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Electric Vehicle (EV) Accident and Charging Problems in Kuwait and the GCC Countries

Jasem Alrajhi[1], N. Alhaifi[2], Jasem Alazmi[3], Farraj Aldaihani[4], Khaled Alhaifi[5]

[1,2,3,4,5]Automotive & Marine Engineering Technology, College of Technological Studies
PAAET (Public Authority for Applied Education & Training) -Kuwait

ABSTRACT

Electric vehicles (EV) have emerged as a modern innovation to combat the emission of greenhouse gases (GHG) in the transportation industry in addition to the aesthetics and functionality benefits associated with these vehicles. This article examines the current status of the EV infrastructure in Kuwait and the Gulf Cooperation Council(GCC) countries. The adoption of EVs is influenced by design aspects such as functionality and safety, infrastructure and policy, and social aspects such as consumer perceptions and preferences. Accordingly, this article explored EV accidents in Kuwait compared to other GCC countries and the challenges faced in charging EVs in the GCC region. The paper utilized primary and secondary data collected by transport departments and other relevant authorities on the status of EV adoption in the GCC countries. Data analysis involved a comparison of the commonalities and differences in EV charging issues. There was insufficient data available to compare EV accidents between Kuwait and other GCC countries. Recommendations emerged for improving safety and reducing EV accidents in the GCC including improving road quality, education of drivers on safe driving and avoidance of unsafe speeding, expansion of charging infrastructures, and encouraging public and private sector collaboration to support EV adoption.

INTRODUCTION

Electric vehicles (EV) have emerged as a modern innovation to combat the emission of greenhouse gases (GHG) in the transportation industry. EVs use electric power derived from acid or nickel metal hydride batteries, lithium-ion batteries, or other sources for propulsion. Unlike vehicles in the petroleum-based transportation infrastructure, EVs are clean as they have no GHG emissions (Alhaifi et al., 2023). In 2021, the global sales of EVs reached 6.6 million. The U.S. and China have the highest share in the EV sector (about 65%), followed by Europe (23%) (Rajper& Albrecht, 2020). A high proportion of available research on electric vehicles comes from the regions with high EV shares. Other countries and regions such as developing countries and the Gulf Cooperation Council (GCC), are actively invested in increasing their EV numbers. There is, however, considerably less information available on the status of electric vehicles in Kuwait and the GCC countries in general (Alhaifi et al., 2023). This article seeks to contribute to the literature and examines the current status of the EV infrastructure in Kuwait and the GCC countries.

Research Question and Objectives

The adoption of new technologies such as EVs is influenced by design aspects such as functionality and safety (Zhang et al., 2018), infrastructure and policy, and social aspects such as consumer perceptions and preferences (Ottesen & Banna, 2021). Since EVs rely on electric power, the availability of charging infrastructure is an important factor in the purchase and use of such vehicles by the population (Zhang et al., 2018). Accordingly, this research project considers two key variables, EV accidents and charging problems related to EVs in Kuwait and the GCC. The research project is guided by two research questions:

1. How prevalent are EV accidents in Kuwait compared to other GCC countries?
2. What are the challenges faced in charging EVs in the GCC region?"

LITERATURE REVIEW

Kuwait is a small Gulf Cooperation Council(GCC) country with a population of roughly 4 million. The country has a rich economy, with nearly 6% of the world's crude oil reserves. Petroleum accounts for 92% of the country's export revenues as well as 90% of government income (Giris & Ramadan, 2018). Due to factors such as low cost of fuel, steady growth in per capita income, and tax-free customs on vehicle imports, Kuwait is recognized as one of MENA's (Middle East and North Africa) most profitable car markets. Kuwait currently has the highest rate of vehicle ownership in the MENA region (Ottesen & Banna, 2021).

The adoption of EVs in Kuwait is an important item in the government agenda given that the country's greenhouse gas emissions per capita is an estimated five times higher compared to the European Union's average and is the second highest in the world after Qatar (Ottesen et al., 2022). The GHG emissions in the country were about 136.69 (MtCO2e) or 32.49 tCO2e/person in 2019. The transport sector is the country's third highest GHG emitting sector, with ground transportation accounting for 12% of the emissions. GHG emissions in the country are driven by industrial development, infrastructure growth, gas and oil activity, and a surging population (Ottesen et al., 2022).

EV Accidents in Kuwait

Kuwait has a superb modern road network and an extremely high rate of vehicle ownership. However, the country hasa very high rate of accidents. The country recorded 71161 accidents, 10305 severe injuries, and 428 road-related deaths in 2017 (Alrajhi et al., 2023). In 2021, there were a total of 9,674 traffic accidents resulting in 323 deaths in the country (Kuwait Ministry of Interior, 2022).

EV Charging Problems in Kuwait

During the summer season, temperatures in the country often are well over 50 °C degrees. The hot climatic conditions require heavy use of air-conditioning, a factor that leads to EV battery depletion, in turn limiting the driving range of EVs in such arid conditions and therefore, their appeal (Kim et al., 2017). Kuwait experiences high traffic speed, infrastructure problems, and bad road conditions which can all affect EVs. Roads are damaged by severe rains in the winter season creating potholes which are bad for EVs as their batteries are generally located at the bottom of vehicles (Ottesen et al., 2022).

Kuwait citizens comprise a quarter of the country and only Kuwait citizens own EVs in the country. Expatriates are not allowed to own real estate in the country and landlords do not allow installation of EV charging boxes on their properties. This limits ownership of EVs by expatriates. There are also no (fast) direct-current charging stations in the country (Banna et al., 2023).

Other GCC Countries

The GCC comprises six countries in the Middle East - Kuwait, Bahrain, Oman, Saudi Arabia, Qatar, and the United Arab Emirates. In the GCC region, EVs comprise less than 1% of all vehicles. The incentives for the adoption of EVs in the GCC region may differ from the considerations in Europe. For example, the cost of driving in GCC countries is lower when using gasoline compared to electricity, unlike the European experience where EVs lead to cost savings of about 8 to 1, electricity versus gasoline (Alhaifi et al., 2023). However, many of the GCC countries are investing in EVs, especially due to their support of reducing global GHG emissions among other EV adoption factors such as design, social perceptions, and other consumer-centric considerations. The market size for EV s in the GCC as a whole is US$3.66 billion with the market size projected to reach US$8.75 billion by 2028 (Mordor Intelligence, 2023).

Accidents in GCC Countries

There is relatively little information related to the status of electric vehicles in GCC countries. This may be explained by the fact that the rate of adoption of EVs in the region is still low – less than 1% adoption (Alhaifi et al., 2023). Like in the case of Kuwait, differentiated data on EV accidents in GCC countries or region is not available.

Charging Problems in GCC Countries

As in other areas of the world, there needs to be an efficient electricity distribution grid to serve the needs that require electric power. Erratic power supply will affect the ability of EV owners to charge their vehicles and use them optimally (The World Bank, 2023). Reconfiguration of existing distribution grids may be necessary in order to meet EV charging requirements (Mordor Intelligence, 2023).In hot weather, significantly higher energy demands are imposed on vehicle batteries as the battery storage system has to power all the BEV functions, including accessory and traction loads, as well as power the cooling function.In the areas of the world with hot summer temperatures, as obtained in the Middle East and North Africa region, there are increased cooling loads for Battery Electric Vehicles (BEVs), leading to decreased driving ranges for these vehicles (The World Bank, 2023).

The GCC region currently does not have a standardized EV charging system, making it challenging for EV owners to use charging stations both within their countries and in different countries. EV charging stations need to be set up at optimal locations to facilitate the optimal performance of EVs. The combined scarcity of charging stations and the resultant limited range of EVs can create range anxiety for both EV owners and potential EV buyers, ultimately limiting the adoption of EVs in the region (Research and Markets, 2023). Lastly, there is limited public funding available to fund EV charging infrastructure in the GCC, although some governments have initiated public-private partnerships to support the deployment of EV charging stations (Markets and Research, 2023).

Charging Infrastructure in Kuwait and the GCC

A complete EV charging infrastructure comprises power infrastructure, charging ports and connectors that meet various standards, and control and communication infrastructure (Mastoi et al., 2022). An efficient charging infrastructure requires an optimization unit to support quick charging and reduce charging time, an effective communication or

information exchange system, and a prediction unit to support the decision-making function of the optimization unit (Mordor Intelligence, 2023).

Kuwait
The literature reveals that demand for EVs in Kuwait is currently low. In 2019, there were 295 EVs in the country (Alhaifi et al., 2023). Currently, there are 400 EVs registered in the country (Banna et al., 2023). However, the sale of EVs in the country is projected to grow as the country is keen on building a sustainable economy and over 50% of drivers in Kuwait have positive attitudes toward EVs (Alrajhi et al., 2023). Kuwait's EV charging infrastructure is also growing. Currently, there are 14 charging stations in Kuwait with the majority located in the city of Al Kuwait, and Salmiya having the least number of charging stations.

The Kingdom of Saudi Arabia (KSA)
KSA has 13 battery charging stations (Alhaifi et al., 2023). KSA's first commercial charging station was deployed in 2019 in Riyadh. The 13 charging stations in the country have connectors. most of which are Schuko (EU Plug). The charging fee for EVs is not regulated like electricity tariffs. Rather, certified, calibrated meters are installed to measure EV power consumption (in Wh) separately. Charges are thus based on charging time. Saudi Arabia opted for the IEC 61851-24 standard which permits communication between the EV and a fast DC charging station to control DC power flow (Sindi et al., 2021).

United Arab Emirates (UAE)
The UAE presently has a higher adoption rate for EVs compared to Kuwait. There are 4000 EVs in the UAE and 919 charging stations in the UAE (Alhaifi et al., 2023; Sindi et al., 2021). The unit sales of EVs in the UAE are expected to increase to reach 15,070.2 by 2027 while the number of charging stations is expected to increase to 2,267 by 2027 (Alhaifi et al., 2023).

Qatar
Qatar is actively investing in expanding its EV charging infrastructure. In 2022, Qatar had an estimated 1,130 EV units comprising both commercial and passenger EVs (Fitch Solutions, 2023). The country had 100 charging networks in 2022 (Fitch Solutions, 2023), meeting its goals for 2021 (International Trade Administration (ITA), 2021).

Bahrain
The proportion of EV owners in Bahrain is less than 1% of motorists. The country currently lacks charging facilities and maintenance facilities for EVs. However, similar to other GCC countries, the EV market in Bahrain is expected to grow as the country moves towards environmentally sustainable transportation. The country deployed its first charging station in 2021 (Sriraj, 2022).

Oman
The government of Bahrain is investing heavily in electric vehicles and charging infrastructure – several projects have been announced in 2023. However, there appears to be insufficient data on the number of EVs in the country and the number of EV charging stations.

Gaps in the Literature
There is limited literature on EVs in the GCC countries in general, perhaps due to the fact that adoption of the technology is still relatively low compared to the Western countries and China. There is limited literature on the number of EVs, trend in EV growth, number of EV accidents, and challenges related to EV charging in the region. This study will, therefore, coalesce available data to present what is currently known and the state of the literature on these issues.

METHODOLOGY

The paper utilized primary and secondary data collected by transport departments and other relevant authorities on the status of EV adoption in the GCC countries.
Data Analysis

Comparison of EV Accident Rates
The Kuwaiti Ministry of Interior collects data on types of traffic accidents (collisions, trampling, overturning, and others) as well as types of consequences (death, serious injury, minor injury); however, these accidents are not categorized based on the type of vehicle whether EVs or other. Thus, there is currently no publicly available data on EV accidents in Kuwait. The Ministry also collects data on the number and types of vehicles operating in Kuwait (such as buses, taxis, motorcycles, and trucks) – EVs were not included in the currently available public data. EV Accident rates for other GCC countries are also not available.

A very basic extrapolation may be made from 2021 data. In 2021, there were 295 EVs in the country. In 2021, there were 9,674 road traffic accidents in Kuwait. From the low numbers of EVs in the country, EV involvement in these accidents would be very low considering the fact that there are over 2 million vehicles in the country.

Commonalities and Differences in Charging Issues between Kuwait and Other GCC Countries

Charging Issues	Kuwait	Other GCC Countries
Impact of hot climate – Increased battery load leading to reduced EV range.	Same	Same
Impact of poor roads – EV batteries are located at the bottom of the vehicle. Driving over potholes and very rough roads leads to negative impacts on the car and batteries.	Same	Same
Scarcity of or limited numbers of charging infrastructure	Same • The rate of deployment of charging infrastructures aligns with the number of EVs in operation and the government is working towards expansion of the charging infrastructure.	Same • Same.
Limited ownership of EVs – Since expatriates who comprise 70% of the population cannot own real estate, they cannot install charging boxes at their residence.	Only Kuwaiti nationals own real estate and can install charging boxes on their properties.	Unclear if this applies anywhere else in the GCC.
Limited availability of public funding	Unclear if this applies to Kuwait specifically.	Applies to the GCC region in general.
Lack of standardized charging system	Unclear if this applies to Kuwait specifically.	Applies to the GCC region in general.

Comparison of Current EV Status in the GCC Countries

Country	Number of EVs (year)	Number of EV charging stations (year)
Kuwait	400 (2023)	14 (2023)
KSA	71,209 (2023) (13,958 imported in 2022 and the rest in 2023)	13 (2023)
Qatar	1,130 (2022)	100 (2022)
Bahrain	N/A (Less than 1% of all motorists)	N/A
Oman	N/A	N/A
UAE	4000 (2023)	919 (2023)

From the current data, KSA is the GCC country with the highest number of EVs, followed by the UAE, Qatar, and Kuwait. The KSA's EV fleet is comprised bylargely of recent imports and the country is working towards building a corresponding charging infrastructure.

Recommendations and Conclusions

Linear comparison of the number of EV accidents in Kuwait versus the GCC region was not possible since there is no publicly available data on the number of EV accidents in the country or any of the GCC countries, or for the GCC region. However, there is a possibility for EVs to be involved in accidents due to factors such as bad road surfaces and high speed.

Based on the findings of this study, the following recommendations for improvements to the charging infrastructure in Kuwait and the GCC countries emerge:

- A standardized EV charging system in the GCC region will make it easier for EV owners to charge their vehicles within their countries and in different countries.
- It is important to set up EV charging stations at optimal locations to facilitate the optimal performance of EVs.
- Given the limited public funding for EVs in the GCC, governments should implement or expand policy frameworks to promote EV adoption such as the provision of subsidies to owners and other financial incentives.
- Collaboration between the private and public sectors should be encouraged in order to create strong EV charging infrastructures within countries.
- Reconfiguration of existing distribution grids may be necessary in order to meet EV charging requirements.

As countries expand their EV numbers, the potential for EV accidents to occur will increase. Based on the findings from the research, a set of recommendations also emerged under safety measures to reduce EV accidents:

- Improving the condition of roads (eliminating potholes and improving road surface quality) will greatly reduce the risk of accidents involving EVs.
- Emphasizing safe driving (avoiding unsafe speeding) among EV owners will also contribute to road safety.
- EVs must be maintained carefully by owners to avoid mechanical, electrical, or even technological failures that may lead to accidents.
- Charging stations must be used carefully and charging boxes installed with care to prevent any malfunctions or unsafe events.

In conclusion, there are important benefits and challenges to adopting EVs in the GCC context. High EV adoption will help countries to reduce GHG emissions. The use of clean energy means that countries will also derive gains in public health through improved air quality. EVs are also fast, luxurious, and modern, delivering benefits in functionality, social positioning, and the enjoyment of new technologies and gadgets that are incorporated into these vehicles. There are challenges that must be overcome, however, in adopting EVs in the Gulf region. These include finding strategies to navigate the cost-effective use of EVs in the hot climate, building effective charging infrastructures, and assuring high road quality.

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