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Review on EV Fast Charging, Stability and Deployment

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ABSTRACT

The rapid growth of electric vehicles (EVs) necessitates the development of robust charging infrastructure. This paper focuses on reviewing advanced charging infrastructure, including converter topologies and quick-charging technologies to meet future demands. The burgeoning popularity of electric vehicles (EVs) necessitates a robust and efficient fast charging infrastructure. This review delves into the technological advancements and practical hurdles associated with high-power charging systems. We examine the latest charging technologies, their impact on EV battery life, and the critical factors influencing widespread deployment. By analyzing the interplay of technology, economics, and policy, this paper offers insights into overcoming stability challenges and optimizing fast charging networks to support the transition to sustainable transportation.

Keywords: Electric vehicle charging station, EV Charging Level, Charging facility, Real-world implementation.

1. INTRODUCTION

The surge in electric vehicle (EV) adoption necessitates a robust fast-charging infrastructure to alleviate range anxiety and accelerate the transition to clean transportation. This paper delves into the technological advancements and practical challenges of deploying such infrastructure. Electric vehicles (EVs) have garnered significant global attention in recent decades as a promising strategy to mitigate greenhouse gas emissions from the transportation sector [1].

2. TECHNOLOGY AND STANDARD

The rapid development and deployment of electric vehicle (EV) fast charging technology are critical to addressing the limitations of EV charging times and range anxiety. This section details the primary technologies and standards employed in EV fast charging, highlighting the key components, innovations, and industry standards [16]. fast EV charging is a crucial technology for accelerating the adoption of electric vehicles by making them more convenient and practical for everyday use.

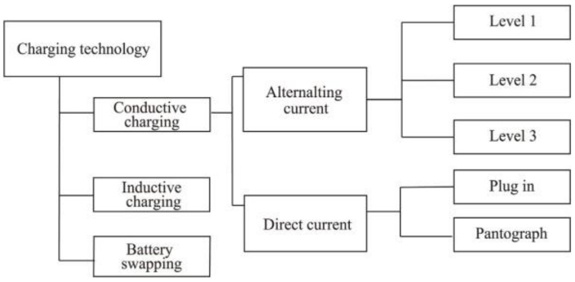

Fig. 1. Charging technologies of electric vehicle(EV)

TABLE 1: VARIOUS STANDARD FOR RAPID DC CHARGING SYSTEM

Charging Standard	Max. Voltage	Max. current	Peak Power Output
Tesla Proprietary	410V	330A	135 Kilowatts
Combined Charging System (CCS) Type 2 (FF Configuration)	1000V	200A	175 Kilowatts
Chinese Standard (GB/T) (BB Configuration)	1000V	250A	120 Kilowatts
Combined Charging System (CCS) Type 1 (EE Configuration)	600V	200A	150 Kilowatts
CHAdeMO	1000V	400A	400 Kilowatts

Battery swapping technology is currently under development to assess its potential uses. Charging methods are categorized into AC Level-1, AC Level-2, and DC fast charging based on the power source and charging topology. The new rulebook introduces additional distinctions within DC charging, defining DC Level-1 and DC Level-2 standards.

TABLE 2: SAE CHARGING LEVELS

Charging Standard	**Power Supply**	**Current Capacity**	**Peak Power Output**
Level 1 AC Charging	120 Volt AC Power	16 Amperes	1.9 Kilowatts
Level 2 AC Charging	240V AC Power (Single-Phase)	80 Amperes	19.2 Kilowatts
Level 3 AC Charging	600 Volt AC Power (Three- Phase)	160 Amperes	166 Kilowatts
Level 1 DC Fast Charging	200-1000 Volt DC Power	80 Amperes	40 Kilowatts
Level 2 DC Fast Charging	200-1000 Volt DC Power	400 Amperes	400 Kilowatts

3. PROBLEM STATEMENT

This research aims to find the ideal locations for stations that can flexibly charge electric vehicles. This is a complex problem, as it involves balancing different costs like operating the stations, buying equipment, and acquiring land. To evaluate the impact of these stations on the power grid, the research uses specific cost measures. Before determining the best locations, the research will also determine the optimal number of these charging stations needed in the specific area [4].

(i). Placement and size of renewable energy sources:

Using EVs powered by fossil fuels doesn't reduce carbon emissions. Integrating Sustainable Distributed Generation (SDG), like solar and wind power, into the grid is crucial. This helps balance power demand and improve grid reliability. This study assumes SDGs will contribute 10% of the East Delta Network's load.

(ii). Number of fast charging station:

The number of Flexible Charging Stations (FCSs) needed was determined based on factors like the region's EV population, battery size, charging frequency, and charging duration.

$$N_{FCS} = \frac{P^{EV} * N^{EV} * CH_{time}}{S_t * Ef * C_p * lf * N^C * pf} \quad (1)$$

The number of FCSs depends on factors like the average power used by EVs (P^{EV}), the number of EVs charged daily (N^{EV}), charging time (CH_{time}), service time per charger (S_t), connector capacity (Cp), number of connectors per FCS (N^C), charging efficiency (Ef), charger load factor (lf), and the power factor of the charging load (pf).

(iii). Investment cost reduction indicator:

Land costs vary significantly by location. Development costs are substantial but expected to decrease with technological advancements. Investors must evaluate land costs for each potential FCS site. Investment cost (IC) is calculated considering fixed costs, land costs, and development costs (Eq. 2). Assuming a minimum 100m² space, land cost is calculated as five years of rental cost. The Investment Cost Reduction Indicator (ICRI) at the ith bus represents the normalized investment cost.

$$IC_i = C^{fix} + 100 * N_D * C_i^{lan} + (N_C - 1) * C_p * C_{dev} \quad (2)$$

$$ICRI_i = \frac{IC_i}{\max(IC_i)} \quad (3)$$

C^{fix} represents the fixed cost of establishing the charger. C_i^{lan} denotes the five-year land rental cost per square meter at the ith bus location. C_P and N_C represent the connector's rated power and quantity. C_{dev} represents the development cost per connector. N_D signifies the planning period in days.

(iv). Active power loss reduction indicator:

Two indicators were used to assess power loss reduction within the East Delta Network (EDN) and determine optimal FCS locations. The first, the Active Power Loss Reduction Indicator (PLRI), evaluates potential increases in grid power losses when FCSs are integrated.

$$PLRI = 1 - \frac{PL^{Base}}{PL^{FCS}} \quad (4)$$

PL^{Base} represents the total active power loss in the distribution system without FCSs, while PL^{FCS} represents the loss with FCSs. The active power loss of the system is calculated using Equation 5.

$$PL = \sum_{b=1}^{Nb} \left(\frac{P_b^2 + Q_b^2}{V_b^2}\right) R_b \quad (5)$$

This equation calculates the total active power loss in a given electrical network. Here's a breakdown of the variables-**Pb:** Active power flow in the b-th branch of the network, **Qb:** Reactive power flow in the b-th branch of the network, **Rb:** Resistance of the b-th branch, **Vb:** Sending node voltage of the b-th branch, **Nb:** Total number of branches in the network.

(v). Reactive power loss reduction indicator:

The second power loss reduction indicator, the Reactive Power Loss Reduction Indicator (QLRI), establishes a threshold for maintaining grid voltage stability by ensuring reactive power losses remain below that limit. This indicator is defined in Equation 6.

$$\text{QLRI} = 1- \frac{\text{QL}^{\text{Base}}}{\text{QL}^{\text{FCS}}} \quad (6)$$

QL^{Base} represents the total reactive power loss in the distribution system without FCSs, while QL^{FCS} represents the loss with FCSs. The reactive power loss of the system is calculated using Equation 7.

$$\text{QL} = \sum_{b=1}^{Nb}\left(\frac{P_b^2+Q_b^2}{V_b^2}\right)\text{X}_\text{b} \quad (7)$$

This equation calculates the total reactive power loss in a given electrical network. Here's a breakdown of the variables- $\mathbf{P_b}$**:** Active power flow in the b-th branch of the network, $\mathbf{Q_b}$**:** Reactive power flow in the b-th branch of the network, $\mathbf{X_b}$**:** Reactance of the b-th branch, $\mathbf{V_b}$**:** Sending node voltage of the b-th branch, $\mathbf{N_b}$**:** Total number of branches in the network.

(vi). Reliability:

Reliability indices are significantly influenced by statistical parameters like failure rates and outage durations. These parameters can change when integrating EV loads and SDG generation. The failure rate and interruption duration for a given bus can be defined by equations [4].

$$\delta_{\text{EV}} = (\text{P}_{\text{base}} + \Delta\text{P}_{\text{EV}})\frac{\delta_{base}}{P_{base}} \quad (8)$$

$$\text{T}_{\text{EV}} = (\text{P}_{\text{base}} + \Delta\text{P}_{\text{EV}})\frac{\text{T}_{base}}{T_{base}} \quad (9)$$

Reliability indices, such as SAIFI, SAIDI, and CAIDI, are significantly influenced by statistical parameters like failure rates and outage durations. These parameters can be altered by integrating EV loads and SDG generation.

SAIFI, a customer-oriented reliability index, reflects the average number of interruptions experienced by a customer. It degrades as the number of disruptions and customers in the system increases.

$$\text{SAIFI} = \frac{\sum(\delta_{\text{EV}} * \text{C}_\text{i})}{\sum \text{C}_\text{i}} \quad (10)$$

C_i represents the number of customers connected to the ith bus after integrating FCSs and SDGs. SAIDI, another customer-oriented reliability index, reflects the average interruption duration experienced by each customer. It provides insights into the network's overall interruption severity.

$$\text{SAIDI} = \frac{\sum(\text{T}_{\text{EV}} * \text{C}_\text{i})}{\sum \text{C}_\text{i}} \quad (11)$$

CAIDI, another customer-oriented reliability index, represents the average outage duration experienced by each customer. It is calculated considering factors such as the average failure rate, the time taken for the failure rate to increase due to higher EV loads, and the number of customers.

$$\text{CAIDI} = \frac{\sum(\text{T}_{\text{EV}} * \text{C}_\text{i})}{\sum(\delta_{\text{EV}} * \text{C}_\text{i})} \quad (12)$$

Expected Energy Not Supplied (EENS) is a key reliability index that quantifies the amount of energy not supplied to customers due to interruptions. It is calculated as the product of load and interruption time, as shown in Equation 13. EENS indicates insufficient energy supply.

$$\text{EENS} = \sum(\text{P}_{\text{EV}} * \text{T}_\text{i}) \quad (13)$$

PEV represents the load on the distribution network after integrating EV charging. AENS (Available Energy Not Supplied) is a reliability index that indicates the amount of load demand that cannot be met during an outage. It provides insights into the impact of increased EV charging loads on energy availability.

$$\text{AENS} = \frac{\sum(\text{P}_{\text{EV}} * \text{T}_\text{i})}{\sum \text{C}_\text{i}} \quad (14)$$

4. AC CHARGING FOR ELECTRIC VEHICLES

AC Energizing involves using standard alternating current power, similar to what powers homes and buildings, to charge electric vehicles (EVs). This method relies on existing electrical infrastructure, making it a widely accessible and cost-effective option [5].

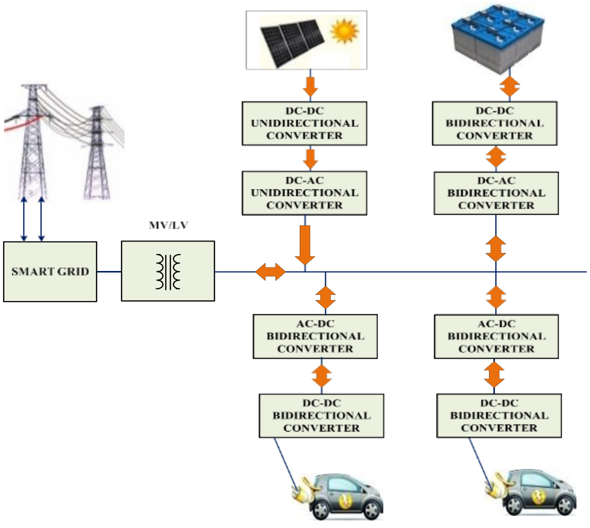

Fig. 2. AC Bus-Based Electric Vehicle Charging

5. STABILITY AND RELIABILITY

The rapid expansion of EV infrastructure worldwide necessitates real-time insights into public charging reliability [13]. While machine learning has been applied to various aspects of intelligent transportation systems, including autonomous driving, EV charging scheduling, and distributed charging management, the real-time reliability of EV charging infrastructure remains understudied.

6. CHARGING INFRASTRUCTURE

This study collected papers in peer-reviewed journals and literature investment for EV fast charging infrastructure. EV fast charging infrastructure is essential for accelerating the widespread adoption of electric vehicles (EVs) [9].

TABLE 3: COMPARATIVE ANALYSIS OF DIFFERENT LITERATURE REVIEW

Ref. No.	Author	Year	Performance	Methodology	Publication journal	Future work
[6]	Chun Sing Lai et al.	2022	BESS real-time scheduling	(TD3) algorithm, Novel optimal power scheduling	Energy 259 (2022) 124852	Fast EV Charging
[7]	Victor Sam Moses Babu K et al.	2024	Minimum Power Loss and Minimum Voltage Deviation	Particle Swarm Optimization Algorithm	International Journal of Electrical Power and Energy Systems 155 (2024) 109502	Potential Benefits of Integrating Energy Storage Systems
[8]	G. Ramanathan et al.	2024	multiport charging of EVs	MATLAB/Simulink	Energy Reports 11 (2024) 5716–5732	Hybrid techniques
[9]	Regina Rablet al.	2024	maximum number of individual charging units.	Multi-period optimization	Transport Policy 148 (2024) 124–144	charging facilities to multiple electricity grid levels
[10]	D. Oyediran et al.	2024	optimal allocation of slow and fast chargers	mixed-integer linear programming	Energy 305 (2024) 132311	integration of renewable energy sources
[11]	Alaa Torkey et al.	2022	plug-in hybrid electric vehicles	objective-oriented optimization techniques	Transport Policy 128 (2022) 193–208	Developing a meso-level planning framework
[12]	Sandy Youssef Rahmeet al.	2023	EV chargers are inherently nonlinear in nature	Lyapunov method	Sustainable Energy, Grids and Networks 35 (2023) 101119	robust controller
[13]	Jiali Fu et al.	2024	Optimal location for charging stations	Clustering method	Transport Policy 152 (2024) 21–28	Fast EV Charging

7. RESULTS OF COMPARATIVE ANALYSIS

- The strategy for setting up EV charging infrastructure prioritized locations based on Traffic patterns, Parking availability, Usage trends over time.
- To simplify implementation, the plan was divided into sub-plans focusing on Government buildings Airports, Private properties, State-owned companies.
- The first phase focused on establishing charging stations at key locations, including NITI Aayog, Major government offices, public sector enterprises such as GAIL, NTPC, and Indian Oil.

8. ECONOMICS AND ENVIRONMENTAL CONSIDERATION

Fast EV charging is a critical component of the transition to electric transportation, but it presents a complex interplay of economic and environmental factors [19].

9. CASE STUDIES AND REAL-WORLD IMPLEMENTATION

***Case Study 1:** Delhi's EV Charging Network: A Location Analysis*

NITI Aayog outlined a plan to rapidly deploy EV charging stations across Delhi within a year. The strategy emphasized strategic placement, considering factors like traffic, parking availability and peak usage times. To expedite the process, the plan was segmented into smaller initiatives targeting government buildings, airports, private properties, and state-owned enterprises [16].

Case Study 2: *Optimal Placement of Charging Stations in Prayagraj City*

Prayagraj, a developing smart city, is expected to see a surge in electric vehicle (EV) usage. This study aims to identify the best locations and sizes for EV charging stations within the city's power distribution network. To achieve this, a combination of Genetic Algorithm and Particle Swarm Optimization (GA-PSO) is employed. The optimization process considers factors like cost, voltage levels, power limits, and the capacity of charging stations [17]. Figure 3 illustrates the city's power distribution network. Red columns represent feeders with existing charging stations, while black columns indicate feeders without such facilities.

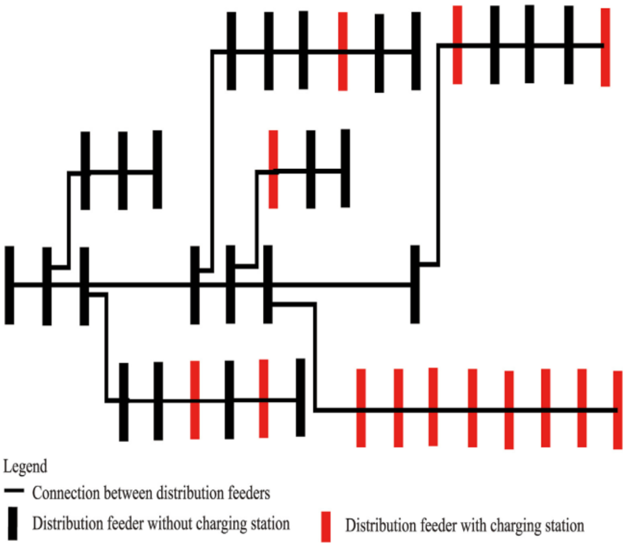

Fig. 3. City's power distribution network

10. FUTURE TRENDS AND CHALLENGES

The future of fast EV charging is marked by exciting technological advancements, evolving market dynamics, and increasing environmental concerns [23].

11. CONCLUSION

In conclusion, the successful deployment of fast EV charging requires a coordinated effort involving policymakers, industry stakeholders, and technology developers. By addressing the technological, economic, and environmental challenges, we can pave the way for a sustainable and electrified transportation future.

REFERENCES:

[1] Abd El-Shafy A. Nafeh, Abd El-Fattah A. Omran, A. Elkholy, Hosam K.M. Yousef “Optimal economical sizing of a PV-battery grid-connected system for fast charging station of electric vehicles using modified snake optimization algorithm” Results in Engineering 21 (2024) 101965, doi.org/10.1016/j.rineng.2024.101965.

[2] Xiangyu Li, Christine Yip, Zhao Yang Dong, Cuo Zhang, Bo Wang “Hierarchical control on EV charging stations with ancillary service functions for PV hosting capacity maximization in unbalanced distribution networks” International Journal of Electrical Power and Energy Systems 160 (2024) 110097.

[3] Naser Nakhodchi, Hamed Bakhtiari, Math H.J. Bollen, Sarah K. Ronnberg, “Including uncertainties in harmonic hosting capacity calculation of a fast EV charging station utilizing Bayesian statistics and harmonic correlation” Electric Power Systems Research 214 (2023) 108933.

[4] Fareed Ahmad, Imtiaz Ashraf, Atif Iqbal, Mousa Marzband, Irfan Khan “A novel AI approach for optimal deployment of EV fast charging station and reliability analysis with solar based DGs in distribution network” Energy Reports 8 (2022) 11646–11660, doi.org/10.1016/j.egyr.2022.09.058.

[5] Mohammed Abdullah Ravindran, Kalaiarasi Nallathambi, Pradeep Vishnuram, Rajkumar Singh Rathore, Mohit Bajaj, ImadRida, Ahmed Alkhayyat, “A Novel Technological Review on Fast Charging Infrastructure for Electrical Vehicles: Challenges, Solutions and Future Research Directions” Alexandria Engineering Journal 82 (2023) 260–290, doi.org/10.1016/j.aej.2023.10.009.

[6] Chun Sing Lai, Dashen Chen, Jinning Zhang, Xin Zhang, Xu Xu, Gareth A. Taylor, Loi Lei Lai, “Profit maximization for large-scale energy storage systems to enable fast EV charging infrastructure in

distribution networks" Energy 259 (2022) 124852, doi.org/10.1016/j.energy.2022.124852.

[7] Victor Sam Moses Babu, Pratyush Chakraborty, Mayukha Pal, "Planning of fast charging infrastructure for electric vehicles in a distribution system and prediction of dynamic price" International Journal of Electrical Power and Energy Systems 155 (2024) 109502, doi.org/10.1016/j.ijepes.2023.109502.

[8] G. Ramanathan, C. Bharatiraja, Hossam Kotb, Ahmed Emara, "PV-assisted modified Z-source inverter for multiport EV charging infrastructure: Access with PV2V" Energy Reports 11 (2024) 5716–5732, doi.org/10.1016/j.egyr.2024.05.036.

[9] Regina Rabl, Melanie Reuter-Oppermann, Patrick E.P. Jochem, "Charging infrastructure for electric vehicles in New Zealand" Transport Policy 148 (2024) 124–144, doi.org/10.1016/j.tranpol.2024.01.010.

[10] Damilare Oyediran, Jagruti Thakur, Mutayab Khalid, Ashish Guhan Baskar, "Electrification of marinas in Stockholm: Optimizing charging infrastructure for electric boats" Energy 305 (2024) 132311, doi.org/10.1016/j.energy.2024.132311.

[11] Alaa Torkey, Hossam Abdelgawad, "Framework for planning of EV charging infrastructure: Where should cities start?" Transport Policy 128 (2022) 193–208, doi.org/10.1016/j.tranpol.2022.09.015.

[12] Sandy Youssef Rahme, Shirazul Islam, Syed Muhammad Amrr, Atif Iqbal, Irfan Khan, Mousa Marzband, "Adaptive sliding mode control for instability compensation in DC microgrids due to EV charging infrastructure" Sustainable Energy, Grids and Networks 35 (2023) 101119, doi.org/10.1016/j.segan.2023.101119.

[13] Jiali Fu, Arne Nåbo, Harrison John Bhatti, "Locating charging infrastructure for freight transport using multiday travel data" Transport Policy 152 (2024) 21–28, doi.org/10.1016/j.tranpol.2024.04.007.

[14] Yifan Liu, Azell Francis, Catharina Hollauer, M. Cade Lawson, Omar Shaikh, Ashley Cotsman, Khushi Bhardwaj, Aline Banboukian, Mimi Li, Anne Webb, Omar Isaac Asensio, "Reliability of electric vehicle charging infrastructure: A cross-lingual deep learning approach" Communications in Transportation Research 3 (2023) 100095.

[15] Muhammad Shahid Mastoi, Shenxian Zhuang, Hafiz Mudassir Munir, Malik Haris, Mannan Hassan, Muhammad Usman, Syed Sabir Hussain Bukhari, Jong-Suk Ro, "An In-Depth Analysis of Electric Vehicle Charging Station Infrastructure, Policy Implications, And Future Trends" EnergyReports8(2022)11504–11529, doi.org/10.1016/j.egyr.2022.09.011.

[16] Sulabh Sachan, Praveen Prakash Singh, "Charging infrastructure planning for electric vehicle in India: Present status and future challenges" Regional Sustainability 3 (2022) 335–345, doi.org/10.1016/j.regsus.2022.11.008.

[17] A. Nikitas, K. Michalakopoulou, E.T. Njoya, D. Karampatzakis, "Artificial intelligence, transport and the smart city: definitions and dimensions of a new mobility era" Sustain vol. 12 (7) (2020).

[18] S. Rivera, S. Kouro, S. Vazquez, S.M. Goetz, R. Lizana, E. Romero-Cadaval, "Electric vehicle charging infrastructure: from grid to battery" IEEE Ind. Electron. Mag. 15 (2021) 37–51.

[19] Sachin Sharma, Nitin Kumar Saxena, "Capability identification for new charging station into distribution system with electric, economic and traffic considerations" e-Prime - Advances in Electrical Engineering, Electronics and Energy 9 (2024) 100669, doi.org/10.1016/j.prime.2024.100669.

[20] Y. Jin, M.A. Acquah, M. Seo, S. Han, "Optimal siting and sizing of EV charging station using stochastic power flow analysis for voltage stability" IEEE Transactions on Transportation Electrification 10, 2024, pp. 777–794.

[21] S.A. Funke, M. Sprei, E. Gnann, "How charging infrastructure development can help achieve environmental goals" J. Sustain. Transp. Syst. 15 (3) (2023) 123–134.

[22] S. Sharma, D. Kaur, N.K. Saxena, “Investigation for size and location of electric vehicle charging station accompanying VRP index and commissioning cost, Int. J. Emerg. Electr. Power Syst. 25 (1) (2024) 45–59.

[23] S.S. Ravi, M. Aziz, “Utilization of electric vehicles for vehicle-to-grid services: progress and perspectives, Energies 15 (2) (Jan.2022) 589.

[24] Gireesh Shrimali, “Getting to India’s electric vehicle targets cost-effectively: to subsidize or not, and how?” Energy Pol. 156 (Sep) (2021).

[25] R.P. Upputuri, B. Subudhi, “A comprehensive review and performance evaluation of bidirectional charger topologies for V2G/G2V operations in EV applications” IEEE Transactions on Transportation Electrification 10 (1) (March 2024) 583–595.

[26] Siebenhofer M, Ajanovic A, Haas R, “How policies affect the dissemination of electric passenger cars worldwide” Energies Jan. 2021;14(8).

[27] Heinisch V, Goransson L, Erlandsson R, Hodel H, Johnsson F, Odenberger M, “Smart electric vehicle charging strategies for sectoral coupling in a city energy system” Appl Energy Apr. 2021;288:116640.

[28] G. Alkawsi, Y. Baashar, U. Dallatu Abbas, A.A. Alkahtani, S.K. Tiong, “Review of renewable energy-based charging infrastructure for electric vehicles” Appl. Sci. (Switz.) vol. 11 (9) (2021).

[29] M.T. Turan, E. Gokalp, “Integration analysis of electric vehicle charging station equipped with solar power plant to distribution network and protection system design” J. Electr. Eng. Technol. vol. 17 (2) (2022).

[30] J.K. Szinai, C.J.R. Sheppard, N. Abhyankar, A.R. Gopal, “Reduced grid operating costs and renewable energy curtailment with electric vehicle charge management” Energy Policy vol. 136 (2020).

[31] Nandini K. K., Jayalakshmi N. S., Vinay Kumar Jadoun, “Risk-based dynamic pricing by metaheuristic optimization approach for electric vehicle charging infrastructure powered by grid integrated microgrid system” Electric Power Systems Research 230 (2024) 110250, doi.org/10.1016/j.epsr.2024.110250.

[32] Alok Jain, Suman Bhullar, “Operating modes of grid integrated PV-solar based electric vehicle charging system- a comprehensive review” Advances in Electrical Engineering, Electronics and Energy 8 (2024) 100519, doi.org/10.1016/j.prime.2024.100519.

[33] N. Muralidharan, et al., “Next-generation cobalt-free cathodes – a prospective solution to the battery industry’s cobalt problem” Adv. Energy Mater. 12 (9) (Jan.2022).

[34] Brown et al., “Electric Vehicle Supply Equipment United States Patent Application” Publication Pub. No.: US 2011/0169447 A1.

[35] Mark Rawson, Sue Kateley, “Electric vehicle charging equipment design and health and safety codes” SAE Trans. 108 (Aug.1998) 3256–3262.

[36] N. Deb, R. Singh, R.R. Brooks, K. Bai, “A review of extremely fast charging stations for electric vehicles” Energies 14 (22) (Nov. 2021).

[37] Abdul Rauf Bhatti, Muhammad Tamoor, Rehan Liaqat, Akhtar Rasool, Zainal Salam, Ahmed Ali, Abdulkerim Sherefa, “Electric vehicle charging stations and the employed energy management schemes: a classification based comparative survey” Discover Applied Sciences (2024) 6:503.

[38] Boya Anil Kumar, B. Jyothi, Arvind R. Singh, Mohit Bajaj, Rajkumar Singh Rathore, Milkias Berhanu Uka, “Hybrid genetic algorithm-simulated annealing based electric vehicle charging station placement for optimizing distribution network resilience” Scientific Reports (2024) 14:7637.

[39] Rania A. Ibrahim, Ibrahim. M.Gaber, Nahla E. Zakzouk, “Analysis of multidimensional impacts of electric vehicles penetration in distribution networks” Scientific Reports (2024) 14:27854.

[40] Mohamed Abdel-Basset, Abduallah Gamal, Ibrahim M. Hezam, Karam M. Sallam, “Sustainability assessment of optimal location

of electric vehicle charge stations: a conceptual framework for green energy into smart cities" Environment, Development and Sustainability (2024) 26:11475–11513.

[41] Abhinav Srivastava, Munish Manas, Rajesh Kumar Dubey, "Electric vehicle integration's impacts on power quality in distribution network and associated mitigation measures: a review" Journal of Engineering and Applied Science (2023) 70:32.

[42] Hongcai Zhang, Xiaosong Hu, Zechun Hu, Scott J. Moura, "Sustainable plug-in electric vehicle integration into power systems" Nature Reviews Electrical Engineering Volume 1 January 2024 35–52.

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