



The Current Situation of the Development of Electric Vehicle Technology in Turkey

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Abstract

The environmental damage caused by internal combustion vehicles used in transportation, the diminishing availability of fossil fuels, and the lower cost of electricity in comparison to gasoline and diesel, are the primary reasons for the trend toward electric vehicles (EV). In parallel to the increase in electric vehicles, the number of charging stations has increased as well, which has contributed to the widespread utilization of electric vehicles. When the history of electric vehicles has been investigated, it became clear that the first studies began in the early 1800s. During those years, as oil output expanded in response to the period's conditions, electric vehicles' popularity diminished in comparison to internal combustion vehicles. Additionally, range, charging durations, and power have limited the commercialization of electric vehicles. With global warming approaching alarming levels and new technology emerging, demand for electric vehicles has increased. Turkey, with its technological advancements and investments in electric vehicles, is observed to be following the global electric vehicle market. In this study, the electric vehicle development process in Turkey was assessed, as was the distribution of existing charging stations for businesses and domestic vehicles.

Keywords: Electric Vehicle, Charging Station, Combustion Engines, Domestic Electric Vehicles, Electric Vehicles Market

Türkiye'de Elektrikli Araç Teknolojisinin Gelişiminin Güncel Durumu

Öz

Ulaşımında kullanılan içten yanmalı araçların çevreye verdiği zarar, fosil yakıtların azalması, benzin ve dizelin yüksek maliyetli olması, elektrikli araçlara (EV) yönelik eğilimin başlıca nedenleridir. Elektrikli araçların artışına paralel olarak şarj istasyonlarının da artması elektrikli araçların yaygınlaşmasına katkı sağlamıştır. Elektrikli araçların tarihi araştırıldığında, ilk çalışmaların 1800'lü yılların başlarında başladığı ortaya çıkmıştır. O yıllarda, dönemin koşullarına göre petrol üretiminin artmasıyla elektrikli araçların popülaritesi içten yanmalı araçlara göre azalmıştır. Ek olarak menzil, şarj süreleri ve güç, elektrikli araçların ticarileştirilmesini sınırlamıştır. Küresel ısınmanın endişe verici seviyelere yaklaşması ve teknolojinin ilerlemesi ile birlikte elektrikli araçlara olan talep artmıştır. Türkiye'nin teknolojik gelişmeler ve elektrikli araçlara yaptığı yatırımlarla küresel elektrikli araç pazarını takip ettiği görülmektedir. Bu çalışmada, Türkiye'deki elektrikli araç geliştirme süreci ile mevcut şarj istasyonlarının işletmelere ve yerli araçlara dağılımı değerlendirilmiştir.

Anahtar Kelimeler: Elektrikli Araç, Şarj İstasyonu, İçten Yanmalı Motor, Yerel Elektrikli Araç, Elektrikli Araç Pazarı.

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1. Introduction

In today's world, accessing clean energy is a major problem. The factors leading to this are the rapidly growing population, industry and technology progressing linearly with population growth, and the consequent energy deficit. The use of fossil fuels to close this energy gap has begun to cause irreversible damage to the ecosystem and atmosphere. Considering the transportation sector, it is clear that the trend is toward electric vehicles rather than internal combustion engines. Electric vehicles have been intensively considered as a potential method of decreasing the greenhouse effect. With advancements in power electronics, energy storage, and support, electric vehicles currently offer comparable range and fuel economy to internal combustion engine vehicles. By utilizing optimized control strategies or the energy management system approach, the efficiency of EVs could be greatly increased (Ding et al., 2017). When the history of electric vehicles is examined, it is seen that it has a history of more than 100 years. At the time, issues with battery technology, range, and charging infrastructure caused electric vehicles to be overshadowed by internal combustion vehicles. Alternative technologies were sought in response to the 1974 oil crisis and the effects of air pollution caused by internal combustion vehicles. As a result, General Motors introduced the first electric vehicle at the end of the 20th century (Tuncay and Ustun, 2012). Globally, extensive research has been conducted to assist the integration of the ever-growing number of EVs into the power infrastructure (Calearo et al., 2021). The global growth of investment in electric vehicles and the efforts that have been made to develop electric vehicle technology have impelled Turkey to enter this market. As a result, research was initiated in the 2000s under the guidance of TUBITAK. Even though attempts at electric vehicles were made in this region, including during the Ottoman period, investments in this industry have accelerated significantly in the last 15 years. In this paper, the development processes in the electric vehicle sector of Turkey, domestic manufacturing efforts, and the charging stations that have a direct impact on the spread of electric vehicles are discussed.

2. Domestic Electric Vehicle and Charging Stations of Turkey

To keep pace with the global market, Turkey has begun to manufacture electric vehicles. However, the first appearance of this electric vehicle in Anatolia dates all the way back to the Ottoman Empire. While electric vehicles were successfully promoted until 2000, internal combustion engines were far ahead of the trend. However, the depletion of fossil fuels, rising costs, increased air pollution, and environmental damage caused by these cars have reintroduced electric vehicles to the popular spotlight. The initial attempts in our country occurred in the early 2000s under the supervision of TUBITAK. In 2003, TOFAS Turk Automobile Factory Inc. introduced the Doblo as Turkey's first electric vehicle. ELIT-1 is Turkey's first hybrid electric vehicle, capable of running on both gasoline and electricity. TUBITAK MAM has completed work on hybrid and electric vehicles, as well as electric vehicle subsystems; ELIT-1, FOHEV-1, and Sultan vehicles are also featured. In our country, research on producing electric vehicles and equipment is performed at various universities, either independently or in collaboration with industry (Simay and Ustabas, 2017). Turkey's Automobile Joint Venture Group Inc. was founded in Italy in 2019 to carry out Turkey's

national electric vehicle project. It is aimed at presenting different models to the world automotive market until 2030, with the intellectual and industrial rights of TOGG, which produces SUV and sedan models entirely in our country (Demir, 2020).

The augmentation of charging stations is a significant factor in electric vehicles' having a more active role in our lives. This straight relationship between electric vehicles and charging stations contributes significantly to the appeal of these vehicles. Various organizations, including Esarj, Gersan, Sharz, Voltrun, and ZES, are investing in this area in order to extend Turkey's charging station network and increase the number of electric vehicles on the road. Turkey's investments are concentrated in urban areas, particularly Istanbul, Ankara, and Izmir. The main reasons for the density of investments in city centers are the low battery capacities of the vehicles and the difficulty of intercity travel due to the limited maximum travel distance. Additionally, legislation and regulations constrain corporations who develop electric vehicle charging stations. As a result of the legal sanctions contained in the parking lot regulation, the electric charging station requirement increases the number of charging stations in the city center by encouraging the installation of charging stations in residences and businesses. On the other hand, it has been noticed that the density of charging stations in urban-intercity road networks fluctuates due to the fact that the above-mentioned rule does not include intercity routes. Stations have accumulated in metropolitan areas, as illustrated in Figure 1 (Demirtas et al., 2021). As of 2011, there are just three charging station manufacturers and fifteen charging stations. By the end of 2020, 18 firms will have installed charging stations in 30 major cities and 81 smaller cities, leaving no city without a charging station (TEHAD, 2020).



Figure. 1 Turkey electrical charge stations map for 2022 of Esarj company (Esarj, 2022)

Turkey's electrical charge stations constructed by Esarj is shown in Figure 1. According to the Electric and Hybrid Vehicles Association's (TEHAD) survey, 11 companies have invested in charging stations in our country. The fact that the charging stations that will be added in the coming years will be positioned on the intercity highway network will both alleviate bias against electric vehicles and encourage people to travel without difficulty or discomfort (TEHAD, 2020).

3. Turkish Electric Vehicle Market and the Current Status

Hybrid and electric vehicles have gained popularity in the automotive sector as a result of their lower cost, environmental friendliness, and comfort when compared to internal combustion

vehicles. As a consequence, automobile manufacturers have rapidly expanded their electric-assisted vehicle options, and efforts have been continued in order for Turkey to rise in the global electric vehicle market. In Turkey, the number of 100% electric vehicles sold was less than 500 in 2011, while only 184 units were sold in 2012. In 2013, 31 units were sold only as electric vehicles, followed by 47 units in 2014, 120 units in 2015, and 44 units in 2016. Table 1 details the cumulative sales of electric vehicles over the years (Energy Atlas, 2022).

Table 1. Electric vehicle sales over the years in Turkey (Energy Atlas, 2022)

Year	Sales	Cumulative Sales
Until 2013	184	184
2013	31	215
2014	47	262
2015	120	382
2016	44	426
2017	76	502
2018	155	657
2019	222	879
May 2020	133	1012

In our country, efforts to produce electric vehicles are carried out independently by many institutions and companies. Among the firms that convert internal combustion engine vehicles to electric vehicles are Derindere Motor Vehicles (DMA), Devimsel Teknoloji, Mekantron Engineering Technologies, Renault, BMW, Toyota, Tesla, Mercedes, Jaguar, Mini Cooper, and Audi. With Derindere Motor Vehicles (DMA), the old systems of traditional internal combustion engine vehicles are disassembled and then released to the market after making the necessary connections and integration of the electrical system. DMA is now manufacturing electric vehicles on the Toyota Corolla's new chassis. The modified vehicle has a top speed of 160–200 km and a range of 280–400 km on a single charge. The software and technology used in the vehicle were completely developed by the company [9]. To help illustrate technical data regarding electric vehicles, Table 2 lists the characteristics of electric vehicles manufactured by the DMA.

Table 2. Characteristic of electric vehicles manufactured by DMA (Kocabey, 2018).

DMA Basic	DMA Plus	DMA Sport
Technical Information		
Range		
280 km	400 km	400 km
Motor Power		
62 kW (84 kW max.)	62 kW (84 kW max.)	84 kW (170 kW max.)
Specified Torque		
225 Nm (330 Nm max.)	225 Nm (330 Nm max.)	260 Nm (350 Nm max.)
Energy		
Capacity		
36 kWh	53 kWh	53 kWh
Charging Time		
Lithium-based cells	Lithium-based cells	Lithium-based cells
Performance		
Last Speed		
160 km/h	160 km/h	160 km/h

0-100 Acceleration	0-100 Acceleration	0-100 Acceleration
11.9 second	11.9 second	7.8 second

Companies are making efforts to guarantee that electric vehicles are preferred in Turkey and that they are seen on the roads more often. However, market research has identified an issue with demand for electric vehicles. This is because the charging time is prolonged and the range is limited. According to KPMG's 2018 Turkey Global Automotive Research, the attitude of automotive purchasers toward electric vehicles is encouraging, indicating that electric vehicles will have a significant role in our lives. In Turkey, hybrid vehicles are preferred by 55% of people looking to buy a new car (KPMG, 2018). Companies' investments in charging infrastructure, battery technology advancements, network infrastructure flexibility studies, and various government agencies, particularly municipalities, all contribute to this increase in demand for electric vehicles. These factors gradually reduce the negative impressions of society about electric vehicles (Kumar and Alok, 2020).

4. Results and Discussion

With the increase in the population, the use of fossil fuels has shown the damage caused by these conventional fuels. Furthermore, the reality that fossil fuels are finite has motivated a search for alternate energy sources. Electric vehicles have the potential to outperform internal combustion vehicles by increasing their presence in our lives through variants such as hybrids or all-electric. It aims to enhance the density of electric vehicles by providing metrics that directly influence electric vehicle preference, such as charging times, range, and battery replacement. With substantial progress being made in this field around the world, Turkey is likewise attempting to establish a presence in the electric vehicle market. Among these investigations are the TOGG project for domestic electric vehicle research and building the charging station network between city centers and cities to ensure that purchasers prefer electric vehicles.

5. Conclusion and Recommendations

Worldwide, the electric vehicle market has been activated as a result of the depletion of fossil fuels, increased air pollution, efforts to reduce CO2 emissions under the Kyoto Protocol, and technological improvements. By the 2020s, it is projected that traditional internal combustion engine vehicles will be phased out and replaced by more eco-friendly electric vehicles. This crisis provides us with an opportunity to build a presence in the internal combustion automotive market. Similar to Turkey's success in the defence and security and white goods sectors as a result of technological advancements, it is predicted that the geography in which it is located in the field of electric vehicle technology has the capacity to host a regional vehicle production center and eventually become a significant automotive production center. Additionally, the growth of high-tech commodities such as electric vehicles is viewed as a significant opportunity to reduce our energy-related trade deficit.

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