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The Role of EV Parking Lots for Supporting the Distribution System Operation Considering EV Uncertainties

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Abstract

Due to the dramatic increase in the penetration of the Electric Vehicle Parking Lots (EVPLs) in future, there will be a crucial challenge in the operation of the distribution systems. In this regard, the potential of the EVPLs for acting as a flexible load can be employed besides their capability to support the system with positive or negative reactive power if they are equipped with the required power electronic facilities. Our results show that EVPLs can modify their charging schedule to provide positive or negative reactive power support to improve the system condition in terms of congestion and voltage to let for deploy the cheaper generation sources that result in a decrease in total system cost. In this regard, EVPLs' location has a very important impact on the optimal operation of the system and the amount of benefit from their active and reactive power support.

Keywords: Electric vehicle parking lot; EV uncertainty, distribution system, reactive power support

1. Introduction

Distribution system management can be impacted both positively and negatively by Electric Vehicles (EVs). It is possible to obtain different results by charging and discharging EVs in controlled and uncontrolled modes. Uncontrolled charging could develop an increase in loss and demand, unbalancing of the distribution system loads, and a decrease in the life span of distribution system infrastructures, as they are assessed in the works of Shariff et al.

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(2022), Kütt et al. (2013), and Shukla, Verma, and Kumar (2019), respectively. On the other hand, taking advantage of controlled charging and discharging technologies such as vehicle-to-grid (V2G) Guille et al. (2009) will grant the distribution system the ability to manage its production-consumption balancing. In other words, peak load shaving Solanke et al. (2020), a decrease in emissions Vidhi et al. (2018), and voltage regulation Hu et al. (2021) could be mentioned as the main advantages of the controlled charging and discharging of EVs. Several studies have been performed to investigate the EVPL's impact on the distribution system and how they can support its operation. In general, researchers have studied the impact of EV charging on the distribution system, including the impact of charging schedule on the distribution system and the potential need for reinforcement and upgrading of the network Ramadhani et al. (2020). Moreover, some articles have also studied the optimization of EV charging in parking lots to improve the overall efficiency of the system Chippada and Reddy (2022); Ebrahimi et al. (2022). Integration of renewable energy sources into EVPLs has also been assessed to reduce the carbon footprint of charging EVs and to improve energy security Al-Thani et al. (2022). Researchers have also studied the integration of smart grid technologies into EVPLs, including advanced metering, demand response, and energy storage systems, to improve the distribution system's efficiency and reliability Judge et al. (2022). User behavior and adoption of EVs, including the impact of incentives and tariffs on user behavior are also investigated in Von Bonin et al. (2022).

Authors in Shahbazitabar et al. (2018) solved a stochastic unit commitment problem considering EVPLs and renewable generations. Similarly, a bi-level method has been presented in Sadati et al. (2019) that incorporates EVPLs in energy and reserve markets. In this research, a novel approach for minimization of costs and addressing the distribution grid constraints was deployed. Authors in Wenzel et al. (2017) proposed a two-level model for charge-scheduling of EVs in order to facilitate frequency regulation services inside the distribution grid. In Zheng et al. (2018) an EV charging scheduling model is presented. In this research, an AC power flow is used to reach the most efficient scheduling in the case of energy cost and EV demand supply. Similar purposes have persuaded the authors of Latifi et al. (2018) to present a game theory-based decentralized model for EV charging strategies. Ref Ahmad et al. (2022) investigated the influences that several EV charging lot allocation strategies have on the distribution system. Authors in Ahmadi et al. (2022) presented a decentralized optimization approach for optimizing the operation of multi-agent microgrids in presence of sector coupling. The authors aim to address the challenges associated with coordinating the decisions of multiple agents, uncertainty in energy demand and supply, and the integration of multiple energy storage technologies. The article Hamidan et al. (2022) focuses on the integration of battery energy storage systems (BESS) and EV charging stations into smart distribution networks to enhance the flexibility and reliability of the electricity grid and presents a flexible planning approach optimizing the deployment and operation of BESS in a way that balances the trade-off between energy storage capacity and energy storage utilization, and considers the uncertainties in load demand and renewable energy sources. Authors in Pirouzi et al. (2019) discussed the potential use of single-phase EVs for power conditioning in distribution networks to enhance the stability and reliability of distribution networks. The proposed approach considers the impact of EV charging and discharging dynamic behavior on the distribution network. Ref Baherifard et al. (2022) explored the impact of intelligent charging planning for EVs on distribution network's imbalance indices.

This paper tries to fill the gap in the literature to investigate the role of EV parking lots in supporting the distribution system with a focus on reactive power support considering the uncertain arrival and departure of EVs. This way the optimal operation of the distribution system components like EVPLs, renewable energy resource, distributed generation units, and energy storage are conducted based on the hourly active and reactive power prices as well as the network topology, lines capacity, and the fixed active and reactive loads by deploying a linearized AC power flow formulation.

2. Problem Formulation

As stated in previous section, the main aim of this paper is to study the operation of distribution system that is equipped with EVPL. This way the optimal energy management of the distribution system operator in presence of EVPL, Renewable Energy Sources (RES) and Distributed Generation (DG) is investigated in this paper.

2.1. Objective function

The objective of the DSO is to minimize its operational cost as stated in (1) where the first and second terms stand for the cost of trading active and reactive power with the upstream grid. The third and fourth terms are related to the generation cost of RES and DGs. $P_t^{DN}, Q_t^{DN}, P_{i,t}^{RES}, and\ P_{i,n,t}^{DG}$ stand for active and reactive power traded between the distribution system and the upstream power system as well as generated power by RES and segment n of the DG generation, respectively.

$$Min\ C_D = \Delta T \sum_{t=1}^{T} \left(k_t^P . P_t^{DN} + k_t^Q . Q_t^{DN} + \sum_{i=1}^{NB} \left[c_i^{RES} . P_{i,t}^{RES} + \sum_{n=1}^{N_i^{DG,seg}} c_{i,n} . P_{i,n,t}^{DG} \right] \right) \quad (1)$$

2.2. Constraints

The operational constraints of the different DSO-owned facilities are explained below.

2.2.1 Grid constraints

The linear active and reactive power flow equations are adopted from Yuan et al. (2016) as stated in (2)-(7). $P_{i,t}^{EVPL}$, $Q_{i,t}^{EVPL}$, $P_{i,t}^{ESS,dc}$, $P_{i,t}^{ESS,ch}$, $P_{L,i,t}^{Fix}$, $Q_{L,i,t}^{Fix}$, P_i, Q_i, P_{ij}, Q_{ij} stand for active and reactive power of EVPL, discharging and charging power of the ESS, nonflexible active and reactive load, active and reactive injection power at bus i as well as active and reactive power in the line between bus i and j.

$$P_{ij} = \frac{r_{ij}}{r_{ij}^2 + x_{ij}^2}(V_i - V_j) + \frac{x_{ij}}{r_{ij}^2 + x_{ij}^2}(\theta_i - \theta_j) \quad (2)$$

$$P_i = \sum_{j=1, i \neq j}^{N_B} P_{i,j} \quad (3)$$

$$Q_{ij} = \frac{x_{ij}}{r_{ij}^2 + x_{ij}^2}(V_i - V_j) - \frac{r_{ij}}{r_{ij}^2 + x_{ij}^2}(\theta_i - \theta_j) \quad (4)$$

$$Q_i = \sum_{j=1, i \neq j}^{N_B} Q_{i,j} \quad (5)$$

$$P_i = P_t^{DN} - P_{i,t}^{EVPL} + P_{i,t}^{RES} + P_{i,t}^{DG} + P_{i,t}^{ESS,dc} - P_{i,t}^{ESS,ch} - P_{L,i,t}^{Fix} \quad (6)$$

$$Q_i = Q_t^{DN} - Q_{i,t}^{EVPL} + Q_{i,t}^{DG} - Q_{L,i,t}^{Fix} \quad (7)$$

2.2.2 EV parking lot

EVPL in this paper is modelled as energy storage where the parameters are obtained via the characteristics of different EV classes hosted by EVPL and the PDF of the arrival and departure of EVs. In this paper, similar to most of the papers in the literature, the EV arrival and departure pattern is modelled with a Truncated Normal Distribution (TND) in the related studies. This way, using the cumulative distribution function (CDF) of TND, the number of arriving and departing EVs in each hour is obtained. Then, EVPL's charging and discharging power, EVPL's stored energy, and EVPL's active and reactive power constraints are represented in (8)-(18).N, E, Cap, cl, arr, and dep denotes the number of EVs, level of energy, capacity of the EV Battery, EV class, arrival, and departure. Moreover, Sh_{cl} and $C_i^{PL,ins,ch}$ stand for share of the EV class and installed capacity of the EV chargers in the EVPL.

$$E_{i,t}^{PL} = E_{i,t-1}^{PL} - E_{i,t}^{dep} + E_{i,t}^{arr} + \Delta t \eta_{ch} P_{i,t}^{PL,ch} \quad (8)$$

$$N_t^{Ev,arr} = N^{EV,ent}\left(F_{t+0.5}^{TND,arr} - F_{t-0.5}^{TND,arr}\right) \quad (9)$$

$$N_t^{Ev,dep} = N^{EV,ent}\left(F_{t+0.5}^{TND,dep} - F_{t-0.5}^{TND,dep}\right) \quad (10)$$

$$E_{i,t}^{arr} = N_{i,t}^{Ev,arr}\left(\sum_{cl} Cap_{cl}^{Ev}\, SOC_{cl}^{arr} Sh_{cl}\right) \tag{11}$$

$$E_{i,t}^{dep} = N_{i,t}^{Ev,dep}\left(\sum_{cl} Cap_{cl}^{Ev}\, SOC_{cl}^{dep} Sh_{cl}\right) \tag{12}$$

$$0 \le P_{i,t}^{PL,ch} \le C_{i}^{PL,ins,ch} \tag{13}$$

$$0 \le P_{i,t}^{PL,ch} \le N_{i,t}^{EV,par}\left(\sum_{cl} P_{cl}^{ch,max}\, Sh_{cl}\right) \tag{14}$$

$$N_{i,t}^{EV,par} = N_{i,t-1}^{EV,par} + N_{i,t}^{Ev,arr} - N_{i,t}^{Ev,dep} \tag{15}$$

$$E_{i,t}^{PL,min} \le E_{i,t}^{PL} \le E_{i,t}^{PL,max} E_{i,t}^{PL,min} = N_{i,t}^{EV,par}\left(\sum_{cl} Cap_{cl}^{Ev}\, SOC^{min} Sh_{cl}\right) \tag{16}$$

$$E_{i,t}^{PL,max} = N_{i,t}^{EV,par}\left(\sum_{cl} Cap_{cl}^{Ev}\, SOC^{max} Sh_{cl}\right) \tag{17}$$

$$\left(P_{i,t}^{PL}\right)^2 + \left(Q_{i,t}^{PL}\right)^2 \le \left(S_{i}^{PL}\right)^2 \tag{18}$$

2.2.3 RES and DG

The generated power by DGs should satisfy the ramp rate and nominal capacity constraint as indicated in (19)-(21). In addition, the uncertainty of RES generation is modelled by the chance-constrained-based formulation presented in (Yi et al. 2020) as represented in (22). $\Phi_a(.)$ is the CDF of the standard normal distribution, η is the confidence level, and $\sigma_{i,t,fore}$ is the standard deviation.

$$P_{i,n,min}^{DG} \le P_{i,n,t}^{DG} \le P_{i,n,max}^{DG} \tag{19}$$

$$\Delta_{i,min}^{DG} \le P_{i,t}^{DG} - P_{i,t-1}^{DG} \le \Delta_{i,max}^{DG} \tag{20}$$

$$\left(P_{i,t}^{DG}\right)^2 + \left(Q_{i,t}^{DG}\right)^2 \le \left(S_{i,t}^{DG}\right)^2 \tag{21}$$

$$0 \le P_{i,t}^{RES} \le \overline{P_{i,t,fore}^{RES}} + \sigma_{i,t,fore}.\Phi_a^{-}1(1-\eta) \tag{22}$$

2.2.4 Energy storage system

The operation of energy storage system (ESS) is modelled as represented in (23)-(26). $\delta_{i,t}^{ESS}$ is a binary variable for defining the charging/discharging status of the ESS. η_{in} and η_{out} are the charge and discharge efficiency.

$$0 \le P_{i,t}^{ESS,ch} \le P_{i,max}^{ESS,ch}.\delta_{i,t}^{ESS} \tag{23}$$

$$0 \le P_{i,t}^{ESS,dc} \le P_{i,max}^{ESS,dc}\left(1-\delta_{i,t}^{ESS}\right) \tag{24}$$

$$E_{i,min}^{ESS} \le E_{i,t}^{ESS} \le E_{i,max}^{ESS} \tag{25}$$

$$E_{i,t}^{ESS} = E_{i,0}^{ESS} + \Delta T \sum_{t=1}^{j} \eta_{in}.P_{i,t}^{ESS,ch} - \eta_{out}.P_{i,t}^{ESS,dc} \tag{26}$$

2.3. Linearization

There are quadratic constraints in the power flow, EVPL, and DG modelling. To remove the nonlinearity the linearization method presented in Yang et al. (2017) is deployed where the circle feasible area of the quadratic constraint is approximated with a polygon. Therefore, the optimization problem is handled via mixed integer linear programming.

3. Simulation results

3.1. Case study

We used the case study of Yi et al. (2020) and modified it by adding EVPLs to the system as depicted in Fig. 1. This way, we have considered two systems for our simulations with different locations of EVPLs in the grid. In the first system, EVPLs are located at the margins of the network, while in the second system, EVPLs are located in the central areas. In this paper, we considered that there are 10 EV classes with the characteristics presented in Table 1. For all EV classes SOC_{cl}^{dep} is equal to 0.85 and $P_{cl}^{dc,max}$ is equal to $P_{cl}^{ch,max}$. Moreover, the share of each EV class in total available EVs is 0.1. Furthermore, the parameters of TND for arrival are as follows: the minimum and maximum EVs arrival times are 5 and 17, the average arrival time is 8 and the standard deviation is 3. In addition, the parameters of TND for departure are as follows: the minimum and maximum EVs departure times are 11 and 24, the average departure time is 16 and the standard deviation is 3. Finally, the number of charging stations in all EVPLs is 3000.

Table 1. EV classes and characteristics

cl	1	2	3	4	5	6	7	8	9	10
$P_{cl}^{ch,max}$ (kW)	7	10	10	7	10	7	5	5	7	10
Cap_{cl}^{Ev} (kWh)	15	20	20	15	20	15	10	10	15	20
SOC_{cl}^{arr}	0.33	0.33	0.16	0.4	0.1	0.45	0.5	0.2	0.33	0.2

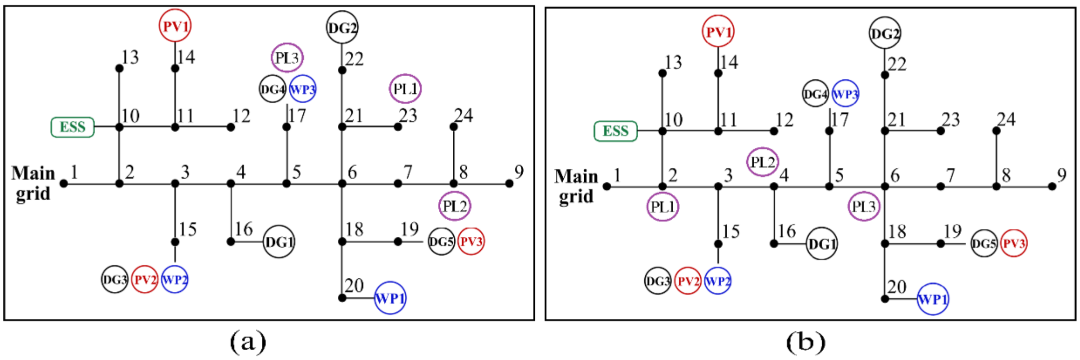

Fig. 1 Distribution system topology in (a) Case 1 and (b) Case 2

3.2. Results and discussion

We have studied the system operation in two cases to study the impact of the reactive power support capability of EVPL, coordinated operation of EVPL, deploying bidirectional EV chargers, and location of EVPL on the optimal system operation in terms of operational cost. As EV chargers in EVPLs are equipped with power electronic facilities to convert the AC current to DC current, there is a possibility to provide reactive power support Paudyal et al. (2017). This way, by investing in the power electronic facilities in the EV chargers, there will be a reactive power support capability in EV chargers. The impact of reactive power support capability on system operation has been investigated in two cases with the same system but different EV locations. The results show that in both cases the EVPLs' reactive power support capability will result in a decrease in the system cost. Moreover, EVPLs based on their location provide the system with different positive and reactive power support during the day as represented in Fig. 2 which is related to case 1 and Fig. 3 which is relayed to case 2. In these figures, the operation of EVPLs with and without reactive power capability is investigated to assess the impact of reactive power support capability and the location of the EVPLs on their operation. In this regard, when there is no reactive power support from EVPLs, their charging schedule is managed like a flexible load to reduce the system cost. However, when there is a reactive power support capability, EVPLs can modify their charging schedule to provide positive or negative reactive power support to improve the system condition in terms of congestion and voltage to let for deploy the cheaper power sources. In this regard, the

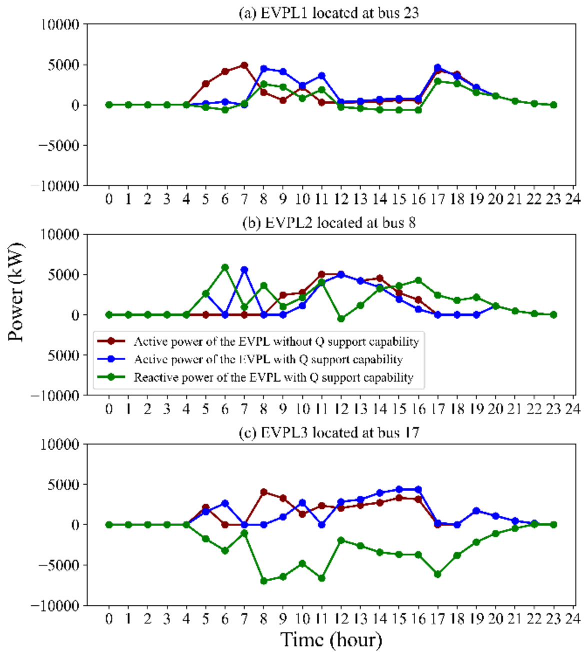

Fig. 2 The active and reactive power of (a) EVPL1, (b) EVPL 2, and (c) EVPL3 in case 1 (EVPLs are located in buses 2, 4, and 6)

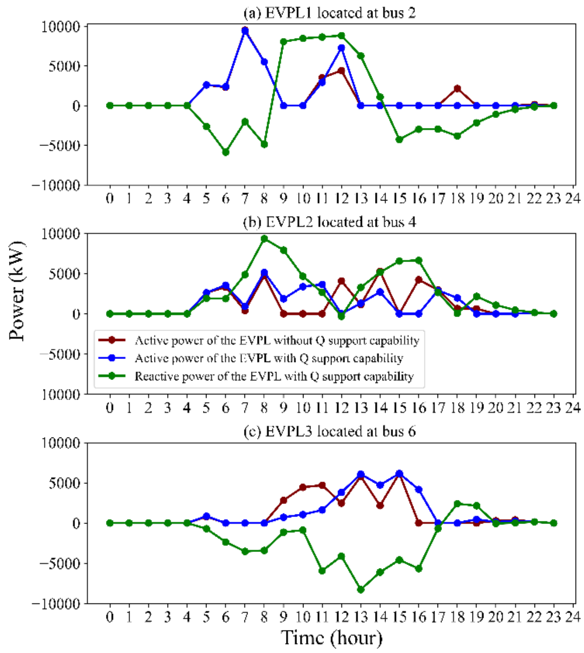

Fig. 3 The active and reactive power of (a) EVPL1, (b) EVPL 2, and (c) EVPL3 in case 2 (EVPLs are located in buses 23, 8, and 17)

operation of EVPLs 1, 2, and 3 are different in cases 1 and 2 as their locations are different in these two cases. Therefore, EVPLs location has a very important factor in the optimal operation of the system for two reasons. Firstly, the active power load would be different in different system buses and secondly, the reactive power support capability is also different in different buses. Therefore, the impact of the EVPLs on the distribution system operation depends on the distribution system topology and active and reactive loads and different assists in different parts of the system besides the characteristics and capabilities of EVPLs. In addition, it is understood that when EVPLs are equipped with reactive power support, their optimal charging schedules are changed to enable them for reactive power support. This way, the system voltage at that bus would be regulated to let for optimal active and reactive power flow to reduce the active power cost.

Table 2. The whole system cost for cases 1 and 2

Case	*Case 1*		*Case 2*	
Q support capability	✓	✗	✓	✗
System cost	18955.68 €	19468.06 €	18369.03 €	18395.24 €

The other important point is that the cost reduction amount is different for the two cases. For case 1, the whole system cost with and without Q support is 18369.03 €and 18395.24 €, accordingly. Therefore, the cost reduction from EVPLs’ reactive power support is 26.21€ in case 1. However, the whole system cost with and without Q support is 18955.68 € and 18468.06 €, accordingly. Hence, the cost reduction from EVPLs’ reactive power support is 512.36 € in case 2. This shows that deploying Q support from EVPLs in case 1 is way more beneficial due to the system topology than in case 2. The different benefits from reactive power support can be understood by noticing the operation of DGs and RES for case 1 and case 2 in the presence and absence of reactive power support as depicted in Fig. 4, Fig. 5, Fig. 6, and Fig. 7. Fig. 4 shows that in case 1, reactive power support capability allows for more RES generation in some hours, while as depicted in Fig. 5, reactive power support from EVPLs has not any impact on the RES generation in case 2. Similar behaviour can be seen in DGs’ operation in cases 1 and 2. In case 1, when reactive power support from

EVPLs is available, the DG generation pattern can be totally modified to let for reducing the system cost, as shown in Fig. 6, while in case 2, the change in the DG generation pattern is way less compared to case 1. This way, deployment of reactive power support from EVPLs is more beneficial in case 1 compared to case 2.

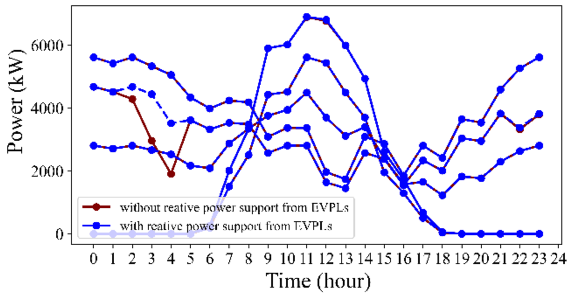

Fig. 4 RES generation in case 1

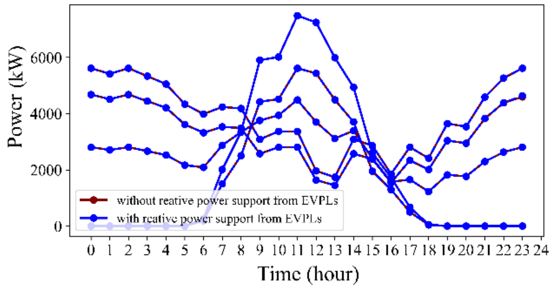

Fig. 5 RES generation in case 2

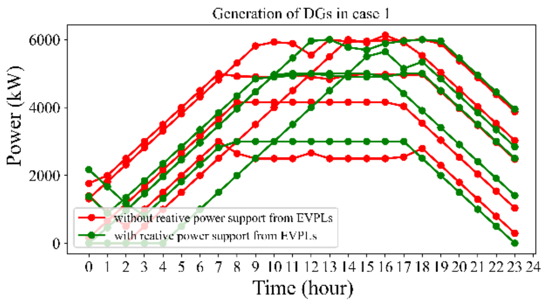

Fig. 6 Generation of DGs in case 1

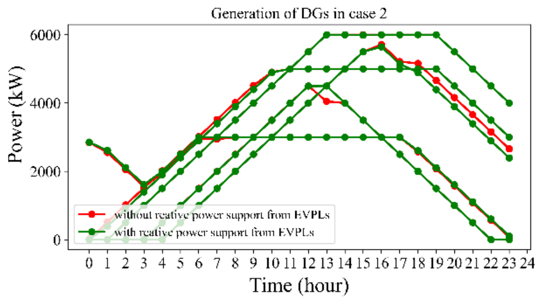

Fig. 7 Generation of DGs in case 2

4. Conclusion

In this paper, the impact of the commercial EVPL on the optimal distribution system operation was investigated. The results show that EVPLs can modify their charging schedule to provide positive or negative reactive power support to improve the system condition in terms of congestion and voltage to let for deploy the cheaper power sources. In this regard, EVPLs' location has a very important impact on the optimal operation of the system for two reasons. Firstly, the active power load would be different in different system buses and secondly, the reactive power support capability is not similar in different buses. Therefore, the location of the EVPLs and their situation in the distribution system is an important factor in deciding on the investment in equipping them with reactive power support facilities. In future studies, the effect of residential EV chargers can also be studied to assist decision-makers to define the proper locations for both residential and commercial EVPLs. In addition, the voltage violation cost should be considered in the whole system cost to better highlight the impact of the reactive power support from EVPLs in improving the distribution system operation.

References

Ahmad, Fareed, Atif Iqbal, Imtiaz Ashraf, and Mousa Marzband. 2022. 'Optimal location of electric vehicle charging station and its impact on distribution network: A review', Energy Reports, 8: 2314-33.

Ahmadi, Seyed Ehsan, Delnia Sadeghi, Mousa Marzband, Abdullah Abusorrah, and Khaled Sedraoui. 2022. 'Decentralized bi-level stochastic optimization approach for multi-agent multi-energy networked micro-grids with multi-energy storage technologies', Energy, 245: 123223.

Al-Thani, Hanadi, Muammer Koç, Rima J Isaifan, and Yusuf Bicer. 2022. 'A Review of the Integrated Renewable Energy Systems for Sustainable Urban Mobility', Sustainability, 14: 10517.

Baherifard, Mohammad Ali, Rasool Kazemzadeh, Ahmad Sadeghi Yazdankhah, and Mousa Marzband. 2022. 'Intelligent charging planning for electric vehicle commercial parking lots and its impact on distribution network's imbalance indices', Sustainable Energy, Grids and Networks, 30: 100620.

Chippada, Devisree, and M Damodar Reddy. 2022. 'Optimal Planning of Electric Vehicle Charging Station along with Multiple Distributed Generator Units', IJISA, 14: 40-53.

Ebrahimi, M, S Haghifam, H Laaksonen, M Shafie-Khah, and Y Xiang. 2022. 'Optimal planning of a virtual power plant hosting an EV parking lot'.

Guille, Christophe, and George Gross. 2009. 'A conceptual framework for the vehicle-to-grid (V2G) implementation', Energy policy, 37: 4379-90.

Hamidan, Mohammad-Ali, and Farzaneh Borousan. 2022. 'Optimal planning of distributed generation and battery energy storage systems simultaneously in distribution networks for loss reduction and reliability improvement', Journal of Energy Storage, 46: 103844.

Hu, Jindi, Chengjin Ye, Yi Ding, Jinjiang Tang, and Si Liu. 2021. 'A distributed MPC to exploit reactive power V2G for real-time voltage regulation in distribution networks', IEEE Transactions on Smart Grid, 13: 576-88.

Judge, Malik Ali, Asif Khan, Awais Manzoor, and Hasan Ali Khattak. 2022. 'Overview of smart grid implementation: Frameworks, impact, performance and challenges', Journal of Energy Storage, 49: 104056.

Kütt, Lauri, Eero Saarijärvi, Matti Lehtonen, Heigo Mõlder, and Jaan Niitsoo. 2013. "A review of the harmonic and unbalance effects in electrical distribution networks due to EV charging." In 2013 12th International Conference on Environment and Electrical Engineering, 556-61. IEEE.

Latifi, Milad, Amir Rastegarnia, Azam Khalili, and Saeid Sanei. 2018. 'Agent-based decentralized optimal charging strategy for plug-in electric vehicles', IEEE transactions on industrial electronics, 66: 3668-80.

Paudyal, Sumit, Oğuzhan Ceylan, Bishnu P Bhattarai, and Kurt S Myers. 2017. "Optimal coordinated EV charging with reactive power support in constrained distribution grids." In 2017 IEEE Power & Energy Society General Meeting, 1-5. Ieee.

Pirouzi, Sasan, Jamshid Aghaei, Taher Niknam, Mohammad Hassan Khooban, Tomislav Dragicevic, Hossein Farahmand, Magnus Korpås, and Frede Blaabjerg. 2019. 'Power conditioning of distribution networks via single-phase electric vehicles equipped', IEEE Systems Journal, 13: 3433-42.

Ramadhani, Umar Hanif, Mahmoud Shepero, Joakim Munkhammar, Joakim Widen, and Nicholas Etherden. 2020. 'Review of probabilistic load flow approaches for power distribution systems with photovoltaic generation and electric vehicle charging', International Journal of Electrical Power & Energy Systems, 120: 106003.

Sadati, S Muhammad Bagher, Jamal Moshtagh, Miadreza Shafie-khah, Abdollah Rastgou, and João PS Catalão. 2019. 'Operational scheduling of a smart distribution system considering electric vehicles parking lot: A bi-level approach', International Journal of Electrical Power & Energy Systems, 105: 159-78.

Shahbazitabar, Maryam, and Hamdi Abdi. 2018. 'A novel priority-based stochastic unit commitment considering renewable energy sources and parking lot cooperation', Energy, 161: 308-24.

Shariff, Samir M, Mohammad Saad Alam, Salman Hameed, Mohd Rizwan Khalid, Aqueel Ahmad, Essam A Al-Ammar, Ibrahim Alsaidan, and Hasan Alrajhi. 2022. 'A state-of-the-art review on the impact of fast EV charging on the utility sector', Energy Storage, 4: e300.

Shukla, Akanksha, Kusum Verma, and Rajesh Kumar. 2019. 'Multi-objective synergistic planning of EV fast-charging stations in the distribution system coupled with the transportation network', IET Generation, Transmission & Distribution, 13: 3421-32.

Solanke, Tiruapti U, Pradeep K Khatua, Vigna K Ramachandaramurthy, Jia Ying Yong, Jeevan Kanesan, Mohd Tariq, and Padmanathan Kasinathan. 2020. "Optimal design of EV aggregator for real-time peak load shaving and valley filling." In 2020 IEEE International Conference on Power Electronics, Drives and Energy Systems (PEDES), 1-5. IEEE.

Vidhi, Rachana, and Prasanna Shrivastava. 2018. 'A review of electric vehicle lifecycle emissions and policy recommendations to increase EV penetration in India', Energies, 11: 483.

von Bonin, Michael, Elias Dörre, Hadi Al-Khzouz, Martin Braun, and Xian Zhou. 2022. 'Impact of dynamic electricity tariff and home PV system incentives on Electric Vehicle Charging Behavior: Study on potential grid implications and economic effects for households', Energies, 15: 1079.

Wenzel, George, Matias Negrete-Pincetic, Daniel E Olivares, Jason MacDonald, and Duncan S Callaway. 2017. 'Real-time charging strategies for an electric vehicle aggregator to provide ancillary services', IEEE Transactions on Smart Grid, 9: 5141-51.

Yang, Zhifang, Haiwang Zhong, Anjan Bose, Tongxin Zheng, Qing Xia, and Chongqing Kang. 2017. 'A linearized OPF model with reactive power and voltage magnitude: A pathway to improve the MW-only DC OPF', IEEE Transactions on Power Systems, 33: 1734-45.

Yi, Zhongkai, Yinliang Xu, Jianguo Zhou, Wenchuan Wu, and Hongbin Sun. 2020. 'Bi-level programming for optimal operation of an active distribution network with multiple virtual power plants', IEEE transactions on sustainable energy, 11: 2855-69.

Yuan, Haoyu, Fangxing Li, Yanli Wei, and Jinxiang Zhu. 2016. 'Novel linearized power flow and linearized OPF models for active distribution networks with application in distribution LMP', IEEE Transactions on Smart Grid, 9: 438-48.

Zheng, Yu, Yue Song, David J Hill, and Ke Meng. 2018. 'Online distributed MPC-based optimal scheduling for EV charging stations in distribution systems', IEEE transactions on industrial informatics, 15: 638-49.