwegian EV association, market watch and PwC reports.

Electric vehicle sales are expected to grow from ~0.2 million in 2015 to ~1.17 million in 2025 in North America, from ~0.53 million in 2015 to ~4.6 million by 2025 in Europe, from ~0.3 million in 2015 to ~2.5 million by 2025 in China and from 34,300 in 2015 to ~0.25 million in 2025 in Norway. The growth is due to incentives for electric vehicles, mandatory Zero Emissions Vehicle (ZEV) program drive, and a change in the customer mindset towards lower levels of CO2 emissions and substantial investments in infrastructure, battery cell, and other R&D.

Automakers are making huge investments in electric cars:

In 2015, Ford announced a **US\$ 4.5 billion** investment in EV technology and 13 new electric models will be added by 2020

Source: Ford Annual Report -2015

In 2014, Mercedes approved an investment of over **US\$ 2 billion** for purpose-built electric vehicles

Source: fool.com

Volkswagen is launching over **twenty electric and plug-in hybrid electric vehicles**, ranging from small-sized cars to large SUVs in China, its largest market

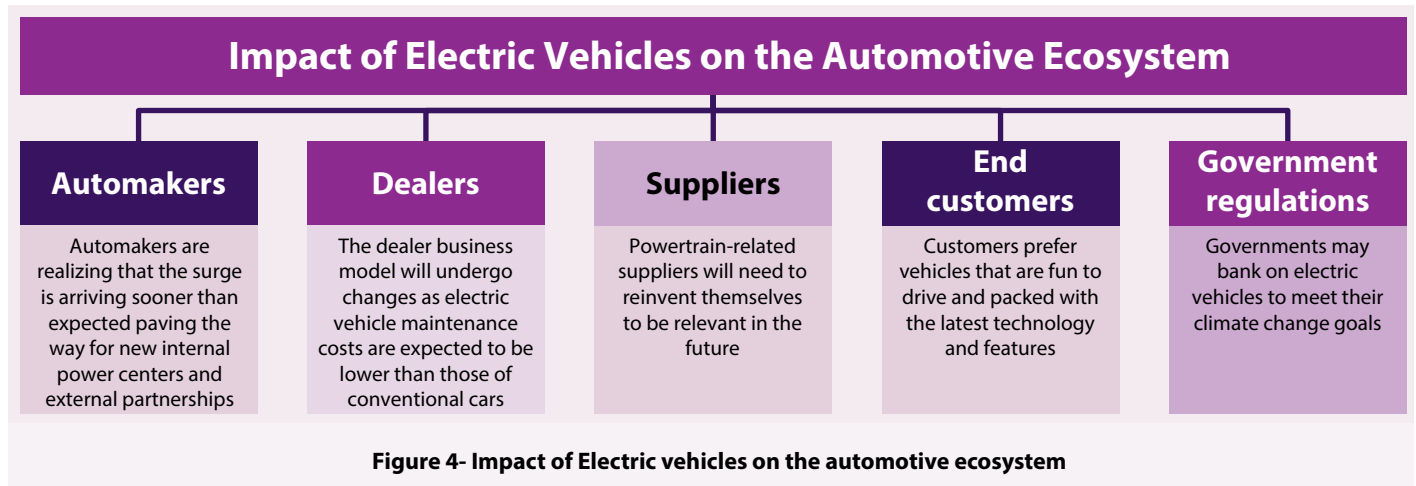
Source : forbes.com

In 2014, General Motors announced an investment of **US\$ 449 million** for the next generation of electric vehicles and advanced battery technologies

Source: gm.com

EVs will disrupt the automotive ecosystem

As automakers sell both conventional and electric vehicles in tandem, it is going to create a significant impact on the automotive ecosystem.



Automakers

- ▶ Automobile manufacturers are making huge investments in electric car divisions as they realize that electric vehicles are disrupting the industry
- ▶ Significant internal changes will take place as teams fight for their share of budgets in R&D activities and existing powertrain heavyweights will refuse to step aside gracefully to electric divisions
- ▶ Many new supply chain partnerships need to be created
- ▶ The focus will move to new technologies as the automobile becomes a true computer on wheels

Dealers

Dealers will have to unlearn and learn to sell both electric vehicles and conventional vehicles

Dealers should equip their personnel with a diversified skillset to sell electric vehicles

The automotive business model is expected to transform with the emergence of the electric vehicle. Profitability from service operations is expected to come down as electric vehicles will require less maintenance

Suppliers

- ▶ Suppliers will be significantly affected as automobile manufacturers switch to the electric powertrain. Only a few suppliers who take appropriate initiatives will survive and succeed, such as Bosch that has a separate division to focus on batteries

End customers

- ▶ Incentives and subsidies will turn the tide in favor of electric vehicles
- ▶ The rapidly growing charging stations network combined with supercharging facilities will make adoption of electric vehicles easier for the end customer

- ▶ Superior driving experience with packed innovative features will make it difficult for customers to resist the experience of owning an electric vehicle. Once they drive an electric vehicle, they will find it difficult to go back

Government regulations

- ▶ Governments will take the Electric Vehicles Initiative (EVI) seriously as adoption of electric vehicles can reduce the carbon footprint
- ▶ Governments will play a key role in resolving subsidy-related issues to promote and make electric vehicles affordable
- ▶ Governments will have to consider providing special privileges such as removal of tolls on expressways and providing priority parking spots to encourage adoption of electric vehicles

It's going to be a disruptive force

The internal combustion (IC) engine that has been powering billions of vehicles, has not been disrupted to a great extent over the past 50 years. Though there have been advancements in terms of performance and fuel efficiency, nothing much has really changed in the way it powers an automobile. Electric cars are disrupting the heart and soul of the automotive. Batteries and drive units will now occupy the space of IC engines and associated accessories. On the one hand, it is going to disrupt some industry suppliers significantly, forcing them to redefine their entire product portfolio to be relevant in the changing landscape. On the other hand, it is going to be an internal challenge for the OEMs as some of their most important teams will lose their position of influence to the electric divisions

The EV story aligns with the circular economy

As the environment imperative goes mainstream, global enterprises are taking steps to focus on sustainability and green supply chains. It can be achieved through circular economy as it involves remanufacturing and re-using products, and putting less strain on the environment and resources. Electric cars fit into the circular economy well as their major components, such as batteries and drive units, are designed for remanufacturing and re-use.

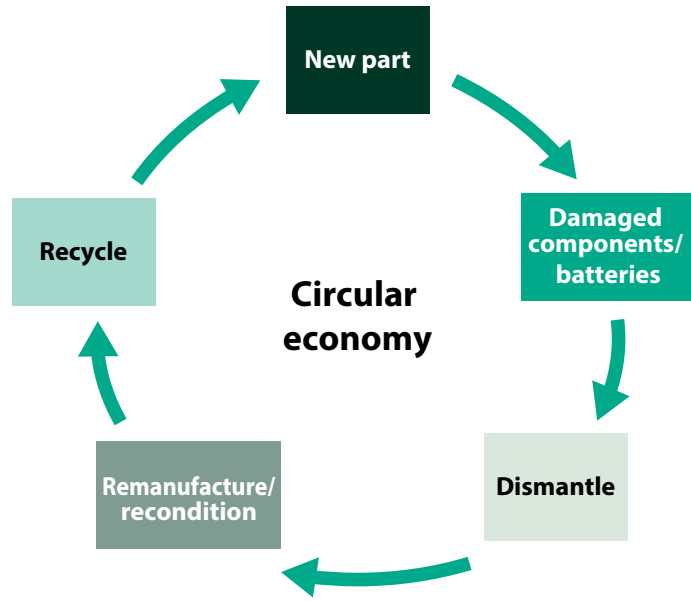


Figure 5: Circular Economy



Electric vehicles will be able to innovate faster

Compared to internal combustion engine vehicles, electric vehicles have a significant advantage - battery technology developments are faster than those of the engine technology on gasoline-based vehicles.

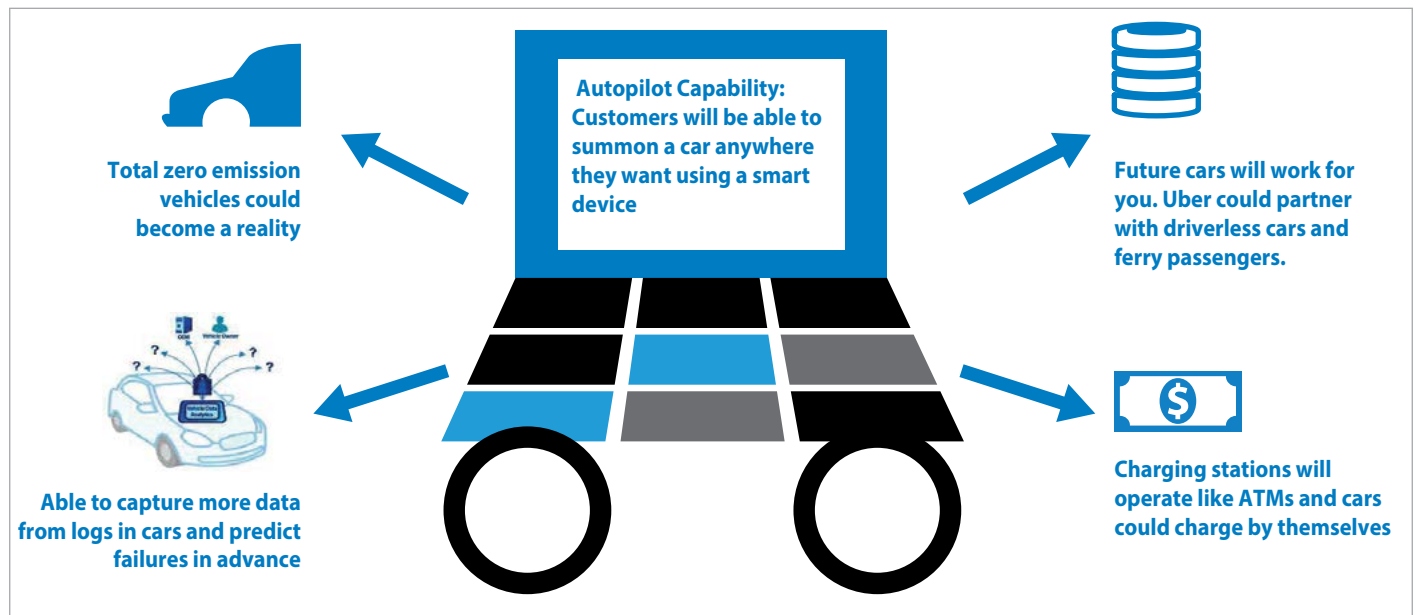


Figure 6: Computer on wheels

In addition, the trend of packing electronics in today's automobiles shows that innovations in electronics will outpace other innovations. The amount of electronics in an electric vehicle is high compared to conventional vehicles. It offers opportunities for more innovations. The electric car of the future will be a true computer on wheels and will change the character of the automobile.

The journey ahead

The electric car is the future of the automobile, and it is becoming a reality sooner than expected. The next 5 to 10 years will be an exciting phase for the auto industry. Automobile manufacturers will invest billions of dollars in this emerging technology to stay relevant. It is also going to be an interesting period for conventional automobile manufacturers as they grapple with investment decisions. Though the electric car divisions of automobile manufacturers are currently not a profitable business, the electric car tide will force them to explore it.

The implications for conventional automobile manufacturers are going to be significant as they will have to discard most of today's technologies. Virtually all reusability between existing models and new models will be gone and will lead to a complete disruption of the industry economics. The influential divisions within

car companies will lose power. They will refuse to transfer power and money to the electric divisions. There are similar precedents: Control Data Corporation, Burroughs and Kodak refused to adapt to the emerging changes and lost their way completely.

The automotive ecosystem, consisting of dealers and suppliers, will also be affected. Dealers will have to face the challenge of selling both electric and conventional cars together and automakers will have a tough time as the margins and future revenue from an electric car will be far lower compared to a conventional car. Electric cars by design will require less maintenance and it will have a direct impact on the profitability of dealers and automakers. Traditionally, profits from servicing have sustained automobile companies and the electric car revolution could affect them. Companies could lose

50% or more in profitability as the industry migrates towards electric-driven vehicles.

The major shift is going to be towards an electric / electronic one, and the focus will shift from engine management, emission control, and fuel efficiency to batteries, drive motors, and other aspects of technology. Electronics / electric companies will become the new power centers and will drive innovations in future cars along with technology companies.

However, there could be another challenge - the availability of rare earth metals as an input raw material. Cobalt (a byproduct of Copper / Nickel mining) is a key ingredient for Lithium-ion batteries and could hit a roadblock in terms of a supply / demand mismatch once automobile manufacturers go electric. The electric vehicle industry could be in trouble as volumes grow and will need to explore alternative battery technologies to maintain the momentum.

About the Authors



Venkataraghavan Sundaram

Venkataraghavan is a principal consultant with more than 14 years of industry and consulting experience in discrete manufacturing, automotive and IT services. His areas of expertise include manufacturing systems engineering, new product development, product costing, value engineering, strategic sourcing, and vendor development.



Natesh Muthalan M.

Natesh is a senior consultant with seven years of industry and consulting experience in auto, manufacturing, banking, and insurance. His areas of expertise include incentive management, dealer allocation methodology, and assembly line operations.



Karthicknathan Shanmuganathan

Karthicknathan is a senior associate consultant with four years of industry and consulting experience in logistics and automotive. His areas of expertise include telematics, auto finance, and automotive deal generation.

For more information, contact askus@infosys.com



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