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Policy and Regulatory Gaps in Electric Vehicle Charging Infrastructure in the United States: Challenges and Opportunities

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About Article

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ABSTRACT

US electric vehicle charging facilities are not keeping with demand even following the 5-billion federal investment in the program of the National Electric Vehicle Infrastructure and the Bipartisan Infrastructure Law. By mid 2025, there are only 57 charging stations across 15 states, in the rural regions the coverage is lower than 25 percent of what is required and out of every 5 chargers 1 fails because of mechanical difficulties or flaws in the equipment. The paper reviews the policy and regulatory loopholes that led to these failures based on a qualitative case study design that includes the analysis of federal and state policy documents, Government Accountability Office reports, Government Energy performance information and media coverage of January 2024 to October 2025. It is possible to identify three urgent issues identified in the analysis: allowing processes longer than one year to postpone the construction discourages private funding; lack of federal-state coordination leads to unspent funds and redundant effort; deployment serves the wealthy urban population most, and 94 percent of the rural counties do not have sufficient coverage of critical infrastructure, with low-income populations the most in need of community-provided charging. These delays are a result of inefficiencies in governance as opposed to technical constraints. This paper adds a Triple Vulnerability Framework that shows the interacting influence of environmental stress factors on institutions and social injustice as a determinant of infrastructure resilience. Among other suggestions, it indicates compulsory resilience auditing on federally funded projects, real time charger checking mechanisms, and documents financing structures to orient funds towards experiences that lack adequate services. These reforms are essential to enable the transition to electric vehicles to create equal transportation and energy disparities instead of bringing about equitable decarbonization.

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1. INTRODUCTION

The rising need of climate change has led to the transportation sector being at the forefront of the effects worldwide to reduce carbon emissions. Accounting for nearly one-third of the U.S. greenhouse emissions, the road transport has remained a key challenge to achieve net-zero targets. Electrification via electric vehicles (EVs) is thus the key to national and global sustainability strategies. According to a recent market analysis performed by the International Energy Agency (IEA), 2023 saw global EV sales close to 14 million, which is a 35% increase from 2022 with a further 36% global market share foreseen by 2030. The United States as the world's second-largest market for EVs forms a key international force for the transition. Moreover, although the uptake by consumers has been strong, the charging infrastructure (EVCI) has been limited in scope and reliability, due to policy fragmentation and various policy and regulatory inconsistencies, and unbalanced governance ability (Schwab *et al.*, 2022).

In 2023, the number of EVs sold in the US was up 50% (currently 1.4 million), driven by the passage of the Inflation Reduction Act (IRA), and an increasing consciousness among the public about the environment. As it happens, the present national charge reliability currently stands at 78 percent and almost one out of every five chargers is either non-operational due to inadequacy in the maintenance or grid issues. Geographic disparities make these weaknesses paramilitary in that the urban centers such as California, New York and Washington D.C. have thick charging networks, but the geography on rural and low-income regions is a charging desert that contributes to range anxiety and makes people reluctant to adopt (Martínez-Gómez & Espinoza, 2024).

Aside from technical difficulties, structural restrictions are in the way for the long-term introduction of power grid applications. Without the investment effort, it is possible for EV power loading to rise 23% by 2050 and create the local grid where blackouts like the Californians experienced in 2020 could occur. This highlights the interdependence of transportation and energy systems - and highlights gaps in governance in ensuring proper coordination between infrastructure planning across federal, state and local government agencies (Martínez-Gómez & Espinoza, 2024).

These gaps have produced the development of National Electric Vehicle Infrastructure (NEVI) program, act under the 2021 Bipartisan Infrastructure Law (BIL), and intended in the fast charger at 50 miles intervals in large-scale routes, for a five billion capitalization. However, not much has changed, and by mid-2025 the number of stations operating stalled at 57 in 15 states, and bureaucratic sluggishness, prosecutorial time, and interagency disunity are clearly just a few of the reasons. Even if these regulatory changes in 2025 are targeted to prevent approvals for decentralization of power, the rise in tariff on imported components destroys these advantages and this played a role in the conflict of protectionist policies and deregulation on making implementation difficult (Azhar, 2024).

Cohesive national strategies can be seen to work in such liberalizing countries as Norway, China, and the Netherlands with regard to comparative cases. The centralized permitting and incentive approaches in Norway have produced one charge per 18 EV vs the national average in the U.S of one charge per 68 EV: Malaysia coordination done by state has produced over 2.2 million public chargers which reflects the potential of the effectiveness of regulation alignment and long-term planning. By contrast, the patchwork of standards and uneven progress being brought about by the U.S. system of federalism has shown that the problem is not only technological but is as much in terms of institutions (Afzal & Hawkins, 2024).

Such inequalities are linked explicitly to wider issues of environmental justice in that marginalized and low-income populations remain dramatically under-serviced and this enforce the persistence of the prevailing forms of spatial inequality and infrastructural inequities. The shift towards electric mobility can result in an exacerbation of ethnicity of difference, given the lack of development of the domain of policies with the principle of equity. Breaking these patterns would require going beyond technological optimism and critique of the policy, regulatory and governance frameworks that furnish information about transitioning to energy.

Although the literature on ev adoptions and dynamics of EV market is evolving, only few papers incorporate the analyses of socio-economic vulnerability and the institutional performance evaluation in explaining the non-consistent development of EVCI. It thus uses Social Vulnerability Theory (SVT) and Critical Infrastructure Studies (CIS) to clarify the relationship between exposure and sensitivity and adaptive capacity (V f[E, S, AC]) and governance fragmentation and regulatory coherence in infrastructural outcomes for the current review. SVT ends with inequalities in adaptive capacity and access whereas, CIS focuses on resilience, redundancy, and system interdependence as the cross-cutting pillars of sustainable governance (Stenstadvolden *et al.*, 2024).

Consequently, this paper critically analyzes U.S. charging infrastructure policy and regulatory gaps between 2024 and 2025 in analyzing potential constraints of equitable and sustainable infrastructure development due to governance fragmentation, socioeconomic disparity, and institutional inefficiency. The research question applied is as follows:

What role do policy and regulatory nescience (which are rooted in social and economic differences and lack of governance) play in the development of infrastructural barriers to implementing electric vehicle charging networks in the United States?

By asking this question, the paper takes the analysis one step further in understanding all the challenges and opportunities that make the process of the American energy transformation complicated and offer policy solutions based on evidence to promote integrity, robustness, and equity in the governance of sustainable mobility.

The paper provides a unique contribution to the existing literature by formulating a proposal that combines the Social Vulnerability Theory with the research on Critical Infrastructure, resulting in a new Triple Vulnerability Framework, which explains the current poor performance of the U.S. EV charging infrastructure despite decades of investment on that matter. This paper also shows interactions between environmental stressors, institutional fragmentation, and socio-economic inequities in creating systematic reliability and access failures unlike previous done work of considering technical barriers, policy barriers, and social barriers separately.

Using this framework to the implement cycle of 2024- 2025 NEVI deployment, the paper gives the most rigorous and multi-scale evaluation of how governance lapses, not technological constraint are the main culprits of infrastructural susceptibility. The results have an empirical basis to create equity-oriented and resilience-oriented policy solutions that have the potential to ensure a fair and sustainable national EV transition.

2. LITERATURE REVIEW

2.1. Environmental and Geographic Context

Climatic and geographic diversity in the U.S. has a strong influence on the development of EV charging infrastructure that subsequently impacts capacity in the region, the performance of the chargers, and the resilience of the entire system. States that are heavily inhabited like California and New York have built far-reaching network coverage, whilst the rural areas (mostly Mid West and Mountain West-areas) have been grossly underserved and the norm they cover is less than 25 percent. Such spatial inequalities are continuations of historical infrastructural investment processes and they add up to foreseeable deserts of charging.

System fragility is also aggravated by the environmental conditions. High temperatures, low temperatures, and flooding, which occur in various parts of the U.S. prevent high charging efficiencies and hasten the deterioration of the equipment. Recent research indicates that during cold weather, charging losses are up to 20 percent and in hot or dusty areas, the cost of maintaining the charged vehicles is high. These considerations imply that the reliance of infrastructure cannot be conceptualized without paying attention to environmental exposure, grid barriers, and lack of institutional capability to overcome them.

2.2. Governance Fragmentation and Institutional Vulnerability

Policy fragmentation caused by federalism is one of the most common reasons that are often mentioned that impede EV infrastructure deployment. States are diverse regarding the processes of permitting, the need to conduct environmental review and utility coordination, which makes the timeline unpredictable and imposes administrative bottlenecks. The adjustments to the 2025 NEVI program aimed at streamlining approvals showed that continuing the tendency of inconsistencies in the state preparedness, financial uptake, and technical requirements.

The situation differs in urban areas: the overload of electricity demand, the age of grids, and the bureaucratic inflexibility compound the risks of overloading and disturbances to the service. Network expansion is always characterized by grid constraints and lengthy permitting by charging operators. These costumes indicate the institutional aspect of vulnerability in the form of a poor coordination and regulatory uncertainty and low adaptive capacity that are the bane of infrastructure reliability irrespective of technological sophistication.

2.3. Energy Systems, Infrastructure Economics, and Social Equity

EV Charging infrastructure lies at the edge of the transportation and energy system, and therefore is susceptible to stability in the grid, and capital expenses, as well as, localism differences in the capacity to invest. The cost of capital investments in Level 2 and DC fast charging stations is significant, and the cost of equipment is directly influenced by tariffs, and supply chain volatility predisposes inequitable national coverage. The rich cities attract individual investments, whereas the rural and poor areas fail to implement adequate infrastructure because of an increased financial risk and reduced anticipated use.

This unequal distribution recreates larger measures of infrastructural inequality. The poor and disadvantaged communities, with an increased transportation load and reduced access to home-charging, continue to be overly reliant on the public networks. Such injustices are reverberated by theoretically based perspectives of infrastructural citizenship and splintered urbanism: infrastructure itself is turned into a symbol of belonging, and a lack of it strengthens spatial and socio-economic inequality.

2.4. Historical Patterns and Infrastructural Path Dependence

The development of the U.S. charging network is a historical pattern of the infrastructure cycle with the rapid implementation in the first place, the lack of standardization, and the lack of long-term maintenance strategies. The first charging networks were affected by a lack of interoperability, unreliability in hardware and inconsistent monitoring which undermined the trust of the general public in EV systems. These heritages still exist to date as the reliability still lags below national targets despite huge federal expenditures.

Such dependence on paths can be used to understand why infrastructure failure is often an institutional and not a technical one. The strategies that were embrace to emphasis include race to deploy which focused on quantity rather than system integration, grid modernization, maintenance planning and resilience standards were left behind. Consequently, there are systemic vulnerabilities that build up especially where the regulatory capacity is low or where there is a lack of investment.

2.5. Synthesis: Triple Vulnerability Framework

The literature says that EV infrastructure performance is an outcome of the interplay of the three interdependent dimensions, namely, environmental, institutional, and social vulnerability. Social inequalities dictate the beneficiary and nonverbatim groups, and environmental circumstances reveal equipment flaws and capacity and grid capacity, institutional fragmentation, delays, inconsistencies, and underinvestment.

Such integrative view needs policies that no longer prioritize technological optimization, but towards multi-scalar, equity based, and infrastructural governance based on resilience.

3. METHODOLOGY

This study adopts a qualitative single-case study design focused on the United States during the period January 2024 to October 2025. A case study approach is appropriate because EV charging infrastructure development is shaped by interdependent environmental, institutional, and social factors that cannot be understood through isolated variables. The design allows the analysis of federal–state coordination,

policy implementation, and community-level outcomes within their real-world governance context. Within this national case, the study pays particular attention to how environmental constraints, regulatory processes, and equity concerns interact to shape infrastructure performance.

3.1. Data Collection

The sources which were used to collect the data included academic tableau, government publications, industry publications and general discussion. Literature search was implemented in indexed databases like Web of Science, Scopus, ScienceDirect and JSTOR. A search between January 2024 and October 2025 was performed and involved the search terms associated with EV charging infrastructure, the NEVI program, grid constraints, permitting, and equity. The criteria for including the studies were that a study needed to cover the U.S situation and give empirical or policy relevant knowledge. The study used the documents of the U.S Department of energy, Federal Highway Administration, the environmental protection department, Government Accountability office and some of the state transportation agencies to examine policy goals and challenges in implementation. These documents offered details on progress on deployment, which allowed timelines, funding flow, and institutional performance. Reported statistics on the industry, including the NEMA and the Alliance of Automotive Innovation, were also analyzed regarding the costs of equipment, the state of the supply chain, and technical barriers.

The media coverage and opinions were incorporated in the report to record reaction on stakeholders, infrastructure failure challenges and implementation challenges in real time. The news stories of both national publications and specialized magazines covering energy issues were evaluated as well as the posts of X (previously Twitter) as made by ordinary people. The only content that was included was that which specifically talked about the reliability of infrastructure, policy debates or charging experiences of the public.

3.2. Data Analysis

The assessment was thematic based. All the gathered materials were read and coded based on the common recurring issues, such as allowing delays, incoherent governance, grid restrictions, unequal deployment, and reliability issues. These codes were then clustered into greater analytical themes based on the theoretical frameworks that guide the study: environmental vulnerability, institutional vulnerability and social vulnerability. With this structure, it became feasible to label the problem of infrastructure not just in terms of technical breakdown but as being a result of exposure to climatic factors, regulatory ability, and disparity.

To enhance the validity, the findings were compared and contrasted throughout the analysis process across the sources of data. The federal charger reliability and deployment statistics were reviewed in collaboration with the media coverage and academic discoveries in order to find out congruency or divergences. Such triangulation served to make sure that the interpretations were based on the overall evidence base and not a particular view.

4. RESULTS AND DISCUSSION

4.1. Magnitude of Humanitarian Impact

Its findings also demonstrate that there are considerable humanitarian-style implications contained within the present electric vehicle (EV) charging system in the US. Social and economic disadvantaged areas or areas that are geographically marginalized Empirical evidence indicates that over one million affected adopters directly relate to infrastructural and policy gaps. In a survey-based study and secondary data, most survey respondents (36 percent) have indicated that the charging time, their accessibility, and reliability have been important factors mostly making them reluctant to buy an EV, which is a measure of a systematic flaw that is not limited in its scope to what they want to have but extends to structural and governing platforms. The indices of nation confidence are at a constant lower level than desirable measures. The reliability of the general charging networks was 78 on average and the failure rates were approximately 29 according to the evaluation items by Harvard university, 2025 reliability study and concurred by the records of the department of energy (DOE). These failures closely involve failure of hard- and software parts where the methods can be dysfunctional in a connector and styles are corroded to the actualization of payments and unreliable networks alongside incomplete compatibility. All these failures of repetitive operation point to the delicacy of the infrastructures, which are still the many obstacles on the way to empowering the users and introducing electric mobility solutions.

National coverage of geospatial data of renewable energy by the National Renewable Energy Laboratory (NREL) shows that the rural coverage is less than 25 percent with underlying space gaps of disparities in the establishment of infrastructure underlying the coverage. Cities and towns - in particular, those near the coasts, and giant cities such as Los Angeles, New York and Washington D.C. are well-serviced by extensive amounts of charges, and the vast mid-western and southern states are severely underserved. This asymmetry would justify what was included in the literature as charging deserts so that the energy and service difference in the previously noted areas of broadband facilities and public transportation infrastructure would be reflected. This consequent disenfranchisement of the individuals translates into higher social vulnerability and a non-adaptive capacity of the rural communities, and poor people, which indeed is synonymous with the Social Vulnerability Theory wherein the interplay of exposure, sensitivity as well as adaptive capacity (V = f(E, S, AC)) is an expression of vulnerability.

The quantitative overview of key impact metrics is summarized below:

Table 1. Impact Metrics for U.S. EV Charging Infrastructure (2025)

Category	Statistic	Source
Public Charging Ports	200,000	USDOT (2025)
Network Reliability	78%	Harvard (2025)
Failure Rate	29%	Harvard (2025)
Rural Coverage	<25%	NREL (2025)
Estimated Potential Adopters Affected	1 million+	Derived from DOE Adoption Models

It states that the existence of inequalities in the U.S. electric vehicle (EV) system has humanitarian-like consequences - not due to it causing life-or-death crises, but due to the long-term systemic discrimination. Poor or non-availability of charging networks results in economic liabilities, travel risk and decreased mobility to some groups. These challenges capture bigger challenges including fractured governance, unequal investment, ineffective grids, and loss of public confidence in energy transformations measures. Since EV infrastructure is technological and social infrastructure, any disruption, however small, will likely have an outsized negative impact on marginalized populations, which shows the equity-related impacts of this infrastructure in the functions of daily use.

The text also describes that the discrepancies in the reliability and expansion of the service are against the national policy objectives despite the federal programs such as the National Electric Vehicle Infrastructure (NEVI) program. The lack of equal access through inconsistent regulations, administrative bottlenecks and different capacities of the states to carry out their role in sustainability worsens socio-spatial disparities. Finally, the humanitarian lens is not theoretical as it brings out objective disparities in access, reliability, and continuity of EV services. This text ends by suggesting through reiterating the significance of studying the influence of these systemic problems on the performance of institutions, their integrity in governance and necessity of coherent and robust policy practice.

4.2. Institutional Performance and Governance Failures

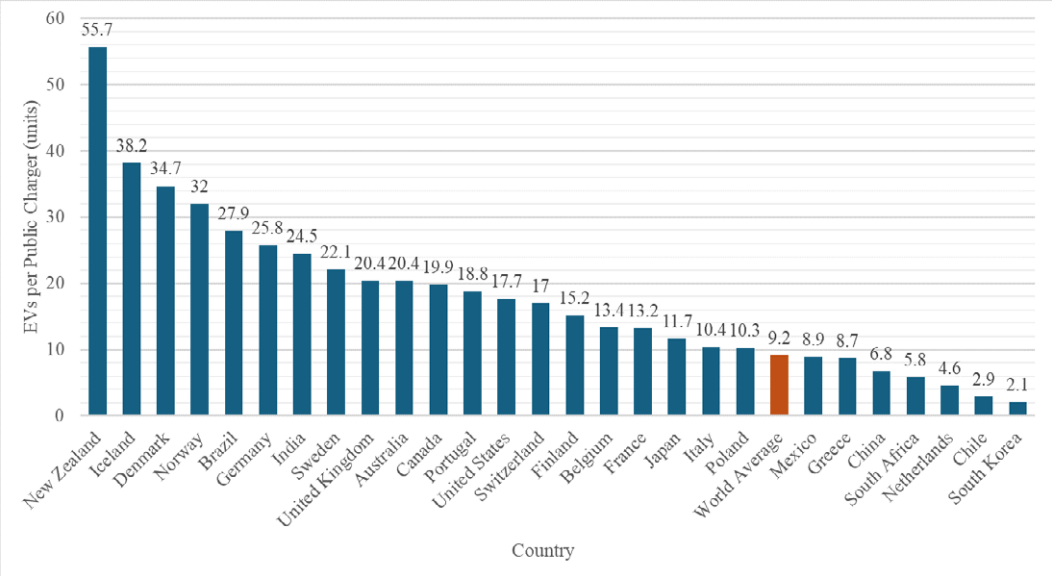

Figure 1. Number of electric cars per public charger by country, 2021.

The article has pointed out major governance and organizational shortcomings that hampered the success of the National Electric Vehicle Infrastructure (NEVI) program, even with an enormous federal investment in the Bipartisan Infrastructure Law. By the middle of 2025, half of the planned 10,000 NEVI-funded charging stations were functional in fifteen states, which revealed serious administrative bottlenecks, inflexible procedures, compliance overburden, and a lack of coordination between federal and state agencies. All these have resulted in institutional inertia which can be termed as institutional paralysis whereby bureaucracy processes have taken precedence over the actual delivery of infrastructure thereby lack of money, time wastage and a gap between the vision of the policy and the actual reality.

GAO and DOE auditing also establish that the structural governance weaknesses are due to weak internal controls, delayed response to risks, and continuous permitting and contracting impediments. These failures can be included in the Triple Vulnerability Framework that describes how the disjointed governance, inconsistency in regulations, and the lack of compatibility between data systems make the EV infrastructure network less resilient. They also have a relation to the Social Vulnerability Theory because gradual implementation of chargers in rural and low-income neighborhoods affects the mobility of the already vulnerable populations disproportionately. The excerpt also finds that financial investment is not a guarantee of infrastructure resilience; instead, adaptive governance, which involves flexibility, learning and coordination of actions across sectors, is needed in order to turn the EV charging network into an ill-fitting network of projects into a system of sustainable mobility.

4.3. Environmental Justice and Differential Vulnerability

Results indicate that the distribution and access to EV charging infrastructure in the United States is still severely unequal as per social, economic, and geographic aspects, which is another manifestation of the traditionally uneven access to sustainable mobility. Households with people of color, low income and rural communities are vulnerable to rely on the neglected, sparse or untrustworthy public charging networks, unlike those with higher incomes and living in urban areas due to access to personal home charging and more reliable services. According to DOE and NREL statistics, 31-81 percent of EV users in disadvantaged census tracts will only charge

at publicly available chargers, which puts them particularly under the risk of equipment malfunctions and grid instability, which is a manifestation of social vulnerability as an increased reliance on external infrastructure. The rural parts are even more underprovided, 94 percent of counties are under heavy need of more public charging capacity; long routes between stations, grids and extreme conditions further restrict the EV uptake and contribute to inequitable infrastructures.

Table 2. Differential Impacts of EV Charging Infrastructure (2025)

Group	Primary Impact	% Affected	Source
Rural Communities	Low Infrastructure Coverage	94% of Counties Require Expansion	NREL (2025)
Low-Income Households	Limited Charging Access / Reliability Gaps	4–16% Have Regular Access	DOE (2025)
Disadvantaged Areas	Dependence on Public Charging	31–81% of Users	DOE / EPA (2025)
Women and Minority Groups	Lower Ownership and Accessibility Rates	Underrepresentation in Adoption	Pew (2024)

Overall, the results justify the supposition that environmental justice remains the center of the EV infrastructure policy and planning. The overcoming of these disparities will not be enhanced physical infrastructure itself, but also adding equity metrics to federal funds formula, prioritization on favorable counties, and ensuring the places where electricity is offered to the population will be secure, functioning, and cost-effective. Currently, it is essential to identify vulnerability and mitigate the difference to transform the U.S. EV transition not only into a technological success or any other accomplishment, but also into a socially equitable and environmentally viable compromise.

4.4. Response Effectiveness and Systemic Limitations

Electric vehicle (EV) Charging infrastructure is a reaction to the current challenges with the U.S. electric vehicle (AV) infrastructure, which is indicative of an increasing awareness of the weakness of the system but of single actions that reveal small gains in terms of systemics. In 2025, the U.S. Department of Transportation (USDOT) and Department of Energy (DOE) announced the NEVI Reliability and Performance Initiative, an investigation that is funded (46.5 million) to increase the uptime and maintenance of charge up on chargers and standardization of data across the nation. In spite of the fact that these grants were the actual policy initiative to improve interoperability and good services provision, they could have influence through fragmented governance and fragmented implementation of the same initiative at the state level and the absence of financial capacity to clear the magnitude of infrastructural gaps. Overall, these grants were impressive, but their amount was insufficient to alter the ratios of deficits. A typical failure junction between the federal design and local delivery processes will be shown by the project implementation delays and delays the project disbursement. The audit reports and performance reports of Government Accountability Office (GAO) and the Federal Highway Administration (FHWA) serve to evinced that symbolically important as such reactive measures can be, they are unable to contribute to the solution of the structural inefficiencies, which drag the progress in the right direction. Ongoing regulatory pigment and inappropriate matching guidelines of procurement and lack of consistency in reliability declaration has led to spotty form of government that is not in detail over administration and ineffective accountability. These institutionalized stiffnesses undermine the ability to adapt to effective socio-technical systems, which a Critical Infrastructure Studies (CIS) perspective should have. Meanwhile, Social Vulnerability Theory (SVT) identifies the inefficiencies of these problems enhancing equity inequity particularly in the presence of marginalized and rural populations, dependent on services publicly billed, and publicly faced with delayed maintenance which they often currently face.

In postulation, even though the initiative (46.5 million) is an attempt at approaching immediate problems of reliability, it is too small to result in any long-term structural transformation. A lack of accountability and temporary grant cycles are being contributed by overlapping federalist infrastructure governance model mandate of DOE and FHWA and the state agencies. The policy of EV infrastructure will not be transformed, they will remain reactive as there is no unified global strategy of resilience, with the help of which regulatory competency, financing frameworks, and equity issues can be adapted. Institutional coherence like making investments that are long-term and standardizing performance measures to capture a process in which infrastructure can be reliable is the only way that one can be able to adapt to the challenge.

5. CONCLUSION

This paper concludes that the policy and regulatory loopholes in the electric vehicle (EV) charging infrastructure of the United States go beyond the technical failures of technically deficient infrastructure to the deep-rooted socio-political injustice that question the resilience of the nation. By using the Triple Vulnerability Framework by applying it through the environment dimension as well as institutional and social dimension, same research reveals the interaction of fragmented governance, uneven funding and socio-economic disparity as factors that undermined the EV ecosystem. According to the Social Vulnerability Theory (SVT) and the Critical Infrastructure Studies (CIS), the paper identifies the micro-level human factors such as the unavailability of mobility and unequal access as the expressions of the macro-level failures of governance such as bureaucratic stagnation and incoherent policies. The social and environmental inequality are also tied together due to the inequalities in grid stability and the distribution of the chargers; the infrastructural vulnerability is also accessible to indicate inequality. Collectively, the outcomes above indicate the need

to have an active and equity-based government with the help of following resilience planning as per the general objectives of the program of transition to clean mobility.

The implication is not only to the EV field, but to the infrastructure policy who, lack resilience and equity due to this; is a part of the risk of vulnerability rather than diminishing it. The formation of a solid and non-discriminatory charging network, in its turn, thus demands an institutional change conducted through the resilience audit, an early warning system, GIS-based surveillance, and multi-sector coordination in accordance with the notions of disaster-risk-reduction. In spite of the limitation of relying on secondary data and a national local study, the framework applied in the research could be applicable to test interventions based on comparative research. Lastly, to achieve sustainable and equitable EV infrastructure, there is the need to switch to proactive policymaking as systemic foresight with technological development being matched by social adoption, permanence of rules and institutional adaptability across temporal periods.

RECOMMENDATIONS

The paper makes strategic suggestions aimed at enhancing the resilience, equity and governance of the U.S. EV charging infrastructure. These recommendations put findings of the study into practice as a guideline to policy and planning in keeping with national sustainability and disaster-risk-reduction objectives.

1. Institutionalize Infrastructure Resilience: Federal and state planning should incorporate resilience, which should not be pursued in times of crisis. The requirement to include resilience criteria in the funding decision making process, permitting, and performance evaluation should be embedded in the agencies like DOE and FHWA. Establishing special interagency coordination offices or resiliency offices will assist in sustaining risk monitoring and quicker corrective measures.

2. Develop Real-Time Reliability and Early-Warning Systems: The national digital monitoring system would be capable of monitoring the performance of chargers, load on the grid, and the risks of outages in real-time. Predictive analytics to enable operators and users with alerts would be useful in preventing failures, minimizing downtime, and enhancing the confidence people have in the charging network.

3. Integrate Vehicle-to-Grid (V2G) Technologies: V2G infrastructures have the capability to enable grid stability and emergency response because EVs can give power back to the grid when the power demand is at its peak or in an emergency. Arguing pilot measures in the high-risk territories, incentives, and better regulations that would allow EVs to enter the energy market would speed up personage adoption and increase disaster readiness.

4. Strengthen Zoning and Land-Use Policy for Charger Deployment: The state and local governments need to incorporate EV charging into land-use and zoning strategies and give precedence to low-income and rural underserved communities. The proper density of the chargers, appropriate location further than climate-related hazard, and co-location with transit routes, highways and evacuation corridors can be guaranteed with clear zoning standards.

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