Research Article

Development of Electric Vehicles and its Role in the Iranian Automobile Part Industry

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Abstract: This research mainly aims to investigate the role of the development of electric vehicles in the Iranian automobile part industry. In terms of purpose, this research is an applied study and in terms of method, it is a descriptive-survey and exploratory research. The population includes all the companies working in electric vehicle industry (including the manufacturers and importers). According to studies, 121 companies work in this area. Out of the mentioned population, 50 companies were selected as the samples by snowball sampling and theoretical saturation. Data analysis was done by descriptive statistics and thematic analysis. The results showed that the production of electric vehicles is not still at a proper situation and this condition should be improved by developing and legal and financial infrastructures. So, it can be concluded that mass production of electric vehicles in the country has not been realized yet and this industry is still developing. Hence, automobile part manufacturing industry does not have a proper situation.

Keywords: electric vehicles, automobile part industry, electric automobile parts, electric vehicle, environment

1. Introduction

Nowadays, with the increased consumption of fossil fuels such as oil and gasoline that has led to the increased air pollution especially in big cities, there is an increasing need for using new energies. Electric vehicles are a new generation of vehicles working with electrical power as some or all of their needed fuel. Meanwhile, due to the growing development of automobile industry, mass production of vehicles with an internal combustion engine that create different problems such as air pollution, and the limited reservoirs of fossil fuel and its high price, research and design of electric vehicles has become one of the main programs in automobile industry especially in the advanced European and American countries.

Over the past years, several studies have been performed in this area in Iran. Development of such vehicles in the country requires the development of the necessary infrastructures and paying attention to automobile part manufacturing industry; because the use of these vehicles will become expanded by mass production or the need for replacing the parts. Regarding the novel nature of this industry and the significant environmental damages of the automobile industry, expanded studies should be done in this area. The fuel used in these vehicles is fossil fuel. So, regarding the natural limitation of some resources, we have to try to use these valuable assets more properly. The attitude to energy sector in the Iranian economy has always been a technical and engineering attitude and the economic aspect of this sector has been paid less attention, while the energy sector is one of the main economic sectors of the country. Regarding the important role of this sector in generation of national wealth in other sectors and the significant effects of energy consumption on the environment, this sector should be organized from economic aspects as far as possible. In this regard, production of electric vehicles will reduce the environmental damages (Wang et al., 2016).

Obviously these vehicles are fueled by fossil fuels that depend on electrical power. In recent years, the world's countries have tried to develop electrical vehicles to expand the production of automobile parts. So, it has led to the increased competition in manufacturing and sale of electrical vehicle parts. This issue should be paid attention in developing countries due to the increased environmental damages. Reduction of these damages leads to increased competitiveness of electrical vehicle industry. In this regard, this research aims to answer the question "what is the role of electrical vehicle manufacturing in the Iranian auto parts industry.

1.1. The research necessity

Since 1970s after the global oil shocks in large energy consuming countries, research on this area has been emphasized and especially developed in the recent years due to importance of energy sector (Arghavan et all., 2016).

Decreased resources of fossil fuels and significant environmental pollution caused by high fuel consumption of vehicles and motorcycles have led many countries to use other energy resources with lower pollution. In this regard, electrical vehicles are one of the most appropriate vehicles for preventing air pollution, decreasing the emission of pollutants and greenhouse gases, and protection of the environment (Mahmoudi et al., 2018). Besides the development of the infrastructures of the internal automobile companies to achieve the needed technologies and optimal consumption, using these vehicles requires supplying their parts in thside the country. However, this issue has not been paid enough attention by researchers and most of the investors are not willing to invest in this area due to the lack of development in electrical vehicle manufacturing. In this condition, scientific studies can provide useful solutions for development of electrical vehicles in the country.

1.2. The concept of electrical vehicle

Electrical vehicle is a type of vehicle working with electrical power. As other electronic devices, electrical vehicles work with electrical power and battery (Li, 2018). These vehicles only need an electrical engine and a chargeable battery that can be connected to electricity plug. Electrical vehicles use different lithium-ion batteries similar to the ones used in mobile phones and laptops. However, the batteries used in electrical vehicles are produced in larger scales (Hamidi, 2018).

Lithium-ion batteries have a high energy compaction, and they lose less power than other batteries while not working. Electrical automobile is a type of electrical vehicles Johno, 2019). The term "electrical vehicle" refers to the vehicles supplied by electricity, while electrical automobile refers to the automobiles that can move in highways (Alipour, 201, 6).

The electrical automobiles supplied by solar cells are called solar automobile and the automobiles supplied by gasoline generator are called hybrid automobile. Thw automobiles only working with a battery are called fully-electrical vehicle. Electrical automobile usually refers to fully-electrical vehicle (Vesal et al., 139, 8).

1.3. The situation of electrical automobiles in Iran

Study of the current situation of electrical vehicles in Iran shows that no effective action has been taken by the country's automobile industry, and especially the Ministry of Industry, Mine, and Trade (that is in charge of the industry sector and a shareholder of the country's automobile industry) and only Saipa and IranKhodro Companies have performed some studies. However, these studies have not reached the commercialization phase (Jafari, 2019).

The two large Iranian automobile companies (IranKhodro and Saipa) claim that they have the capacity of manufacturing electrical vehicles in the country in terms of the technological and designing knowledge. However, the problem is the cost of manufacturing these vehicles that usually cost three times more than the gasoline vehicles. So, there is no guarantee for the existence of demand for these vehicles. It should be noted that one of the factors involved in the development of electrical transportation in every country is the governance attitude in that country that is reflected in the country's rules. Over the past decades, the legal capacity of development of electrical transportation in Iran has been concerning the replacement of electrical vehicles that constitute a part of transportation system, and especially public transportation in metropolises. So, several rules and articles have been included in the upstream documents for supporting the development of electrical transportation vehicles in the country (Alipour et al, 2019).

As it is observed, there are various encouragements in the government's rules and regulations to develop the use of electrical vehicles in the country. However, the supporting factors included in the rules and regulations have not been so effective in the development of electrical vehicle market so far (Bashtani et al, 2019).

The reasons for ineffectiveness of the supporting rules include the following:

1. Ineffectiveness of financial resources: The financial resources considered in the upstream rules and documents are mainly supplied by saving the fuel consumption of the costs of technical examination and traffic fines. However, it is obvious that the legislator has not determined any separate share for the development of electrical vehicles and since other consumptions have been defined for these financial resources, they have lost their effectiveness. The grants included in the enactment number 283917 of the Economic Council for electrical vehicles are equal to 3780 dollars for 5 years (756 dollars per year). The electrical vehicles currently used as public vehicles in the world cost about 30-50 thousands of dollars. It suggests that the allocated grant is less than 10% of the vehicles prices and even, the supportive fees determined in Iran is less than those of the other countries, especially the countries whose electrical vehicles constitute more than 2-3 percent of their whole vehicles (Zhan et al, 2015). On the other hand, allocation of these financial resources decreases the effectiveness of such financial resources (considered for a five-year period) and their attractiveness. Also, the currency rate allocated to this sector is not the same as the currency rate of the free market and the legislator has considered the allocation of its Rial equivalent.
2. Based on the experiences of development countries, one of the factors motivating the development of electrical vehicles in the country is adopting non-price policies in fuel consumption, imposing polluting fines to vehicles with high fuel consumption, etc. As a result, depreciation of the vehicles increases its maintenance costs and the vehicles using fossil fuels are not economically optimal. In this way, people will be encouraged to use electrical vehicles. This rule has been included in the law of public transportation development and fuel consumption management (Faramarzpoor, 2012).
3. The other legal gap is the lack of infrastructural supports such as construction of charging stations, special traffic routes, and special parking lots for electrical vehicles (Petit et al, 2016).

1.4. The research background

A. National studies

- Mahmoudi et al. (2018) investigated the opportunities and challenges of the presence of electrical vehicles in the active distribution network and they proposed different solutions for resolving the existing obstacles. They stated that so far, various studies have investigated the electrical vehicles and their role in the future of the electrical transportation network is obvious to anyone. In general, one of the most properties of electrical vehicle is creating no environmental pollution and reducing the dependence on fossil fuels. In this regard, they can create significant challenges and opportunities in the electrical industry and especially the distribution sector. This study investigates the requisites and solutions of providing the possibility of the presence of electrical vehicles in the distribution network proportional to the mentioned charging methods. Also, it discusses the way of interacting with this technology to improve the challenges existing in the active distribution network.
- Mahmoudi and Shahhosseini (2018) investigated the infrastructures and legal requisites of providing electrical vehicles, and they stated that over the recent years, the national and international automobile industry has been focused on producing electrical vehicles. In this regard, the governments and policy makers have highlighted the environmental opportunities and job creation. In the electricity sector, electrical vehicles are being prepared to enter into the electricity distribution network and this issue is of great importance currently. This paper investigates the infrastructures and legal requisites of providing electrical vehicles. In this regard, the updated versions of the standards of charging stations and the charging equipment are introduced in this paper. Also, this paper introduces the necessary changes that should be made in the existing national rules and the extra infrastructures that may need to be controlled by the new rules.
- Sohrabi and Maghbali (2018) investigated the role of electrical vehicles in transportation industry in 2030, and they stated that due to its high costs, the development of electrical vehicles is directly related to the government's will in the developed countries. The unfavorable situation of greenhouse gas emission and its negative effects on the environment and the frequent fluctuations of crude oil price and its decreasing reservoirs have forced the countries to plan long-term programs to global transportation. The results of the study suggest that the countries' decision for quantitative development of these vehicles is so serious that in 2030, more than 30% of the market share of transportation system in the studied countries will be allocated to these vehicles. As a result, it will lead to the 50% decrease in greenhouse gas emission and environmental health.

1.5. Foreign studies

- Khan (2018) investigated the electrical vehicle transportation in the smart network system stating that hybrid electric vehicles can reduce the dependence of the transportation system on fossil fuels and greenhouse gas emission. The economic and environmental advantages of hybrid vehicles have significant affected the modern transportation sector. Transportation electronization has created a lot of challenges for smart grid. These challenges include the capacity quality, reliability, and control. The most efficient property of transportation sector is the concept of vehicle to grid (V2G) that helps to store the surplus energy and transferring that to the main grid during the period of high demands. This paper provides an inclusive study of the onboard and offboard charging infrastructures and the communication necessities of EV.
- Rebecca (2017) investigated the feasibility of V2G system as a technological-economic analysis of electrical vehicle-based energy storage. It was stated that the potential capacity of electrical vehicles for revenue generation by supplying the energy needed in commercial buildings has been evaluated beside the revenue generated in side service markets on England. In this study, a hybrid time series/statistical simulation model has been described by real data and this model has been applied for analyzing the electricity trade by V2G system and the buildings and markets. The key parameters used for this purpose include the price of selling electrical power for electrical vehicles, the battery depreciation cost, and the infrastructures price. Also, the analyses show that the gross revenue generation is strongly affected by the battery depreciation costs related to the V2G cycle.
- Alipour et al. (2016) investigated the random planning of plug-in electrical vehicle accumulators for attending the electricity and side service markets. They claimed that due to the increased environmental problems the energy crisis, plug-in electrical vehicles are expected to play a more significant role in transportation. By implementing a lot of vehicles with proper control, large scale storage and flexibility can be achieved in power systems. Plug-in electrical vehicle accumulators are responsible for providing the capacity and controlling the charging pattern of these vehicles in the contracted zone. The constraints of operating plug-in electrical vehicles and the V2G constraints have been modeled in the proposed framework. Meanwhile, a descriptive example has been proposed for approving the function of the proposed model.

2. Method

In terms of purpose, this research is an applied study and in terms of method, it is a descriptive- survey and exploratory research. Data analysis was done by descriptive statistics and thematic analysis.

- The research domain is the development of electrical vehicles and its role in the Iranian auto part industry.
- The research location includes all the companies importing and manufacturing electrical automobile.
- The research has been done in the period of March 2019-Novemeber 2019.

The population includes all the companies importing and manufacturing electrical automobile. Out of the 121 companies working in this area, 50 companies (1 manger from every company) were selected as the samples by snowball sampling. Since the research is a qualitative study, the interviews should continue until it is possible to get new information. In this research, data saturation was reached while interviewing the 50th subject and the interviews were stopped.

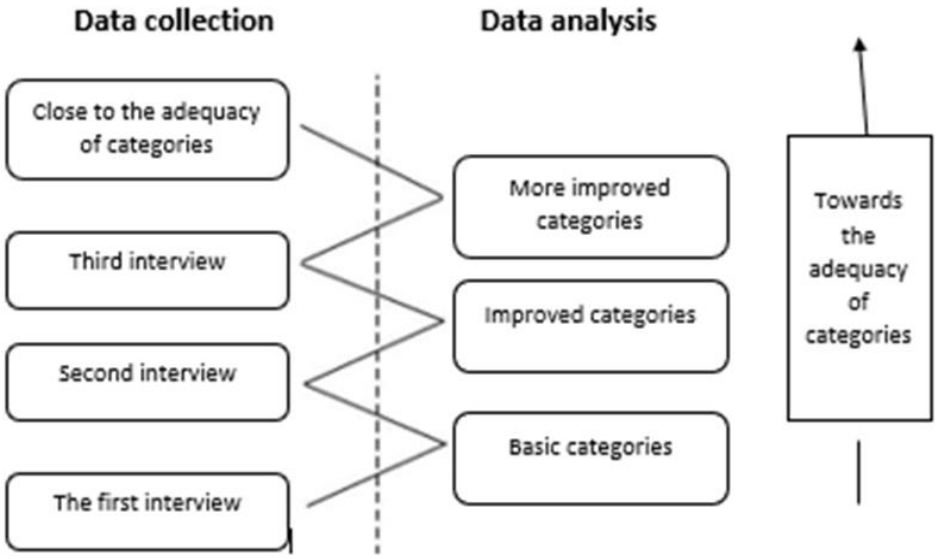

Figure 1. Data collection and analysis for saturation of the interviews

3. Demographic descriptive findings

A. The respondents' gender

Table 1. The respondents' gender

Gender	Number	Frequency
Female	16	0.32
Male	34	0.68
Total	50	0.100

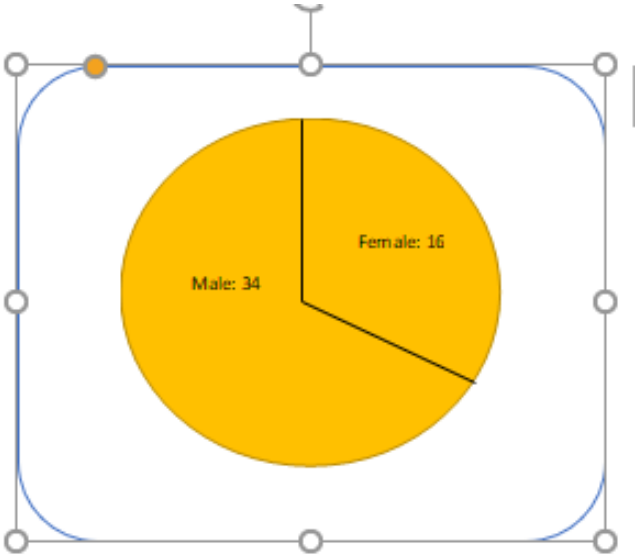

Chart 1. The respondents' gender (Error! No text of the specified style in document)

B. The respondents' education

Table 2. The respondents' education

Education	Number	Frequency
BA	42	0.84
MA and higher	8	0.16
Total	50	0.100

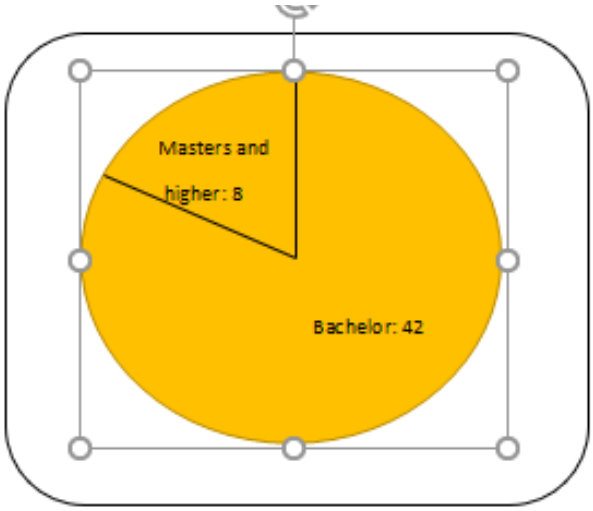

Chart 2. The respondents' education

C. The respondents' age

Table 3. The respondents' age

Age	Number	Frequency
30-40	35	0.70
40-50	6	0.12
Above 50	9	0.18
Total	50	0.100

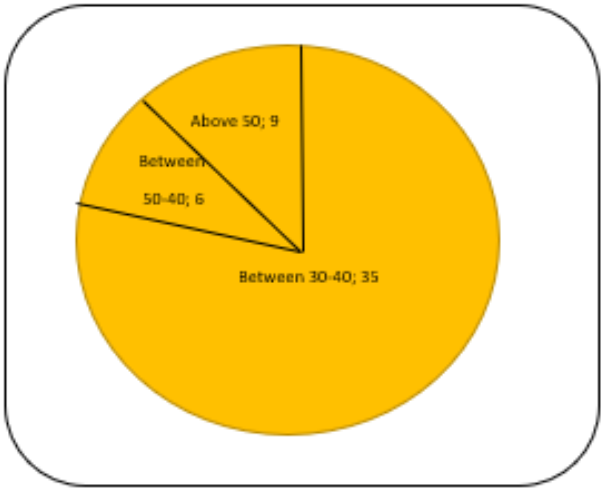

Chart 3. The respondents' age

D. The respondents' working background

Table 4. The respondents' working background (Error! No text of specified style in document)

Working background	Number	Frequency
10-15	37	0.74
15-20	7	0.14
Above 20	6	0.12
Total	50	0.100

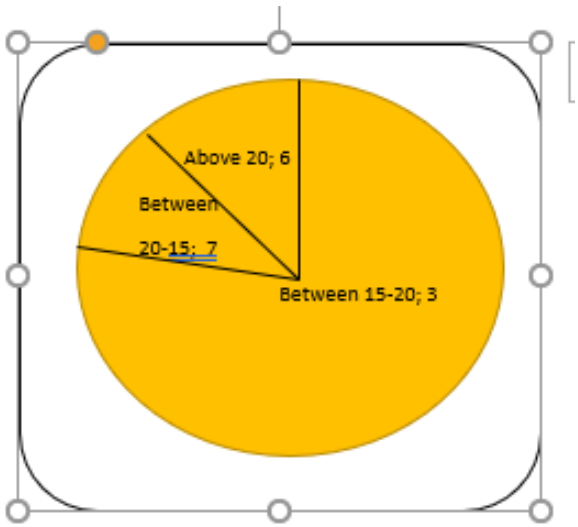

Chart 4. The respondents' working background

4. The results of qualitative findings

In this part, the research questions are answered. For this purpose, the experts of automobile industry and auto part manufacturers were interviewed and the analyzed data were presented as the results and the answer to each question.

The first question: How is the situation of electrical vehicle manufacturing in the country?

Table 4. The quantitative findings of the first question

The major theme	The minor themes
Environmental factors	Lack of using culture, lack of trust with electrical vehicles, inconsideration of environmental crises, lack of competition, existence of governmental automobile manufactures, auto part import, the tendency to using gasoline vehicles
Legal factors	Lack of governmental support, lack of appropriate rules, the gap in the management structures, failure to implement the 44th principle of the constitutional law properly
Technological factors	lack of technological infrastructures, lack of skilled human force, inconsideration of specialized educations, copying the auto parts, low quality of auto parts, lack of laboratory equipment

Based on Table 4, it can be claimed that electrical vehicle manufacturing does not have a proper situation in the country and the experts believe that three factors are involved in this issue including the environmental, legal, and technological factors.

- The environmental factors include the lack of using culture, lack of trust with electrical vehicles, inconsideration of environmental crises, lack of competition, presence of governmental manufactures, auto part import, and the tendency to gasoline vehicles.
- The legal factors include the lack of governmental supports, lack of appropriate rules, the gap in the management structure, and failure to execute the rules of the 44th principle of the constitutional law.
- The technological factors include the lack of technological infrastructures, lack of skilled human force, inconsideration of specialized educations, copying the auto parts, low quality of auto parts, and lack of laboratory equipment and facilities.

Managing the three mentioned factors can improve the electrical vehicle manufacturing condition.

The second question: How is the situation of electrical auto part manufacturing in the country?

Table 5. The quantitative findings of the second question

The major theme	The minor themes
Managerial factors	Lack of research and development, lack of commercialization, lack of technological management, lack of proper planning, the country's currency system, the high price of auto parts
Organizational factors	Failure to respond to the varying market conditions, dependence on gasoline vehicle industry, lack of market attraction, legal weaknesses, traditional orientations
Individual factors	Poor creativity and innovation, poor education and lack of specialty, lack of adaptive behavior, lack of individual participation

Based on Table 5, the three factors of management, organizational, and individual factors are involved in the improvement of electrical auto part industry in the country, while they are not paid attention enough.

- The management factors include the lack of research and development, lack of commercialization, lack of technological management, lack of proper planning, the exchange system of the country, and the high price of auto parts.
- The organizational factors include the lack of responsiveness to the changing market condition, dependence on gasoline car industry, lack of market attraction, legal weaknesses, and traditional orientations.
- The individual factors include the poor creativity and innovation, poor education and specialty, poor learning, lack of adaptive behavior, and lack of individual participation.

The third question: The solutions of developing electrical vehicles and their parts in the country

Table 6. The qualitative findings of the third question

The major theme	The minor themes
Strategic factors	National culturization, paying attention to environmental requirements, empowerment of auto part industry, bank facilities, export possibility, designing and engineering, manufacturing experiences, foreign specialties
Market factors	Market need assessment, improvement of auto part quality, decreased production of gasoline vehicles auto part, providing legal platforms for foreign countries' attendance, liquidity, technology attraction, production and demand flow, focusing on the market demand
Political factors	Lack of exclusiveness in the Iranian automobile industry, decreased intervention of the government, private sector's participation, attraction of foreign investment, development of cooperation with foreign countries, legislation

Based on Table 6, there three type of factors involved in this issue:

- Strategic factors including national culture creation, consideration of the environmental requirements, empowerment of the auto part industry, bank facilities, expert possibility, designing and engineering, manufacturing experiences, and foreign specialties. The market factors include the market need assessment, improvement of the auto part quality, reducing the production of gasoline vehicle parts, creating legal platforms for attendance of the foreign companies, liquidity, technology absorption, production and demand flow, focusing on the market need.
- The political factors include the lack of the exclusiveness in the Iranian automobile industry, decreased share of the government, participation of the private sector, attraction of foreign investment, development of international cooperation, and legislation

5. Conclusion

The three questions of the research showed that the Iranian electrical vehicle industry is still in the starting phase, and it does not have a favorable situation. So, the lack of market desirability has affected the electrical auto part industry, so that electrical auto parts are manufactured in a limited manner or they are imported. It seems that governmental supports, investment, and creation of the infrastructures necessary for the development of electrical vehicles can play a significant role in the expansion of the market of these vehicles and finally, the auto part industry. In addition, the high price of gasoline over the past years has make the automobile companies pay attention to production of electrical and hybrid vehicles. Unfortunately, no electrical or hybrid vehicle has been manufactured in Iran so far. The growing increase in the number of automobile users, the increased environmental pollution caused by the vehicles, and the limited energy resources and fossil fuels have made the countries revise their energy consumption and design their vehicles by observing the reduction of fuel consumption. So, these companies have tried to produce vehicles with a high efficiency, low fuel consumption, and low pollutant emission. Electrical and hybrid vehicles provide an appropriate solution for reducing the consumption of fossil fuels and environmental pollution. So, with the development of this industry, electrical auto part industry can be developed, too.

Unfortunately, the old and inefficient policies of automobile industry have prevented the development of Iranian electrical vehicles and their availability for the customers. However, the lack of appropriate platforms such as special routes for electrical vehicles in our cities should not be forgotten. It seems that some of the Iranian authorities of automobile industry and the relevant organizations try to prevent or dealt the import of these vehicles into the market for unknown reasons. It can create many obstacles to the development of auto part industry in Iran.

6. Suggestions

1. Using electrical vehicles requires special infrastructures without which, it is impossible to use electrical vehicles. One of these infrastructures is the need for electrical vehicle charging stations. Charging stations are similar to fuel stations and they are used for charging electrical cars.
2. It is suggested to plan some programs for supporting public electrical transportation, large scale orders to electrical vehicle manufacturers, enacting the taxes imposed to greenhouse gas production, providing financial encouragements for electrical vehicle purchasers, reducing the parking rates and the fees for electrical vehicles, developing the infrastructures of using these vehicles, and enacting some rules for forcing the automobile manufacturers to produce electrical vehicles by the government. So, this new automobile industry can be increasingly developed.
3. In order to develop the use of electrical vehicles, in addition to create a competitive market, the technical properties of the vehicles should be proportional to the prices that are considered affordable (either in the country or the imported cars). So, the consumers will be encouraged to purchase this type of vehicle. So,

including the subside of purchasing electrical vehicles in the annual budget is one of the best supportive policies that can be used beside the other policies such as tax discounts.

4. The government and domestic automobile manufacturers should pay attention to decision making and policy making in this area, so that the Iranian automobile manufacturers can compete with the foreign manufacturers in this area.
5. All the proposed suggestions can develop the electrical vehicle manufacturing in the country and by development of this industry, consumers will need electrical automobile parts. This process can finally lead to the development of electrical vehicle industry in the country. However, an industry that depends on other industries cannot be planned alone. Rather, the main industry should be paid attention for realization of the growth of the subset industries.

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