TEXAS A&M
UNIVERSITY at QATAR

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PROJECT ONE: Problem Statement

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Scarcity of EV Staions in Qatar

I. Abstract

Once all sections are complete, Yousif must write the Abstract, a 150–200-word summary that restates the central problem, the research approach, the evaluation of solutions, and the final recommendation. The abstract must be written neutrally, but it should reflect the logical flow from the Problem Statement to the Project 2 findings — exactly what your professor expects.

II. Introduction

Al-Anoud is responsible for writing the entire Introduction of the technical report, which must clearly restate the central problem exactly as defined in your Project 1 Problem Statement. Her introduction should open by placing Qatar's transportation challenges within the larger national transformation described in Qatar National Vision 2030, emphasizing the environmental development pillar that requires reducing emissions, conserving resources, and promoting cleaner mobility. From there, she must explain the significance of EV adoption as part of Qatar's sustainability goals and use verified national data — such as KAHRAMAA's installation of approximately 200 stations and the Ministry of Transport's targets of 600 stations by 2025 and more than 1,200 by 2030 — to contextualize the issue. She must also incorporate the key findings from the Problem Statement PDF: that only around 100–150 chargers are reliably accessible (CITAEVCharger, 2025) and that 78% are concentrated in Doha, creating geographic inequities and discouraging early adopters.

Her introduction must then link Qatar's situation with global and regional comparisons using sources cited in Project 1, such as the International Energy Agency's Global EV Outlook, Roland Berger's GCC EV Charging Index, and studies noting that countries such as the UAE, China, and Norway have expanded dense, well-distributed charging networks. By integrating the literature cited in the problem statement, including Al-Shaiba et al. (2023) on unequal charger distribution, Ajel (2023) on regional EV trends, and Deshmukh et al. (2024) on voltage instability risks she must demonstrate that Qatar's issue is not just a shortage of chargers but a deeper structural problem involving grid readiness, spatial inequality, and slow infrastructure expansion. Her introduction must conclude by defining the central engineering challenge for Project 2: that Qatar needs not only more charging stations, but strategic planning, optimized placement, and solutions that respond directly to the infrastructural and socio-technical gaps identified in the problem statement.

In addition, Al-Anoud is responsible for building the final APA References page at the end of the report. She must collect all citations used by every team member, ensure formatting consistency, and include the full list of scholarly articles, government documents, mapping sources, and media references from both the problem statement and the new research used in Project 2.

III. Methodology

To investigate possible solutions for improving Qatar's electric vehicle (EV) charging infrastructure, our team used secondary research based on credible government reports, academic studies, and real-time mapping tools. We began by returning to the gaps identified in our problem statement, such as the limited number of functioning public chargers, the uneven distribution of stations, and the electrical risks associated with unmanaged EV charging (Deshmukh et al., 2024; CITAEVCharger, 2025). Because Qatar does not publish large public datasets on EV charging usage, we relied on official documents from KAHRAMAA and the Ministry of Transport to understand Qatar's national goals and current progress. The Tarsheed Smart EV Charging Platform provided information about the country's installation efforts and expansion plans (Ministry of Communications & Information Technology (MCIT), 2024). These sources helped us compare the difference between the number of chargers announced and those that are actually available to the public, which is one of the main issues highlighted in Project 1.

To verify this gap, we used mapping tools like CITAEVCharger and Electromaps, which showed the real locations and accessibility of EV chargers across Qatar. This step was important because it confirmed that the majority of chargers are concentrated in Doha, leaving suburban and industrial areas an issue that was previously discussed in the literature (Al-Shaiba et al., 2023). Mapping data also helped us understand how many chargers were active, how many were offline, and how they were distributed geographically. This supported our understanding of why Qatar's charging network feels insufficient to many users despite having around 200 installed stations (The Peninsula Qatar, 2024).

We also conducted a detailed academic literature review to understand the technical and environmental challenges associated with different charging solutions. For example, Deshmukh et al. (2024) examined the risks of voltage drops and transformer overloading under uncontrolled charging conditions, which helped us evaluate solutions based on their potential impact on the grid. Al-Wahedi and Bicer (2020) discussed hybrid renewable-based charging models and explained why solar-powered stations could reduce pressure on the national grid, although they may face high upfront costs. Additional studies showed how charger distribution affects user acceptance, especially when most stations are concentrated in high-end areas (Al-Shaiba et al., 2023). Reviewing these studies helped us understand the technical, social, and environmental dimensions of the problem.

After gathering all the data, we developed a criteria system to fairly evaluate each proposed solution. The criteria were directly connected to the issues highlighted in Project 1. For example, scalability was included because Qatar aims to significantly increase EV adoption by 2030 (PwC Middle East, 2025). Sustainability was included to reflect QNV 2030's environmental goals (General Secretariat for Development Planning, 2008). Technical feasibility and grid impact were included because several studies warned about voltage instability and transformer loading (Deshmukh et al., 2024). Cost-effectiveness and user accessibility were added because these factors determine whether a solution can realistically work in Qatar. Using these criteria, we created a decision matrix where each solution: Solar-Powered EV stations, portable fast-charging units, and the Esh7an smart optimization system was scored on a consistent scale. This allowed us to compare them objectively and determine which option best fits Qatar's needs.

IV. Results

Our research focused on understanding how three different solutions could help improve Qatar's current EV charging network. The main goal was to see how each option addresses the specific problems we discussed in our problem statement, including limited accessibility, uneven charger distribution, and pressure on the grid. To do this, we collected information from government reports, published research, and real-time mapping platforms, and then matched those findings with Qatar's actual needs. Below is a summary of what we found for each potential solution.

Three possible solutions were identified to promote a stronger, more sustainable EV charging system across Qatar.

1. Solar-Powered EV Charging Stations (Long-Term Solution)

Solar-powered EV charging stations use photovoltaic panels to generate electricity that can power EV chargers. They are especially practical for Qatar because of the country's extremely high sunlight levels throughout the year. This makes solar energy one of the strongest long-term options for supporting the increasing number of EVs on the road. Research from Qatar shows that combining solar power with battery storage can reduce strain on the national grid and create a more stable charging system, which is something Qatar needs as EV adoption grows (Al-Wahedi & Bicer, 2020).

This solution directly responds to two of the problems we highlighted earlier: the need for more sustainable charging options and the pressure that fast charging puts on the electrical grid. Solar stations allow part of the load to be supported by renewable energy instead of relying fully on KAHRAMAA's grid. At the same time, there are challenges. Heat, dust, and humidity can reduce panel performance, and the systems require open space for installation. These limitations were discussed in other studies as well, especially those focused on renewable integration in Gulf countries (Maher et al., 2025). Even with these constraints, solar-powered stations remain a promising long-term solution for Qatar because they help meet the goals of the Qatar National Vision 2030 while reducing emissions and diversifying the energy mix.

Figure 1- Visual of Solar Powered Netwrok (*Kahramaa*, 2024)

2. Portable Fast-Charging Units (Short-Term, Flexible Solution)

Portable fast-charging units are mobile chargers that are usually placed inside a modified shipping container that can be moved and installed wherever they are needed. This makes them a good short-term option for Qatar, especially because many chargers today are concentrated in Doha while other regions have little or no access. Portable units can be deployed quickly in areas with sudden demand, during events, or in emergency situations, and they do not require the same level of construction as permanent stations (Luobinsen Global, 2024).

These chargers help address one of the biggest problems identified in Project 1: the lack of chargers in suburban and industrial areas. Because portable chargers can be moved around, they allow temporary coverage until more permanent stations are built. They also support situations where the existing grid may not be ready for a full installation. However, research also shows that portable units are not intended to serve as a permanent solution because their batteries require frequent maintenance, and extreme heat can affect their reliability. Portable fast-charging units have been implemented in several countries to provide flexible, temporary charging capacity. One example is the Power Up mobile charging truck used in the United States, which demonstrates how container-based or vehicle-mounted chargers can be rapidly deployed during emergencies or in areas lacking permanent infrastructure. The image below serves as a reference for the type of short-term solution our research considers. (Mullen Automotive, 2024)

Figure 2- Visual of a Portable Fast-Charging Truck Used in the United States. (Mullen Automotive, 2024)

3. Esh7an: Smart EV Optimization System (Digital Planning)

The third solution is Esh7an, the digital optimization system developed by our team. This system was designed specifically for engineers and planners who work on EV infrastructure in Qatar. The main idea behind Esh7an is to use real data from Tasmu/Kahramaa and combine it with GIS mapping and AI prediction models. This allows planners to see exactly where chargers are needed, how demand is changing, and whether the surrounding electrical grid can handle new stations.

One of the strongest functions of Esh7an is its ability to help with station placement. Qatar's problem is not only that chargers are limited; it is also that most are clustered in the same areas. With Esh7an, engineers can identify underserved regions, compare them with traffic patterns, and make more strategic decisions about where to install new chargers. This directly responds to the geographic inequality problem we identified in our problem statement.

Another important feature is load redistribution. Using the data provided through Tasmu, Esh7an can detect stations that are underused and stations that experience high demand. It then recommends shifting electrical load from low-demand areas to high-demand ones whenever technically possible. This improves efficiency and reduces the risk of overloading transformers, an issue highlighted in several studies about grid impact in Qatar (Deshmukh et al., 2024). Overall, Esh7an offers a scalable digital solution that improves planning, reduces wasted investment, and supports Qatar's goals for sustainable transportation.

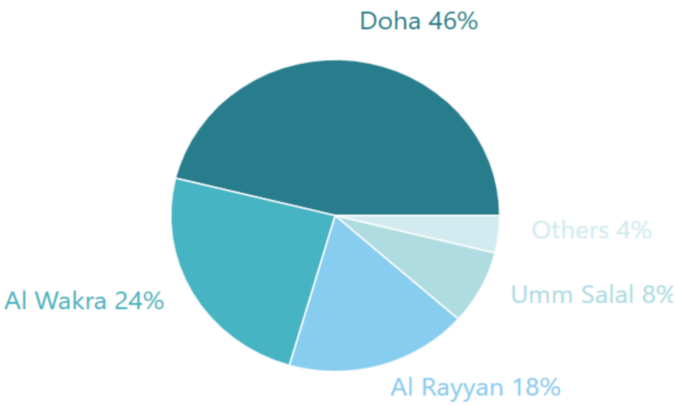

Figure 3- Current EV charging station distribution by municipality in Qatar (Esh7an Prototype Dashboard).

V. Analysis

After comparing our three solutions Solar EV Network, Portable Fast-Charging Units, and the Esh7an Smart EV Optimization System we used a decision matrix, as seen in ***Table 1,*** to evaluate each one based on four criteria from the Qatar National Vision 2030: Human Development, Social Development, Economic Development, and Environmental Development. Each solution was scored on a 1–10 scale, where 1 represents minimal contribution and 10 represents strong alignment with national development goals.

Human Development:

For human development, we looked at how each solution helps people gain skills and supports future knowledge in the country. We gave the Solar EV Network a 7 because it requires workers who understand solar energy systems, and this helps build experience in renewable technologies. Portable fast-charging units also earned a 7. since they need technicians for setup and operation, but they do not create long-term learning the way larger systems do. Esh7an scored 8 because it introduces planning tools that rely on data, GIS maps, and forecasting. These skills are important for future engineers and planners in Qatar, so we ranked it the highest in this category.

Social Development:

For social development, we focused on accessibility and how each solution supports different communities. The Solar EV Network received a 7 because it adds more charging stations over time, but installation takes longer and depends on available land. Portable units scored 8, which is the highest here, because they can be moved to areas that do not currently have chargers. They help during emergencies and support drivers in places that are usually underserved. Esh7an scored 9 because it directly helps us understand where the demand is the highest. By using data, it shows where new chargers should be built so that every area is treated fairly. This makes it the strongest option for long-term social impact.

Economic Development:

For economic development, we compared the cost and long-term value of each solution. The Solar EV Network earned an 8 because even though it costs more at the start, it saves money in the long run through renewable energy. Portable units scored 7 because they are useful and not extremely expensive, but they do not give the same long-term economic benefits. We gave Esh7an a 10, which is the highest score, because it helps prevent financial waste. By predicting demand and guiding where chargers should go, it avoids building stations in the wrong place. This reduces cost and supports better planning, which matches Qatar’s goals for efficient growth.

Environmental Development:

For environmental development, the Solar EV Network received a 10, since it runs on renewable energy and reduces emissions. This makes it the strongest environmental option. Portable units scored 6, since they do not use renewable energy and offer only small environmental benefits. Esh7an scored 8 because it improves environmental outcomes by reducing pressure on the grid and preventing overbuilding. Even though it is not a physical charger, it helps make the entire charging network cleaner and more efficient.

When we added all the scores, the results showed that Esh7an had the highest total with 35, followed by the Solar EV Network with 32, and then Portable Fast-Charging Units with 28. These results make sense because Esh7an does not only add more chargers; it helps solve the main problems we mentioned earlier: lack of proper planning, uneven charger distribution, and uncertainty about grid capacity. Solar stations give the best environmental impact, and portable units help in the short term, but neither of them fix the deeper issues. Esh7an supports Qatar’s long-term goals by guiding decisions using real data and helping the country expand EV infrastructure in a smarter and more organized way. Because of this, we identified Esh7an as the most suitable and effective solution for improving EV charging in Qatar.

Table 1- Decision Matrix to Choose the Most Optimal Solution.

Solution	Human Development	Social Development	Economic Development	Environmental Development	Total
Esh7an	8	9	10	8	35
Solar EV Network	7	7	8	10	32
Portable units	7	8	7	6	28

VI. Discussion of Recommendation

Yousif is responsible for writing the Discussion of Recommendation and the Abstract. His Recommendation section must clearly link back to the core problems defined in the Problem Statement, showing that the team's chosen solution, Esh7an, is the most effective method of addressing Qatar's uneven charger distribution, grid instability risks, and slow infrastructure growth. He must make explicit references to earlier citations, such as Deshmukh et al. (2024), the MCIT Tarsheed platform updates (2024), and the Ministry of Transport's EV deployment milestones, to demonstrate that the recommended solution is grounded in both research and national policy direction.

Yousif should also outline a realistic implementation plan for Esh7an, showing how it can be integrated into existing systems and how it resolves the infrastructural and policy challenges outlined in the Problem Statement. This includes describing how Esh7an improves long-term planning, reduces wasted investment, and reinforces national sustainability commitments. He must address constraints such as cybersecurity, inter-agency collaboration, and data availability, as these issues were noted in the Problem Statement as structural limitations within Qatar's current infrastructure development.

VII. Conclusion

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