



## Electric Vehicles: Innovation Process for Sustainable Development and Future Market Forecasting

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**ABSTRACT**

Conventional vehicles are a threat to environmental pollution, as the emission of the gasses from the vehicles using fossil fuel affects the whole environment. This concern has led the researchers and inventors to work upon the study of electric vehicles. Electric vehicles are said to be incorporating as the approach for decarbonisation and environment friendly transportation system. The contemporary world is emerging its focus on the Electric Vehicles as an alternative of the old school vehicles they emit harmful gasses. This paper focuses on the invention and innovation of the electric vehicles as they not only reduce the noise pollution, air pollution and greenhouse gas emissions but also focuses on the economic sustainability keeping the inflation across nations in mind. Hence, the study soaks data from the available literature in order to have point of view regarding how Electric Vehicles play a role in sustainable development and further talks about the future market of these vehicles that depends upon its sustainability.

**INTRODUCTION**

Electric vehicles refers to the vehicles that are dependent on electric power of plug-in chargers rather than traditional vehicles depending upon gas, petrol and diesel. The sustainable development within the Electric Vehicles industry has the objective to benefit ecological and economic departments. In order to bring the idea of Electric Vehicles into common practice, all the stakeholders should play their part to fulfil the needs of this agenda. The future lies in the hands of electric vehicles as there would be no place for oil and gas in 1.5 degree world in future. Innovative electric vehicles invention is the biggest way of decarbonising the transportation sector by transforming the sector from oil to renewable resources such as electricity. This tells how much importance it holds in the future of the automative sector. Moving ahead, this paper will discuss the innovation process of sustainable development in regard to the invention of electric vehicles and will forecast the future of them in the market by analysing and forecasting the available literature.

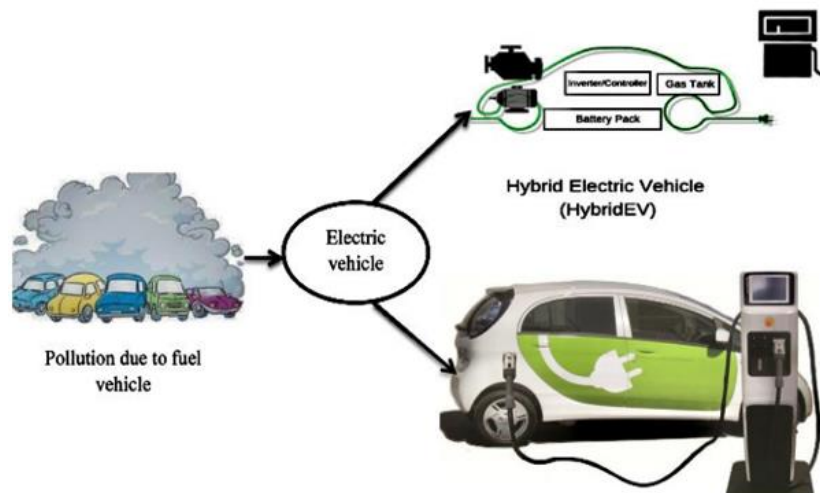


Figure1. Pollution created due to traditional vehicles



**LITERATURE REVIEW**

The entrance of electric vehicle in the market would create a path for sustainable development and innovation in the automotive industry being the first brick to the project of sustainability. The sustainable innovation processes would help in the creation of green environment, as a single private car alone is apparent to be responsible for huge amount of harmful gas emission in the environment. The current rate in several researches show, that the emission from the vehicles will be doubled by the year 2050. Therefore, it is important to reduce 75% of fuel emissions to achieve the reduction target of the world [1]. This is an alarming situation for the world; hence, the innovation of the conventional vehicles into electric vehicles would lead towards the sustainable development of the planet. Europe and China are seem to be in the favour of promoting these cars for the save earth projects. China in regard to several studies has given the policies shown below in the table to promote Electric Vehicles [2]:

<b>Zero emissions vehicle mandate</b>	<b>All the Chinese automotive manufacturers are required to import 10% Electric Vehicles.</b>
<b>Subsidies</b>	Electric Vehicles manufacturers are given subsidies.
<b>Tax exemptions</b>	The sales and consumption taxes are exempted from electric vehicles.
<b>Procurement</b>	The government of China uses procurement power in order to promote EV.
<b>New auto factory requirements</b>	The new vehicle factories the construction capacity for electric vehicles.
<b>Support for charging infrastructure</b>	The government of China promotes the policy of electric vehicle development.

Technological change is an almost permanent opportunity for and threat to firms and, more indirectly, national economies. The majority of changes are small, incremental ones but now and then larger ones take place which challenge the whole industrial structure. Firms with a leading position in the ‘old’ technology often find themselves struggling for survival after such a major change, or paradigmatic shift in technology (as many researchers call it). From a theoretical perspective, technological change and paradigmatic shifts in technology have been addressed in several studies, normally on either a policy or firm level (predominantly firm level and predominantly policy level). This polarisation of research may be problematic, as technological change normally depends on a combination of policy and firm-level efforts, which either strengthen or weaken each other. The automotive industry is famous for its efficient generation of incremental innovations. However, as the concept of a road vehicle hardly evolved at all in its first century, the capability of the industry to manage more radical innovations or paradigmatic shifts is less well-proven. One such larger potential shift is vehicle electrification, which has been an issue ever since the internal combustion engine gained a dominant position at the beginning of the 20th century. In mature industries, such as the automotive one, most development is decided and carried out within the firms. Not least for this reason, the introduction of firm-level aspects to a policy framework might be valuable for a better understanding of the development.

In addition to this, the scholars have found several factors that affect the development and sustainability innovation of the electronic vehicles which are, social impairment, subsidy, patents, fuel economy and the stakeholders. The sustainability is added on to the development plan of electric vehicles via data collection, data analysis and result evaluation of the SDES. There are three evaluated phases for the sustainability that are, Vehicle Exhaust Emissions, Climate Change and Integration. The early development stage of the electronic vehicles gain a lot of attention from the concerned stakeholders who are highly directed towards



the environment, hence, refers and promotes the sustainable electronic vehicles which are the great alternate to the traditional fuel vehicles. The most problematic and highly concerned pollutants emitted by vehicles are ground level ozone and particulate matter; these are the most studied topics in the area of literature [3]. According to the study conducted by Environmental Protection Agency, almost around 5 to 20% of the population in the United States of America are highly affected by the ozone which includes mainly the adolescents, pregnant woman and aged people [4]. This shows that the sustainable development of electric vehicle has become a necessity now by keeping the climate change and other effects of the traditional vehicle emissions on the world. The development of electric vehicles are in a rapid development phase at this point of time. Sustainability evaluation would help to find out the development problems and solve them on the right time, hence, sustainability development in an innovation of electric vehicles is very important. The usage of electronic vehicles is connected with the symbolic behaviour in social concerns. It has been studied that there are variety of positive examples towards the societal functional ultimate impact. It is safe to say that, the consumers who are interested in electronic vehicles are most of the time concerned in the sustainability of the car as a first priority. The option of electronic vehicles can be enhanced by working on the performance characteristics in addressing the trust of the consumers by taking some appropriate actions. The development of these cars will appear to be a useful innovation in future. The main aspects of the Electric Vehicles comprises of the following areas [5]:

- Energy trading
- Smart charging
- Mechanism of payment
- Vehicles communication

The achievement or disappointment of battery innovation not entirely set in stone by utilising the four essential highlights that structure imagination, development and seriousness around the world: the coordinated effort and collaboration between legislatures, organisations, research lab and other expert associations, colleges and little and medium-sized undertaking support administration (SMEs), the force of battery innovation, the proficiency which can be accomplished underway and exchange by the board and authoritative designs, and the peaceful accords, rules and guidelines. For an organisation, it is difficult to make a mechanical leap forward or advancement or to foster something new except if the innovation is utilised to make the business more serious by raising benefits, diminishing expenses and comparative changes in its financial outcomes.

Nonetheless, not all mechanical advancements can be available on the lookout. There are numerous untold advancements that never emerged, and other presumably progressive ideas fall into the alleged specialised "valley of death" due to the distinction between logical science and modern advertising. It is a lost an open door for the organisation's monetary and social development and benefit. Subsequently, an improvement is required by introducing better technology and advancement framework in battery innovation development the executives, which will be concentrated in the future.

Current ICE vehicles envelop top solace, amazing execution and high level security, at generally low costs and, obviously, have become starting from the starting the most alluring buyer items. In any case, notwithstanding roughly a very long term industry and the scholarly community battle to further develop ICE proficiency, this is, and will keep on being, unbelievably low. It has been researched exclusively around 30% of the energy delivered in the ICE burning response is changed over into mechanical power. At the end of the day, around 70% of the energy freed by burning is lost. Truth be told and more terrible than that, the squandered energy of warm engines, as ICEs might be called, is changed into engine and fumes gases heat. The exhaust gases are a mix framed generally of carbon dioxide (CO<sub>2</sub>) and, to a lower degree, nitrogen oxides (NO<sub>x</sub>), hydrocarbons (C<sub>x</sub>H<sub>y</sub>), carbon monoxide (CO) and sediment. Carbon dioxide is known to hinder the world's radiation emanations back into the space accordingly advancing worldwide temperature climb the supposed nursery impact.

A plug in hybrid electric vehicle (PHEV) is a hybrid electric vehicle (HEV) with the capacity to reenergise its electrochemical energy stockpiling with power from an off-board source (like the electric utility lattice). The vehicle can then drive in a charge-depleting (CD) mode that diminishes the framework's state-of-charge (SOC), in this manner utilising power to uproot fluid fuel that would somehow have been consumed. This fluid fuel is normally oil (gas or diesel), in spite of the fact that PHEVs can likewise utilise options, for



example, biofuels or hydrogen. Plug in hybrid electric vehicles’ batteries ordinarily have bigger limit than those in hybrid electric vehicles in order to build the potential for petrol removal.

Moreover, it has been assessed that the future of the electronic vehicles market will depend upon its stakeholders which are the government, the public and the suppliers. There are several factors that the stakeholders keep in mind, which are, the corporate governance, acquisitions, mergers, business evolution, ethical dilemmas and Corporate Social Responsibility (CSR) in their mind before creating a market space, encouraging and doing promotion of any product. According to the CEO of Europe’s fastest growing electric vehicle charging company, known as Virta. The rise of electric cars has become the biggest force of development and is growing approximately 40 to 80% every year. It has been forecasted that the change is about to come in the environment as the electronic vehicles not only protect the environment but they create the additional benefit to the life of buyer by being more efficient. Automotive industry is said to be completely electric with internal combustion engine not being the option in the industry anymore. It is safe to say that the future forecast and outlook of electronic vehicles has a huge share of the market in comparison to the traditional vehicles. The sales of electric vehicles in the United States of America and Europe has increased by 79% and 34% respectively. The sales of electric vehicles across several countries is shown below in the figure 2. But the problem is that more countries need the charging stations for the electronic vehicles. Virta is said to be operating and dealing with 7.1% market share in the Europe and it has gained a great market growth which is really fast and is working to serve in different continents as well so that the area of charging is grown [6]. There should be charging points for residential areas as well as commercial areas so that people do not feel adversely affected after the purchase of electronic vehicles [7]. The sustainability and innovation assessment has clearly shown the future outlook of the market being a successful one with increased growth of the sale of electric vehicles across the world on the basis of the data collected from EV outlook and BloombergNEF shown below in the figure 3 below.

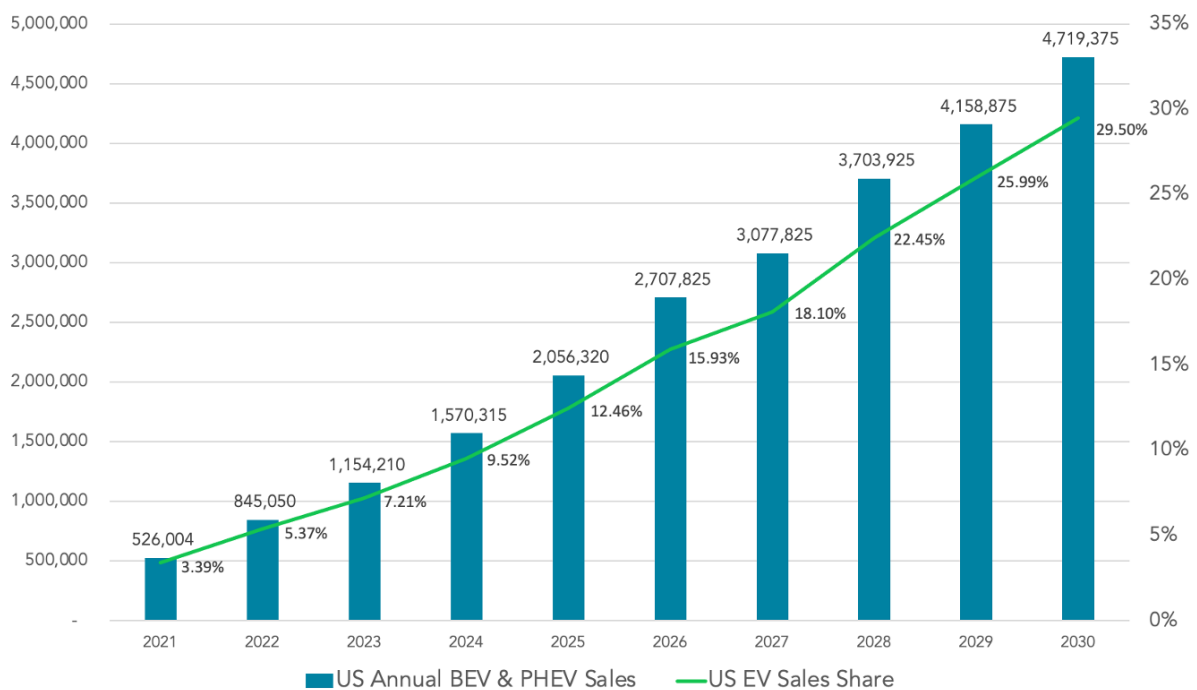


Figure1. Sales Forecast of Electric Vehicles in the USA [8].

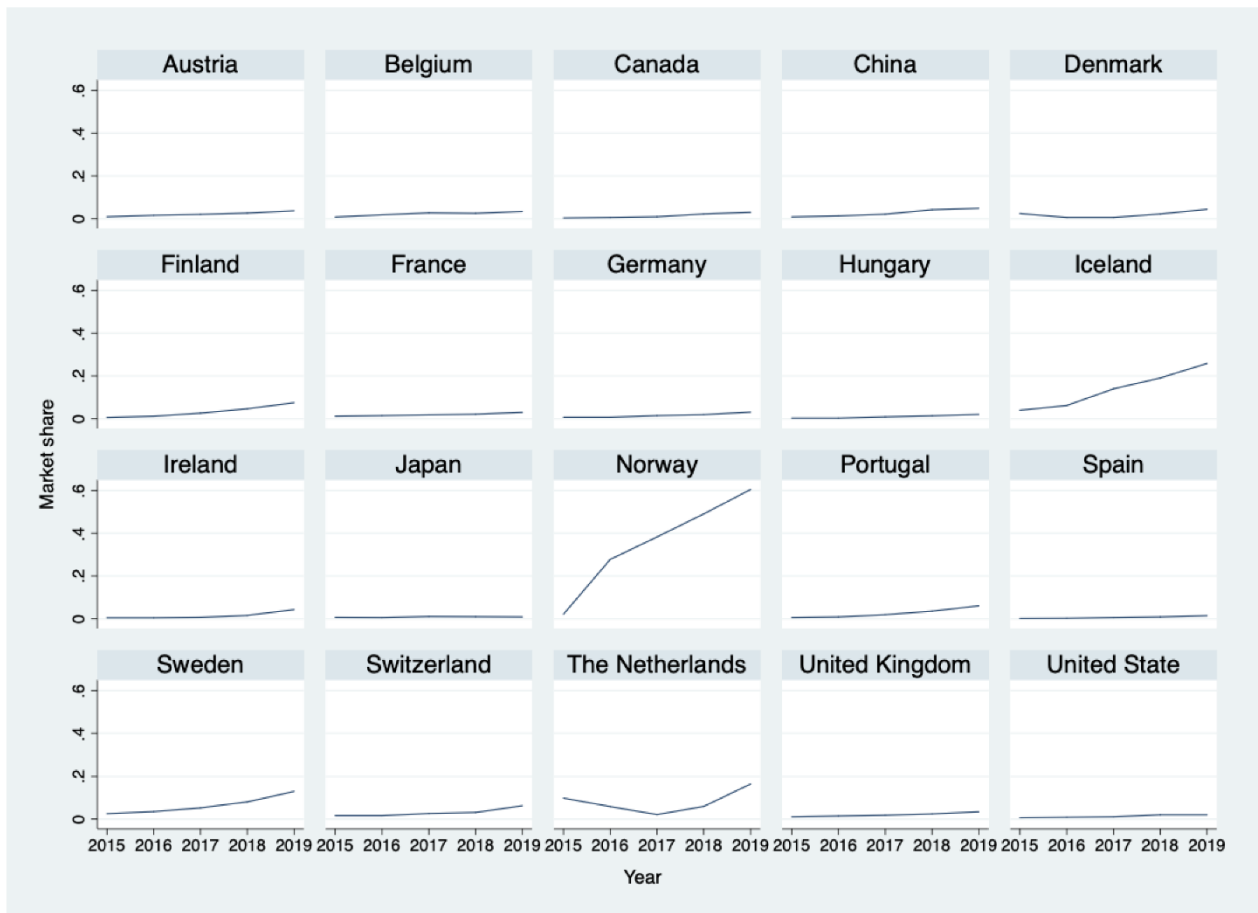


Figure 2. Time trend graph of 20 countries [9].

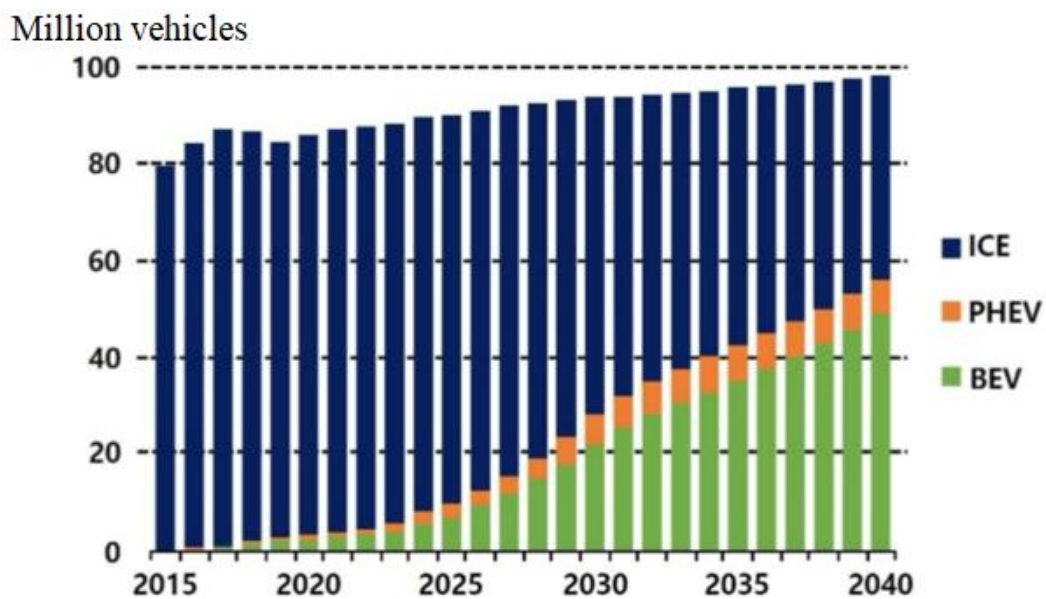


Figure 3. Global long-term passenger vehicle sales by drivetrain [10].





## CONCLUSION

In a nutshell, it has been studied that electricity will be produced from the clean and renewable resources and has several factors to be kept in mind while keeping the electric vehicles into consideration, which are, structure of the automotive market, behaviour of consumers and fuel price. Fuel price in today's world is the biggest factor to be considered. Therefore, the innovation and sustainability of the environment would be maintained with the increased use of electric vehicles. Hence, it is important to promote Electric Vehicles in the automotive industry. The developed countries have been playing a huge role in the promotion of Electric Vehicle yet are working more to achieve success.

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