

Final Project 1

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Project Template

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To

Faculty of Management
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Project title

**Integration of Electric Vehicles for Grid Support in Urban
Environments: A Case Study of Amman**

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Table of Contents

1. Chapter 1: Introduction	3
1.1. Research Background.....	4
1.2. Research Problem.....	5
1.2.1. Theoretical Gaps	5
1.2.2. Practical Gaps	6
1.3. Research Significance	7
1.3.1. At the theoretical level.....	7
1.3.2. At the practical level	7
1.4. Research Questions	8
1.5. Research Objectives	8
1.6. Research Hypotheses.....	8
1.7. Research Model.....	9
1.8. Research Methodology.....	9
1.9. Scope of The Study	9
1.10. The Suggested Project Structure.....	9
2. Chapter 2: Literature Review	10
2.1. Introduction	11
2.2. The independent variable	11
2.3. The dependent variable	11
2.4. The relationship between the independent and the dependent variables	12
2.5. Conclusion.....	12
References.....	12

1. Chapter 1: Introduction

1.1. Research Background

The increase in GHG emission is an important global concern. High costs and substantial energy waste from voltage regulation, daily load demand fluctuations and frequency adjustments are the main reasons why operational efficiency of power grids is still unsatisfactory. In times where the amount of energy required surpasses that which can be supplied by base load power plants, peak load plants come into operation. Conversely, on days with minimal electricity needs, unwanted energy from base load generators ends up as waste. Also, Voltage/frequency control of this nature has high operating costs.

This issue can be solved through Vehicle to Grid (V2G) technology that uses electric vehicle's (EVs) extensive energy storage capacity as a buffer for both power grid and renewable sources of electricity. EVs can be attached to the smart grid either in V2G or G2V modes. The vehicle-to-grid involves flow of energy from EV to grid while grid-to-vehicle mode involves movement of electric charges from the grid to the EVs.

Smart grids and V2G systems are interconnected and have a symbiotic relationship between them. An important function is played by AC to DC (and vice versa) conversions during energy exchange processes. Energy storage systems in electric vehicles become very useful when exchanging electrical power with a grid system. as an example, when grid demand goes down sharply, the cars can take on extra energy overloads which in turn help to reduce power plant strains.

is during low periods of network load demand that electric vehicles can be used as storage for excess electricity to avoid wastage. When prices drop, purchasers of EVs may prefer to import power from the distribution companies only to sell them back during peak periods at high costs, thus providing a chance for gains.

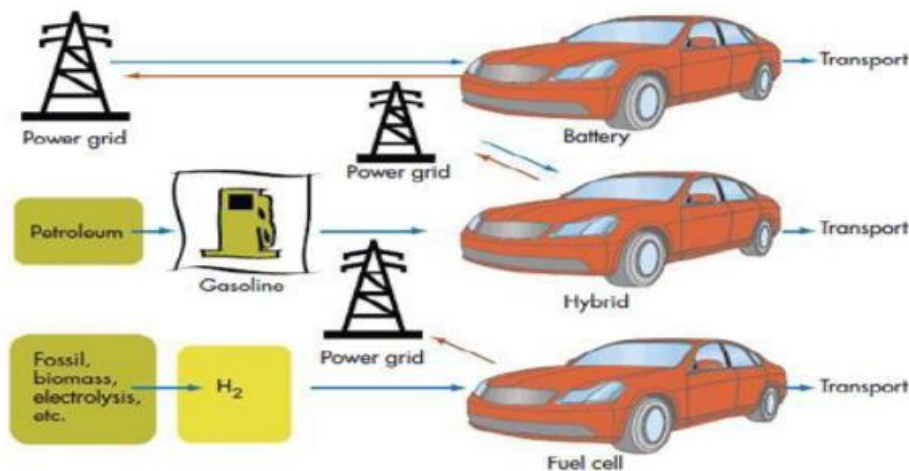


Fig. 1: The schematic diagram of V2G (Harighi et al., 2018).

1.2. Research Problem

The main research problem addressed in this project is:

1.2.1. Theoretical Gaps

- Existing literature primarily focuses on technical aspects of EV integration for grid support, such as:
 - Modeling EV charging behavior
 - Optimizing charging schedules
 - Analyzing impact on grid stability and power quality?
- Lack of research addressing business and management implications of EV integration, including:

- Development of viable business models
- Assessment of economic feasibility
- Analysis of policy and regulatory frameworks needed to incentivize EV adoption and V2G participation
- Existing theories and frameworks fail to consider unique challenges and opportunities presented by urban environments, such as:
 - High population density
 - Presence of diverse stakeholders
 - Need for coordinated planning and decision-making

1.2.2. Practical Gaps

- Rapid growth of EV adoption in urban areas can strain existing power grid infrastructure, leading to challenges in:
 - Grid stability
 - Peak demand management
 - Energy distribution
- Uncontrolled EV charging can cause:
 - Voltage deviations
 - Overloading of distribution transformers
 - Increased energy losses
- Practical implementation of EV integration for grid support in urban environments is hindered by:
 - Lack of coordination among stakeholders (utility companies, EV manufacturers, policymakers, end-users)
 - Need for investment in infrastructure upgrades (smart charging infrastructure, V2G-enabled vehicles)
- Practical application of EV integration for grid support is limited by lack of clear policy and regulatory frameworks that incentivize EV adoption and V2G participation

1.3. Research Significance

The findings of this study will contribute to the following:

1.3.1. At the theoretical level

At the theoretical level, this research project contributes to the existing body of knowledge on electric vehicle (EV) integration for grid support in urban environments by addressing the gaps in the current literature. The study provides a comprehensive analysis of the business and management implications of EV integration, including the development of viable business models, the assessment of economic feasibility, and the analysis of policy and regulatory frameworks needed to incentivize EV adoption and V2G participation.

Moreover, the research extends the existing theories and frameworks used to analyze the integration of EVs for grid support by considering the unique challenges and opportunities presented by urban environments, such as the high population density, the presence of diverse stakeholders, and the need for coordinated planning and decision-making. By incorporating these factors into the analysis, the study offers a more nuanced and context-specific understanding of the potential benefits and challenges of EV integration for grid support in urban settings.

1.3.2. At the practical level

- **Grid Optimization:** The study will provide empirical insights into the impact of EV integration on grid stability, peak demand, and energy distribution in Amman, enabling utility companies to develop effective strategies for optimizing grid performance and supporting renewable energy integration.
- **Economic Benefits:** The research will analyze the feasibility and benefits of V2G technology for grid support, energy trading, and peak shaving in Amman, potentially leading to cost savings for both EV owners and utility companies.
- **Sustainability:** By proposing empirically grounded strategies for transitioning to a Smart Grid model in Amman, the study will contribute to enhancing energy efficiency, grid

resilience, and sustainability in urban settings, ultimately promoting a greener and more sustainable future.

- **Policy Implications:** The research findings will inform policymakers and regulatory authorities in Amman about the necessary policy and regulatory changes needed to incentivize EV adoption and V2G participation, thereby facilitating the large-scale integration of EVs for grid support.

By addressing both the theoretical and empirical significance of the study, this section highlights the importance of the research project in advancing academic knowledge and informing practical decision-making in the context of EV integration for grid support in Amman.

1.4. Research Questions

1.5. Research Objectives

1.6. Research Hypotheses

1.7. Research Model

1.8. Research Methodology

1.9. Scope of The Study

1.10. The Suggested Project Structure

2.Chapter 2: Literature Review

2.1. Introduction

Brief introduction for the chapter

2.2. The independent variable

2.3. The dependent variable

2.4. The relationship between the independent and the dependent variables

2.5. Conclusion

References

Harighi, O., Bayindir, R., Padmanaban, S., Mihet-Popa, L., & Hossain, E. (2018). An Overview of Energy Scenarios, Storage Systems and the Infrastructure for Vehicle-to-Grid Technology. *Energies*, 2(8).

