

Distribution Study of Electric Vehicles Charging Stations in Egypt

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Abstract - The transportation sector in Egypt is one of the most energy consuming sectors, which makes it one of the largest factors causing greenhouse gases. The trend towards spreading and using electric vehicles (EV) is considered a global trend, not just a local one. There are a number of alternatives to improve air quality and reduce the negative impact of fuels. These alternatives include relying on natural gas, importing EV, or localization manufacturing it, or using hybrid vehicles. The localization strategy is based on a set of important pillars, which are the establishment of 1,000 fast electric charging stations annually. This research presents the development of charging stations in Egypt and the current capabilities available.

Key Words: Electric vehicle, battery, charging station, Environmental impact, vehicle manufacturers.

1. INTRODUCTION

In the 21st century, EV charging station technology is experiencing rapid and exciting developments. These stations play a vital role in stimulating the transition to electric transportation vehicles and expanding transportation sustainability. In this part, it will explore the evolution of technology and infrastructure for EV charging stations in Egypt. Fast charging and ultra-fast charging technology are among the most important developments in charging stations. These technologies enable drivers to charge their EV more quickly and efficiently, increasing the appeal of it. The 21st century is expected to witness sustained and continued development in these technologies [1].

With the advancement of communications and internet technology, charging stations have been able to connect to power grids and EVs more intelligently. Smart stations can direct drivers to the nearest available charging station and provide information about station availability and charging rates. These technologies are expected to increase the efficiency of using charging stations and reduce their congestion. Charging stations are moving towards using renewable energy sources. Some stations are equipped with photovoltaic (PV) panels and energy storage systems and other use wind energy where wind speed available with economic rate to reduce reliance on electricity generated from fossil fuels. This drive towards sustainability will be an important part of the development of charging stations in the future [2-3].

Battery technology is the key in the development of charging stations. The 21st century is expected to witness significant improvements in battery performance and increased capacity, which will enable drivers to take longer trips without the need for frequent charging [4].

The spread of EV in Egypt began since the decision of the Minister of Trade and Industry in March 2018 to exempt customs duties for used EV imported from abroad, provided that they are not more than 3 years old. Since that time, interest in EV charging stations began [5]. The report of the Egyptian Association for Compulsory Vehicle Insurance, in cooperation with Traffic Department and Al-Ahram newspaper, dealt with the number of EV in Egypt that were licensed in the period from July 1, 2021 until April 30, 2023, total of 2,333 including 1,692 new private cars. This means that the number of EV that were licensed in April is comparable with March, 65 EV increased [6]. In the period from July 1, 2021 to July 1, 2023, the report said that during these two years, 2,618 EV were registered, including private, transport, and others, of which only 1,933 were private EV. The association reported that the month of July witnessed the licensing of 145 EV, an increase of 30 EV compared to June of this year. The Volkswagen brand occupied first place for licensed EV during this aforementioned period after licensing 43 cars. The Chinese BYD cars came in second place with 12 cars, and BMW ranked third with 7 cars.

2. Distribution of EV in Egypt

Because using less fossil fuel results in less gas emissions, interest in EV has grown significantly, making them a popular mode of transportation. It is anticipated that as technology in the battery sector advances, the usage of EV will become more prevalent.

Egypt's particular mix of conditions favors the growth of the EV industry. The nation has a dense population, especially in its cities, which exacerbates traffic and pollution. These issues can be resolved by using EV, which lower emissions and enhance air quality. Egypt also has a large potential for renewable energy, especially solar and wind energy. This offers a chance to combine the environmental advantages of EV with those of renewable energy sources. The government's initiative to encourage the use of EV is one of the major developments in Egypt's EV sector. To promote the purchase and usage of EV, the Egyptian government has put in place a number of incentives and legislation.

Transport traffic in Egypt accommodates many EV from major international manufacturers. A number of automobile manufacturers, such as BMW, announced plans to import EVs into the Egyptian market. Table (1) shows the ranking of EV in Egypt till July 2023.

Table1: The ranking of EV in Egypt

No.	Type	Model	Quantity	Total
1	VW	ID4	227	
		ID4Cross	171	
		ID4X	159	
		Id6	153	710
2	Tesla		162	162
3	BMW	I3	70	
		IX	14	84
4	Mercedes	Icos 580	30	
		Icos 450	28	58
5	Porches	Tican	13	
		TicanS	21	
		Tican Turbo	18	52
Rest of others EV types			867	
Total of private EV			1933	
Total of all EV types			2618	

The Egyptian government has indicated that it plans to create an e-mobility strategy to encourage the usage of eco-friendly cars on Egyptian roadways. The Ministry of Electricity and Renewable Energy is leading an interagency effort to create an electric charging strategy that will coordinate the installation of charging infrastructure with the growing demands of EV sales.

The present Egyptian government plan is centered on producing them domestically in order to reduce costs and boost profits. Furthermore, it intends to exclude EV imports and solely offer financial incentives for EVs produced domestically. This strategy has multiple drawbacks. First off, not all consumers find EV appealing, and their market share is now quite small.

The association later indicated that the number of EV in Egypt that was licensed in the period from July 1, 2021 to August 31, 2023 reached 3,028 EV, and that the number of EV during August reached 265 units. Distributed as follows in descending order: Volkswagen is 53, Tesla is 22, Mercedes is 14, BMW is 13, Honda 13 and remaining units other models.

Table 2 shows the total number of licenses per month for all types of vehicles and Table 3 shows the distribution of licenses for the EV companies.

Table 2: Total EV licensed / month at 2023

Month	April	May	June	July	Aug.
No	65	73	115	145	265
Month	Sep.	Oct.	Nov.	Dec.	
No	184	481	333	427	

Table 3: EV types licensed / month at Sept.-Dec. 2023

Month	Sept.	Oct.	Nov.	Dec.
VW	42	114	136	196
Mercedes	14	21	33	35
BMW	10	23	31	29
Tesla	10	109	22	22
Honda			81	
Porches			16	28
MCV		7		
BYD	20			36
Others	88	48	14	13
Total Private EV	184	322	319	359
Total all types	184	481	333	427

From tables 2 and 3 it is clear that in average about 400 EV are licensed / month and this number increasing gradually.

3. Charging of EV

One of the most important factors affecting the spread of EV, in the view of many owners, is the method of charging and the length of time it takes, which makes them see it as an illogical choice in some circumstances, especially when compared to gasoline cars. The limitations of battery technology are one of the main obstacles to the widespread use of EVs. The present battery design for EVs has a poor energy density, which impacts the vehicle's driving range [7].

3.1 Charging Duration

EV can be charged at home or at any public charging station. EV can be fully charged in just 30 minutes, or it may take up

to half a day. The time required can also change depending on the size of the battery or how fast the charging point is.

The time required for charging depends on two basic factors. The first factor is the capacity of the EV battery and the second factor is the power of the charger. The capacity of EV batteries is measured in KWh, and the larger their capacity, the time required for charging them is longer. As for chargers, there are multiple levels, the first operates with AC of 2.7 KW, and the majority of EV supports this amount of power as standard, while charging with this power may take between 14 and 17 hours.

It is possible to install a home unit that operates with AC with a power of up to 11 KW. The charging time with this option ranges between 7-11 hours depending on the type of EV and the battery capacity [8].

At January 2024 the Chinese company Nio has developed a battery for EV that operates for a range of 1,000 KM. This battery will enter production in April 2024. It was used in the ET7 EV for a distance of 1,044 KM before it needed to be recharged. A separate test was conducted on the battery and it covered 1145 KM.

There are some charging stations operating with AC with power of 22 KW, which significantly reduces charging time, while some EV support DC for fast charging with a power up to 50 KW. Here, on average, EV needs about half an hour in order to charge between 90% and 100% of the battery. While other stations has charging capacities reach 100 KW or more. Most companies calculate the charging time for their EV based on, how it takes between half an hour and 45 minutes to charge the battery from 10% to 80% [9].

3.2 EV Charging Cost

Infinity, a company working in the field of renewable energy solutions, announced the start of implementing EV charging tariffs at all charging stations in Egypt, starting 28 June , 2022. The charging tariff for AC, up to 22 KW starts from 1.89 pounds /KWh. To calculate the charging cost, this value is multiplied by the battery capacity. There is a choice higher than 22 KW and its cost is estimated at 3.75 pounds /KWh.

3.3 Charging Speed

Due to the limited power cell performance of EV drivers endure a short cruising range and a long charging time. Additionally, uneven charging facilities and unreasonable charging arrangements result in partial queuing and partial idling of charging stations. To solve these problems, it is critical to understand EV charging behavior and its influential factors. There are five main factors that affect the charging speed of EV [10].

1- Battery size: the larger the battery capacity, the longer it takes to charge.

2- Battery status (empty vs. full).

It takes longer to charge an empty battery than to charge it when it is half full.

3- The maximum charging rate of EV.

The charging speed is limited to the maximum charging rate of the EV, so it can't charge faster even at a charging point with a faster charging speed rate.

4- The maximum charging rate of the charging point.

The charging speed is also limited to the maximum charging rate at the charging point that is available, and therefore it is not recommended to charge at a charging point with a charging rate lower than the charging rate of EV.

5- Weather.

It is obvious that all of the batteries do have a lack of capacity at low temperatures.

Therefore it is important to carefully choose the battery for an application, keeping in mind that there is a lack of performance at temperatures different to normal temperature. Charging time tends to be longer at low temperatures (below 20°C), especially when using a fast charger. Also, EV is less efficient at low temperatures (below 20°C). So it cannot add much to the travel distance depending on the charging time.

The infrastructure that serves EV is an essential factor in encouraging buyers to acquire it. Electric power chargers around the world 70% are located inside homes, but 30% can charge on highways or within cities.

4. EV Charging Stations in Egypt

The two largest EV charging companies in Egypt are Infinity and Revolta. Infinity is the first and largest company in Egypt that provides EV charging services. The company began its work three years ago in establishing EV charging stations in Egypt. The company obtained its first license in April 2022 to establish rapid electric power stations within cities. Infinity has more than 90 charging points located on all major travel routes in Cairo, Alexandria, Hurghada, Ismailia, and Ain Sokhna, and on highways reaching Hurghada, Sharm El Sheikh, and Ain Sokhna. The company hopes to expand its charging stations to reach 200 stations this year, then to 300 stations next year, located in gas stations, residential complexes, and commercial malls.

There are more than 120 charging stations around Cairo. The largest amount is found in the areas of New Cairo and its environs, 6th of October, and Sheikh Zayed, and most of it is distributed among commercial and residential complexes and gas stations [11,12]. All charging stations in Egypt mentioned in Appendix.

5. Conclusions and Future Plan

There are nowadays 4,000 EV in Egypt, and it cannot consider that there is a market for it before this number reaches 15,000 or 20,000 units.

There are many EV producing companies operating in Egypt but the most common and widespread EV in Egypt is Volkswagen and Mercedes. There are also many companies working in the field of charging EV in Egypt, and the study showed that the two largest EV charging companies in Egypt are Infinity and Revolta. All charging stations are AC i.e. slow charging, while several DC charging stations i.e. fast charging under erection at the moment. The most stations that have an electric charger are Chill out and Watania then the rest of the stations are in small numbers. In addition, many residential communities and social clubs have charging points. All charging points and stations are fed from the electrical network; therefore come the importance of feed the stations with renewable energy such as solar energy and wind energy at north coast and Red sea coast where wind speed is economic. It is a qualitative shift of utmost importance because of its effects on the environment and the loads on the network. The future plan for charging stations targets 1,000 stations next year and year after 3,000 stations, which is enough for 60,000 EV. As the number of EV increases, the stations can be increased, between 1,000 and 3,000 stations annually.

It is also expected that the number of charging stations for EV in Egypt will increase by 2025 to be 5,000 charging stations.

Stations will be deployed on the Corniche, the Ring Road, the Mehwar, the Cairo-Alexandria Desert Road in October, Zayed, the mall areas, the Smart Village, residential complexes, the Banha Free Road, the Cairo-Ismailia, 10th of Ramadan Road, in addition to stations in front of Shorouk, Obour, near Mostaqbal City, May, and Helwan. The map of the new stations also witnesses the deployment of stations on El Alamein Road, the Coast Road, the International Coastal Road, Dabaa, the Pyramids Area, Al-Remaya, Mariouteya, Al-Haram Street, Faisal Street, Al-Omraniyah Street, and Nile Street.

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Appendix

Locations of charging stations in Egypt

A) EV charging stations in Cairo

1 Nile City Towers - Revolta, Nile Corniche - Boulaq

2 Skoda Smart Service, Taraat Al-Jabal Street, Hadayek Al-Qubba

3 Infiniti, Sikkat Al-Waili Street, Hadayek Al-Qubba.

4 Revolta 3 Kamal Al-Abbasiya Al-Gharbiyya, Al-Wayli

5 Holiday Inn - City Stars, Ali Rashid Street - Heliopolis - Mohandiseen Housing

6 City Stars-Infinity Gate "No. 1" Nasr City

7 City Stars - Infiniti Gate "No. 2" Nasr City

8 Blu Radisson Hotel, Abdel Hamid Badawi Al-Thawra Street, Al-Nozha

9 Ankara Street - Revolta. Sheraton Airport, Qesm El Nozha

10 Mirage Mall Al-Rehab and Investors, East Nasr City,

11 Al-Rehab Shell, Abu Hanifa Al-Numan, east of Nasr City

12 Oil Libya, First Settlement - Al-Rehab

13 Oil Libya, Fifth Settlement, Camombed, Yossi Mas

14 Oil Libya Industrial Zone, Fifth Settlement

15 IKEA Mall, Mubarak Youth Housing, first in New Cairo

16 Al-Narges gas station from Mubarak Housing to Al-Shabab and from the beginning of New Cairo

17 Al-Wataniya Station - Revolta, Palestine Street, East Katameya - Industrial Zone, Al-Basateen and Dar Al-Salam

18 National-Revolta Al-Abajiya, Al-Khalifa and Mokattam stations

19 Wataniya Station - Carrefour Maadi Revolta No. 50 Zahraa El Maadi El Basateen and Dar El Salam

20 Castle Square, Autostrad Road, Al-Khalifa and Mokattam

21 Arkan Al Bustan Mall

22 Triumph Hotel - Revolta, Al-Khalifa Al-Maamoun Street, Heliopolis

23 Al Taawun Station - Infiniti, Salah Salem Street, Stadium, Egypt City

24 City Center Almaza - Infiniti Sheraton Airport, Qism El Nozha, Cairo.

25 Chillout Infinity Station, Ramses Extension Street, Al Moshir Axis.

26 Chillout Infinity Station, Ramses Extension Street.

27 Chillout station. - Infiniti 19, Martyr Axis, 10th District, Nasr City,

28 Chillout station. - Infiniti, Al Taqa Street, Al Ahly Club, Nasr City

29 Chillout Station - Infiniti Railway Club, Second Section, Nasr City.

30 Chillout - Infinity Station.. 496 Sheraton Airport, Nozha

31 National Station - Infiniti, 10th District, Nasr City

32 Carrefour - Revolta Carrefour station, Maadi, El Basateen, Dar El Salam, Cairo

B) Charging stations in Giza

1 Pyramids Suites Hotel, 60 Mourad St

2 Four Seasons Hotel 37-38 Mohandes Salah Amer Street

Charging stations on 6th of October

3 AAA Shell Abu Rawash store, 6th of October

4 Al Gezira Square Mall, 6 October

5 Gallery Mall 40 Sheikh Zayed, Al Haram, 6th of October

6 Chill Out Gas Station Khamayel 1

7 Chill Out Gas Station Khamayel 2

8 Chill out Desert Gas Station

9 Chill Out gas station next to Galleria 40

10 Chill Out gas station next to Mall of Arabia

11 Chill Out Waslet Dahshur Gas Station

12 Chill Out gas station near Cityscape

13 Chill Out gas station in Vodafone Square

14 charging stations in New Giza

15 charging stations in New Giza Golf

16 CLUB charging station in Palm Hills Compound

17 GOLF charging station in Palm Hills Compound

18 charging station on 88th Street inside Palm Hills

19 charging stations inside Al Jazeera Plaza

20 charging points before the Cairo-Alexandria Desert Road

21 Al-Bargasy Motors charging point

22 Two charging points Park Street

23 Three charging points inside Capital Business Park

24 charging point on Street No. 12, 13th District, Sheikh Zayed

C) Charging stations in Alexandria

1 Green Plaza Mall, behind the Astros, Sidi Gaber

2 Hilton Kings Ranch Nubaria Hotel, Alexandria

3 Moto Cafe and Restaurant at the end of the Taamir axis

4 Charging station 581 Army Street - San Stefano

D) Charging stations in Suez

1 National Station, Ain Sokhna Road, Ataqa

2 Al-Nasr National Station, Hurghada

3 National Station Road to, Suez

4 Wataniya Station, Maadi - Dove Jandali – Katameya

E) Charging stations in Beheira Governorate

1 National Station 107 across the Alexandria desert to the lake

2 Al-Wataniya Station, Egypt-Alexandria Desert Road, South Mashreq

3 Darshel, Omar Oasis, Desert Road, Dalangat Center, Lake

F) Charging stations in Sharqia, Dakahlia, and Qalyubia Governorates

1 Shell branded store Belbeis - Cairo Road, Belbeis

2 Infinity charging station, Mansoura - Dakahlia Governorate

3 Shubra Banha Al-Hur Road charging station, Toukh

G) Charging stations in the Red Sea

1 Saffron Desert Lodge Ras Gharib, Red Sea

2 National Gas Station, Ras Gharib District, Hurghada,

3 Shell branded store Hurghada, Red Sea