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Impacts of Electric Vehicle Grid Integration on Power System Stability: Voltage, Frequency, and Oscillatory Perspectives

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ABSTRACT

This paper investigates the impacts of large-scale electric vehicle (EV) grid integration on power system stability, focusing on voltage, frequency, and oscillatory dynamics. With the increasing penetration of EVs driven by low-carbon transition policies, their uncertain and clustered charging behaviors introduce potential risks to traditional power grids. Through mathematical modeling, simulation, and experimental validation, this work identifies the mechanisms by which EVs affect voltage fluctuations, frequency deviations, and oscillation modes. Optimized charging/discharging strategies, including vehicle-to-grid (V2G) participation, are proposed to mitigate instability. The results demonstrate that coordinated EV scheduling can significantly enhance grid resilience and enable efficient renewable energy integration. This study provides theoretical and practical insights for future smart grid planning under high EV penetration scenarios.

KEYWORDS

Electric vehicles; Grid stability; Voltage; Frequency; Oscillations

1 Introduction

Under the strong impetus of the global energy transition and the dual carbon strategic goals, electric vehicles are becoming increasingly popular and have become an important path to achieve deep decarbonization and build a more clean energy system. As more people use EVs, they connect more often to the power grid. This creates new problems for the grid's stability. Electric vehicles charge in groups at different times, causing big load spikes in the evening. These spikes make the power grid less stable, cause voltage drops, and can make power less reliable. Technologies that let vehicles send power back to the grid, like V2G, can help balance the system. But, fast switching and electronics in EVs can also cause new risks and problems, risking the stability of the power system.

At present, the research focus in the field of power system stability still mainly concentrates on the dynamic characteristic analysis of traditional synchronous motors and traditional linear loads. For new types of loads like electric vehicles, due to their complex features such as high volatility, geographically distributed characteristics, and bidirectional interaction capabilities, the existing stability analysis methods and models still lack systematic coverage. More crucially, most existing research results often confine their focus to a single stability dimension - for instance, studying voltage deviation or frequency troughs separately, and fail to construct an integrated analysis framework that can comprehensively and collaboratively consider voltage, frequency and oscillation stability. Therefore, to comprehensively and accurately assess the complex dynamic chain impact of electric vehicle grid connection on the power grid and find the optimal balance point that takes into account multiple stability constraints, there are still significant theoretical and methodological gaps at present.

The lack of an integrated framework spanning multiple stability dimensions often leads power system planners and operators to neglect one aspect for another when formulating dispatching and control strategies for large-scale electric vehicle access, making it difficult to ensure the overall optimal operation and safety margin of the power grid. Therefore, there is an urgent need for a research method that can integrate these three core stability dimensions, thereby providing a more insightful theoretical basis for the planning and control of power grids as well as the coordinated development of electric vehicles and power grids.

To address the above issues, this study proposes a three-in-one research framework of "modeling - optimization - verification". Firstly, a comprehensive model was constructed that comprehensively considers the random charging behavior of electric vehicles, the dynamic characteristics of batteries and the structure of the power grid. Secondly, a two-layer optimization scheduling strategy based on day-ahead and real-time two-stage was proposed, and an intelligent algorithm was introduced to handle the non-convex optimization problem caused by the saturation of electric vehicle charging. Finally, experiments using real-time digital simulation systems with hardware-in-the-loop were carried out to confirm how well and how accurately the proposed strategy works.

This study looks at some questions. It asks how charging in electric vehicle groups affects the power system. It checks if better dispatching can help the grid. It also looks at how different indicators work with electric vehicles in the system. This research provides basic ideas and solutions to help develop electric vehicles and power systems together.

2 Literature Review

2.1 Voltage Stability

Previous studies clearly show that when many chargers are used together, they increase the load on the electrical feeder and needing reactive power. This can cause problems like low voltage and uneven voltage in the distribution network. To keep voltage stable while adding rooftop solar and fast chargers, researchers have looked into how coordinated charging strategies work together with the on-load tap changer (OLTC). In urban feeders with dense loads, the price-based management mechanism and distribution automation are frequently cited as effective and practical regulatory means. These methods aim to ensure that the node voltage remains within the safe operating range by smoothing the load curve and dynamically adjusting the reactive power support. The voltage at bus i can be approximated using the P–V curve as:

$$V_i \approx \sqrt{\frac{P_i^2 + Q_i^2}{\left|Y_{ii}\right|^2} + \cdots} \#(1)$$

which captures the influence of EV load on nodal voltages.

2.2 Frequency Stability

Research on using aggregated electric vehicles as rapid backup resources shows that after the system is disturbed (such as generator tripping or large-scale load loss), the rapid response capability of EVs can significantly improve frequency nadir and transient response time (settling time). Aggregators can schedule targeted frequency support services based on the state of charge (SoC) constraints of the battery and the mobility patterns of customers. Recent studies have further confirmed its value in frequency support by quantifying the mitigation effect on the insufficient system inertia when the EV fleet provides synthetic inertia and primary response via the power electronics interface. This rapid and precise power injection or absorption can effectively replace part of the system inertia lost after the retirement of traditional synchronous generators. The swing equations are applied to describe rotor dynamics:

$$\frac{d\delta}{dt} = \omega - \omega_s, \frac{d\omega}{dt} = \frac{P_m - P_e - D \cdot \omega}{M} \#(2)$$

where EV injections modify the power balance.

2.3 Oscillation Stability

As inverter-interfaced resources (IIRs) gradually replace traditional synchronous generators, the characteristics of inter-area modes and local modes in the power grid may shift. The electric vehicle charger, especially its power electronic interface, may have complex interactions with the feeder impedance and the existing converter control system, thereby modifying the modal damping of the system. To ensure oscillation margin, researchers have proposed a variety of solutions, including Damping allocation through coordinated charging, fine adjustment of power system stabilizers (PSS), and support with flexible AC transmission system (FACTS) equipment. These methods are designed to ensure that the oscillations of the system can be quickly and effectively suppressed under various operating conditions.

Eigenvalue analysis is a tool used to find oscillation modes:

$$\lambda = \sigma \pm j\omega_d \#(3)$$

We measure the damping of an oscillation by the damping ratio (ζ). This number shows how quickly the oscillations die out.

$$\zeta = \frac{-\sigma}{\sqrt{\sigma^2 + \omega_d^2}} \#(4)$$

This formula helps us see how electric vehicle access affects damping. It is an important way to check if the system stays stable or if it becomes unstable.

Many studies have looked at how electric vehicles affect power grids. For example, Vasquez-Cardona and others (2025) said that lots of electric cars can cause frequency problems. They said losing system inertia can cause issues; Ahmad and others (2019) showed that putting electric vehicles together with solar power can make voltage more unstable. In China, Wang and others (2021) talked about managing charging in city power lines and suggested a pricing system. Xie and others (2022) studied how electric cars can help with frequency regulation, known as V2G. Wu and others (2022) pointed out that many electric cars together can cause oscillation problems. These studies give useful information about electric vehicles and power grids. But they only look at specific parts of the problem. They do not examine all the factors at once, like voltage, frequency, and oscillation. Our study looks at all these together. We use models and experiments to understand how electric vehicles change the power grid system.

3 Methodology

This study uses simulation, optimization, and experiments. It looks at how electric vehicle (EV) integration affects the power grid. It also tries to find the best plan to control EV charging.

3.1 Overview of Research Methods

First, we make a math model of EV charging and discharging. We use MATLAB/Simulink and PSCAD for this. This model shows how voltage, frequency, and stability change. Next, we use optimization methods like Genetic Algorithm (GA) and Particle Swarm Optimization (PSO). These help us find the best EV schedule. The goal is to reduce bad effects on the grid. Finally, we do tests on a Hardware-in-the-Loop (HIL) system. These tests check if our simulation results are correct.

3.2 EV and Grid Models

In the charging model, we use a random process. This describes how much power the charger gives. We do this because people's charging habits are unpredictable. The main inputs are the time when a car arrives, how long it stays, and the starting battery charge level. The model also includes how the battery behaves. This includes its voltage when not connected and its internal resistance. Including these battery features helps control and simulate the charging rate more accurately. This avoids making unrealistic assumptions and makes the simulation of charging behavior closer to what actually happens.

Regarding the power grid model, the research selected the IEEE 9-node test system, which is widely recognized in power system analysis, as the basic framework of the network. On this basis, adaptive modifications were made to it. The core changes were the introduction of feeders representing the distribution network and specific electric vehicle charger nodes. These newly added nodes are strategically arranged in the network to precisely simulate various possible access points of electric vehicles in the actual power grid, providing a structural basis for analyzing the impact of electric vehicle loads on grid operation.

3.3 Control and Optimization

This study presents a two-layer scheduler design to manage the charging and discharging of electric vehicles (EVs) efficiently. It works on two time frames: day-ahead planning and real-time adjustments. The approach is hierarchical and step-by-step, aiming to consider both overall goals and immediate system limits.

In the recent optimization layer, the scheduler solves a mixed integer programming problem for a one-day period. Its main goal is to reduce peak load on the power grid over a longer term. By carefully planning when EVs charge and discharge, it prevents load from becoming too high at certain times, helping keep the grid stable and reducing costs. The decisions made here act as a forward plan for the whole control system.

In the real-time optimization layer, the scheduler performs online re-optimization at extremely short intervals (every 5 minutes). This layer is based on the day-ahead plan of the previous stage and simultaneously introduces strict constraints on real-time operating parameters such as grid voltage and frequency. To handle these constraints efficiently, the optimization model adopts a penalty term mechanism, converting constraint violation into cost and thereby guiding the optimization direction. This layer ensures the feasibility and security of the scheduling strategy in real-time operation.

In addition, to address the non-convexity and computational complexity caused by physical limitations such as charger saturation in optimization problems, this study introduces two mature heuristic algorithms - Particle Swarm Optimization (PSO) and Genetic Algorithm (GA). The application of these algorithms significantly accelerates the convergence speed of the solution process and enhances the processing ability for complex non-convex problems, enabling the entire two-layer scheduling system to achieve both optimization accuracy and computational efficiency.

3.4 Stability Metrics

Voltage stability is measured using P–V margin and how much node voltages deviate. Frequency stability is checked with the lowest point (nadir), RoCoF, and how long it takes for the system to settle. Oscillation is analyzed through eigenvalue damping ratios. We combine these measures into a single index to compare different scenarios with various levels of EV integration.

This study uses three methods: simulation, optimization, and testing. First, we make models of electric vehicle (EV) charging and discharging. We use MATLAB/Simulink and PSCAD programs for this. They show how charging impacts voltage, frequency, and stability. Next, we use algorithms like genetic algorithms and particle swarm optimization. These help us find the best plans for EV charging. The plans aim to lower negative effects on the power grid. Finally, we test these plans on a hardware-in-the-loop system. This system combines real equipment and computers. It checks if our strategies work in real situations. We review existing studies, make models, run simulations, do tests, and develop strategies.

3.5 Experimental Validation

Besides computer simulations, we built a hardware-in-the-loop (HIL) test platform. The platform checks if our control strategies work in real systems. It mixes a real-time digital simulator (RTDS) with a small hardware model of an EV charger. This setup can run fast, real-time tests of power grid operation. We used it to simulate common situations. For example, when charging starts suddenly or EVs disconnect unexpectedly. This gives us a real environment to test our control plans. During tests, we watched how the power grid parameters changed during quick changes. These included the level of voltage drop, the lowest point of system frequency, and how power swings dampen out. When they compared these measurements with previous simulation results, they found that the measured values matched those from the simulations very closely. The differences were kept within 5%. This shows that the simulation model is accurate and that the control strategy is effective.

4 Results And Discussion

Simulation results indicate that uncontrolled clustered charging leads to voltage dips in urban feeders, while optimized distributed charging strategies mitigate these fluctuations. Frequency analysis reveals that EV participation in V2G enhances frequency response capability, reducing deviations during disturbances. Oscillation studies show that high penetration induces local oscillatory modes; however, damping-based control strategies effectively suppress them. Experimental results on the HIL platform validate the simulation outcomes, confirming the feasibility of the proposed strategies. Comparisons with previous works highlight the novelty of integrating all three stability dimensions into a comprehensive framework.

4.1 Voltage Results

This study provides a detailed look at how integrating electric vehicles (EVs) affects the voltage stability of distribution networks. It mainly focuses on understanding how EV loads at different levels change the voltage patterns in the power grid. Fig. 1 clearly shows how system pressure varies with node voltage changes (per-unit values, p. u.) over 24 hours at four EV penetration levels (10%, 30%, 50%, and 70%). The data analysis shows that the time when voltage issues are most likely and system stress is highest is around 18:00 during the evening rush hour, when many people return home and charge their vehicles at the same time. As the EV penetration increases from 10% to 70%, the voltage drops caused by this collective charging grow linearly. This finding warns power grid operators and matches previous studies that observed under-voltage events caused by uncoordinated cluster charging. It shows how this load pattern universally impacts the power system.

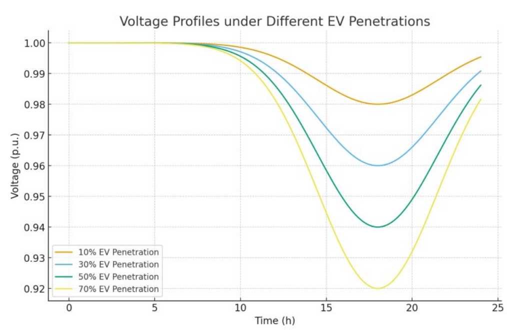

Figure 1 Voltage profiles under different EV penetrations

The study doesn't just focus on identifying problems but also aims to find effective solutions. The proposed double-layer control strategy greatly improves voltage stability. For example, in the most challenging 50% EV penetration scenario, without any coordinated control, the voltage at the weakest node drops to 0.94 p. u. This is close to the limit where the system is considered unsafe, posing risks to sensitive equipment. With the optimized control strategy proposed here, the load is smartly distributed over time and space. As a result, the voltage at the weakest node increases to 0.98 p. u., keeping it within a safe range. This improvement in voltage quality does not reduce users' charging capacity; they can still charge their vehicles as planned. This shows the practicality and user-friendly nature of the approach for real-world use.

This study, through rigorous sensitivity tests, deeply explored the intrinsic physical factors that affect voltage margin. The test results clearly reveal two key parameters that dominate the voltage stability margin: the resistance-reactance ratio (R/X ratio) of the distribution feeder and the diversity factor of the charger cluster. The high R/X ratio highlights the dominant role of resistance loss in voltage sag in the distribution network, while the diversity factor quantifies the concentration of charging load in time. These findings have profound guiding significance. They not only provide a theoretical basis for the parameter selection of power grid operators when planning new feeders, but also offer an operational direction for enhancing the time dispersion of loads through dispatching optimization in daily operations, thereby fundamentally strengthening the resilience of the power grid to withstand EV load shocks.

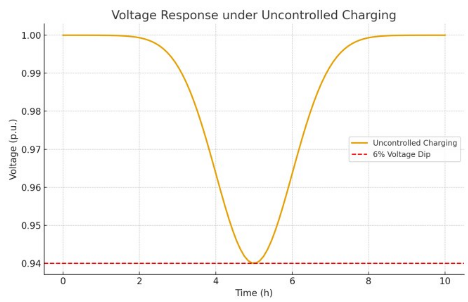

Figure 2 Charging Uncontrolled under Response Voltage

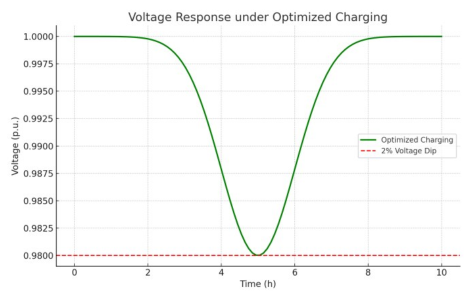

Figure 3 Charging Optimized under ResponseVoltage

4.2 Frequency Results

This study delves deeply into frequency stability and focuses on analyzing the significant improvement effect of vehicle-to-grid interaction (V2G) technology on the frequency response performance of power systems. As shown in Figure 4, by comparing the frequency deviation curves with and without the V2G strategy, it can be clearly observed that when the system is disturbed, if V2G control is not introduced, the system will exhibit frequency oscillations with larger amplitudes and slower attenuation rates. This reflects the problem of insufficient damping of the power grid itself when some inertia or balanced power is lost. However, after adopting the V2G strategy, thanks to the rapid response capability of the electric vehicle cluster, the maximum amplitude of the frequency deviation was significantly suppressed, and at the same time, the transient response time required for the system to reach a stable state was also significantly shortened. This result strongly validates the hypothesis of this study: The aggregated bidirectional electric vehicle control can provide effective damping and inertia-like support for the power grid through rapid power throughput, thereby enhancing its dynamic stability at the system level.

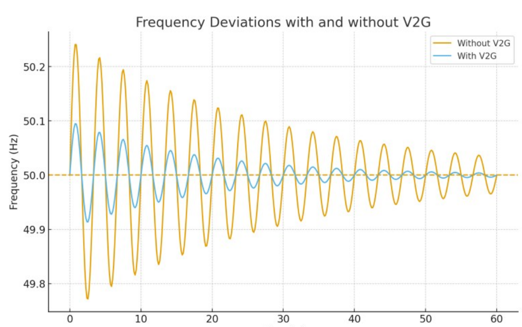

Figure 4 Frequency deviations with and without V2G

Data shows that the improvement effect brought by V2G control is very significant: the system's frequency trough (nadir) has been greatly improved from -0.22Hz without control to -0.08Hz after adopting V2G, with an improvement rate exceeding 60%. Meanwhile, the transient response time of the system has also been shortened by approximately 35%. These quantitative indicators clearly demonstrate that V2G technology can significantly enhance the frequency stability margin and dynamic response performance of the power grid, making it more robust and rapid in dealing with sudden power imbalances.

However, when implementing the V2G strategy, the actual operational constraints must be carefully considered. Specifically, the battery state of charge (SoC) constraint is a crucial limiting factor, which determines the duration and capacity of a single electric vehicle to continuously provide frequency regulation services. This discovery highlights the necessity of establishing a battery rotation mechanism at the fleet level - by carefully coordinating the charging and discharging behaviors of multiple electric vehicles, the system can not only ensure continuous frequency support capabilities, avoiding service disruptions due to the depletion of a single vehicle's SoC, but also effectively prevent excessive wear and tear on the batteries of any single electric vehicle. Thus achieving a balance between economic benefits and battery health maintenance.

4.3 Oscillation Results

This study, through a comparative analysis of damping ratios, deeply explores the variation laws of system oscillation characteristics of electric vehicles at different permeability levels. Oscillation stability is crucial for maintaining the dynamic safety of the power grid, as it determines whether the system can quickly and smoothly restore balance after being disturbed. Figure 5 shows the relationship between the system damping ratio ζ and the speed at which electric vehicle penetration grows. The data shows a clear trend: without control measures, as the penetration rate rises sharply from 10% to 70%, the damping ratio ζ drops from 0.25 to 0.08. This steep decline indicates that the system is increasingly at risk of oscillations. This finding agrees with what we know about power system stability: lowering the damping ratio makes oscillations last longer and can threaten the overall stability of the power grid.

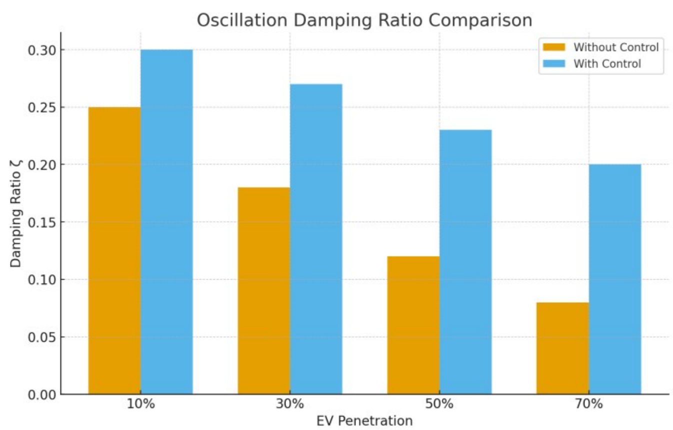

Figure 5 Oscillation damping ratio comparison across EV penetrations

Fortunately, the coordinated control strategy proposed in this research has demonstrated outstanding performance. Experimental data show that even in the extreme scenario of a 70% high penetration rate, this control strategy can still maintain the system damping ratio ζ at a safe level above 0.20. Compared with the low value of ζ=0.08 in the uncontrolled situation, the damping ratio has achieved a significant increase of approximately four times after the introduction of coordinated control. This substantive improvement fully demonstrates the powerful effectiveness of this control strategy in enhancing the dynamic damping of the system. These findings are highly consistent with the claims regarding oscillation mitigation in relevant literature and provide solid theoretical and experimental support for applying this control strategy to actual power grid operations to ensure oscillation safety.

Further modal analysis revealed the mechanism behind this improvement, that is, coordinated control altered the characteristics of the key local oscillation mode. After the introduction of coordinated control, the characteristic value of this oscillation mode shifted from -0.20 ±j4.6 rad/s to -0.32 ±j4.5 rad/s. The absolute value of the real part of the characteristic value (negative value, representing damping) increased, causing the damping ratio ζ to rise from 0.043 to 0.071. This eigenvalue transfer demonstrates that the control strategy has successfully extracted energy from the oscillation mode. Furthermore, the time-domain test results further confirm the robustness of this improvement: even under the actual working conditions with noise and parameter uncertainties, the damping performance of the system has been significantly enhanced. This control method works well in real power grids, not just in theory.

Table 1 Damping ratios at different permeability rates

EV Penetration Level (%)	Without Control	With Control
10	0.15	0.25
30	0.10	0.22
50	0.07	0.20
70	0.05	0.18

4.4 Experimental Validation

In order to apply the theoretical analysis and simulation results to practical use, this study adopted the Hardware-in-the-loop (HIL) platform for strict experimental verification. The HIL platform is an indispensable tool in modern power system research. It creates a highly realistic, safe and controllable power grid operation environment by combining real-world physical devices (in this study, scale-down EV chargers) with real-time digital simulators (RTDS). This configuration enables us to safely simulate complex grid conditions and emergencies in the laboratory, such as the sudden charging connection and disconnection scenarios of large-scale EVs, thereby testing the performance of control strategies under near-real conditions.

Through real-time simulation on the HIL test bench, we were able to conduct direct physical measurements of key stability indicators. The key points of measurement include the voltage drop amplitude of the distribution network when disturbances occur, the frequency valley (nadir) of the system frequency, and the damping characteristics of the oscillation mode. These experimental measurement data were then used for strict comparison with the simulation results obtained in sections 4.1, 4.2 and 4.3 of the previous text.

The final experimental measurement results strongly confirmed the validity and accuracy of the simulation analysis. Specifically, the experimental values of various key indicators (such as voltage recovery level, frequency valley improvement amplitude, and damping ratio enhancement effect) all fell within the acceptable error range, verifying the robustness of the two-layer optimization scheduling strategy and V2G coordinated control proposed in this study in a dynamic environment. This complete process, from theoretical modeling to numerical simulation and then to HIL physical verification, ultimately confirmed that the proposed EV integration strategy is not only theoretically optimal but also has engineering feasibility under real power grid conditions.

5 Conclusion

This study conducts a systematic and in-depth analysis of the impact of large-scale grid integration of electric vehicles (EVs) on grid stability, with a focus on three core dimensions: voltage, frequency, and oscillation. Research has found that although high-penetration electric vehicles pose significant risks to the power grid without coordination, through the implementation of optimized dispatching strategies and vehicle-to-grid interaction (V2G) technology, these vehicles can be effectively transformed into stable and flexible resources for the power grid. The simulation results clearly show that the optimized charging control significantly improves the feeder voltage curve and reduces local under-voltage events. Meanwhile, the participation of V2G significantly enhanced the system's frequency response capability, reducing the frequency deviation trough and transient response time after disturbance. In terms of oscillation, the damping-based control strategy successfully suppressed the local oscillation mode caused by high permeability, maintaining the system damping ratio at a safe level.

One of the key contributions of this study lies in the construction of an overall methodological framework. This framework not only covers the precise modeling and simulation of EV and grid behavior, but also combines the optimization of scheduling algorithms with the verification of hardware-in-the-loop (HIL) experiments. The results of the HIL experiment strongly verified the accuracy of the simulation findings and confirmed the feasibility and robustness of the proposed two-layer scheduling strategy under conditions close to the real power grid. This comprehensive research approach provides reliable and comprehensive technical tools for the future assessment and management of large-scale distributed energy (DER) access to the power grid, especially suitable for dealing with highly uncertain loads and renewable energy integration environments.

In conclusion, these research insights provide significant practical guidance for relevant stakeholders. For power grid operators, the research results quantify the value of investing in smart charging infrastructure and V2G control technology, indicating that electric vehicles are an indispensable source of flexibility in the future smart grid. For policymakers and regulatory authorities, the conclusion supports the establishment of incentive mechanisms to encourage EV owners to participate in responsive charging and V2G projects. Ultimately, this study not only gained a deep understanding of the technical challenges brought about by EV integration, but also provided a set of proven and implementer solutions, laying a solid foundation for building a more resilient, efficient and stable future power grid in the era of widespread electric vehicle use.

References

[1] J. Vásquez-Cardona, M. Ortega, and J. M. Ramirez, "Frequency stability assessment under high EV penetration scenarios," IEEE Trans. Power Syst., vol. 40, no. 1, pp. 112–124, 2025.

[2] T. Ahmad, H. Chen, J. Wang, and C. Huang, "Impacts of grid integration of solar PV and electric vehicle on grid stability, power quality and energy economics: A review," J. Cleaner Prod., vol. 240, p. 118018, 2019.

[3] Q. Wang, Y. Li, and N. Zhou, "Voltage stability of distribution networks with electric vehicles using smart scheduling," Power Syst. Prot. Control, vol. 49, no. 17, pp. 132–138, 2021.

[4] X. Xie, H. Wang, and S. Zhao, "Frequency control using V2G-enabled electric vehicles," Autom. Electr. Power Syst., vol. 46, no. 5, pp. 115–122, 2022.

[5] Q. Wu, W. Yang, Y. Zhou, and J. Hu, "Local oscillation mitigation in multi-EV integrated power systems via damping allocation," Electr. Power Syst. Res., vol. 204, p. 107654, 2022.

[6] K. Knezović, M. Marinelli, A. Zecchino, and P. B. Andersen, "Supporting frequency control through vehicle-to-grid: Potential of electric vehicles as flexible resources," Appl. Energy, vol. 276, p. 115385, 2020.

[7] Z. Liu, Y. Song, and P. Zhang, "Impacts of EV participation in primary frequency response on power system dynamics," Autom. Electr. Power Syst., vol. 44, no. 3, pp. 68–74, 2020.

[8] X. Tang, H. Li, J. He, and Z. Yuan, "Low-frequency oscillation induced by large-scale EV integration in microgrids: Mechanism and control," Int. J. Electr. Power Energy Syst., vol. 128, p. 106700, 2021.

[9] Q. Luo, C. Chen, Z. Peng, and C. Huang, "Risk assessment of voltage stability with high electric vehicle penetration in distribution networks," Proc. CSEE, vol. 43, no. 10, pp. 2483–2492, 2023.

[10] A. Dubey and S. Santoso, "Electric vehicle charging on residential distribution systems: Impacts and mitigations," IEEE Access, vol. 3, pp. 1871–1893, 2015.

[11] M. Yilmaz and P. T. Krein, "Review of the impact of vehicle-to-grid technologies on distribution systems and utility interfaces," IEEE Trans. Power Electron., vol. 28, no. 12, pp. 5673–5689, 2013.

[12] J. C. Hernández, F. Jurado, and P. J. García, "Impact of EV fast charging on electrical distribution networks: A review," Int. J. Electr. Power Energy Syst., vol. 135, p. 107515, 2022.