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REVIEW

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Can electric vehicles be an alternative for traditional fossil-fuel cars with the help of renewable energy sources towards energy sustainability achievement?

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Abstract

The use of conventional fossil-fuel vehicles in the transportation industry contributes to climate change. The energy producing sector has actually adjusted its strategy to utilize more renewable energy to satisfy the energy demand as a result of this change in strategy. The use of electric vehicles (EVs) in the transportation network has also helped to reduce pollution from the energy industry. However, the distribution network would be placed under a lot of stress if a lot of EVs are attached to it, which might cause a number of problems and worries. However, several initiatives have been made in this direction to help find answers to these issues. The contribution of this review article is that, a number of the benefits of using the employed EVs techniques for the purpose of utilizing renewable energy sources (RESs) towards the accomplishment of a sustainable energy goal for a green environment in the so foreseeable have been highlighted; aiming to provide a larger variety of readers insights and suggestions for future research development. There have been a number of studies that have recommended various ideas and strategies for a reliable renewable energy supply. Their findings have been published in scientific journals. But the relationship between RESs and EVs in terms of energy efficiency is still needed to be further investigated to shorten such a gap in order to assess how EVs can help RESs achieve energy sustainability. Besides, the purpose of this study is to identify and assess the most recent advances and methodologies in the field. It's been possible to use numerous EV technologies to help with various problems and challenges, including the need for quick EV charging stations. However, there is a worry over the viability and applicability of EV-applied technologies that are ideally suited towards greater and more efficient usage of RESs in order to either attain or contribute to energy sustainability. In this article, we will discuss a variety of EV technologies that have been used in the past and contributed to the development of RESs. The method has applied the PRISMA 2020 strategy for inclusion and exclusion criteria. Also, the method has used specific keyword related to the topic including "electric vehicles" and "renewable energy sources". It is found that EVs can

be an effective alternative for currently used fossil-fuel vehicles due to a set of reasons highlighted in this review including fast EV charging stations, efficient design for PV solar panels, and effective utilization of RESs.

Keywords: Electric vehicles, Renewables, Sustainable energy

Introduction

There is no question that electric vehicles (EVs) might play an increasingly crucial role in the transportation industry moving ahead in order to assist ease issues related to the environment as well as the existing worries related to energy (Schmeck et al. 2022; Papoutsoglou et al. 2022). Increased flexibility and agility of energy systems are made feasible by the increasing adoption of plug-in hybrid electric vehicles (PHEVs) into distribution networks, provided that these cars are handled and controlled in an appropriate manner (Harewood et al. 2022; Xiaoluan et al. 2022; Laha et al. 2019). The substantial integration of renewable energy generation (REG) and the widespread use of plug-in electric vehicles (PEVs) have both shown to be beneficial in the fight against climate change (Suman 2021; Solaun and Cerdá 2019; Wang et al. 2018; Lin and Zhu 2019). This is because non-renewable energy (RE) thermal power plants are responsible for massive amounts of greenhouse gas (GHG) and carbon dioxide emission (Karmaker et al. 2020; Yang et al. 2018; Khan 2019). Because of this, there has been a major reduction in efficiency throughout both the functioning of the grid as well as its administration. As a result of this, the scheduling of variable energy systems has become essential for managing intermittent REGs and the widespread implementation of PEVs (Zhao et al. 2022).

It has been suggested and reported that the efficient use of appropriately controlling that charge and discharge PEVs would substantially assist to lessen the harmful impact on the stable operation of the energy system that is produced by, for instance, the intermittent wind energy production. This is something that has been discussed and reported. This results in a higher usage of RESs for the longer periods of time, leading to the production of a favorable environment for sustainable energy in the very near future (Zhao et al. 2022).

This paper is organized as follows: In the following section, the existing reviews are mentioned where the issues concerned by them have been highlighted. The method applied to extract papers has been explained in the third section. The fourth section gives a conclusion regarding the results obtained and reported in the previous and reviewed articles. Analysis according to research questions has been provided. Discussion has been given in then. The last section has drawn the conclusion where a number of future directions have been implicitly pointed out.

Existing assessments and review studies

Existing assessments have been conducted that have addressed the subject of EVs and its consequences on the economic and environmental sectors. These reviews have explored a variety of themes, and some of them have indicated worries about certain problems. According to these reviews, there are a number of problems that could pose a threat in the not-too-distant future. Some of these problems include extremely high energy demand, a problem with emissions of GHG, the depletion of fuel supplies, climate

change, expensive energy prices, a problem with the generation of renewable energy, an imbalance in the supply of energy, and many other problems. However, the recent review articles have helped to evaluate and highlight a great deal of potential answers to the problems and concerns that have been identified.

Few issues considered by the existing reviews will be discussed as follows.

The problem with climate change

Changing to modes of transportation that only use electricity might help reduce the severity of the danger posed by global warming. The entrance of EVs into the market has had a negative impact on a great deal of companies and organizations, one of which is the electrical grid. It's heartening to see that EVs' market share has increased over the last several years as a direct consequence of these legislation. Because to advancements in EV and charger technologies, EVs are now more readily available. Yong et al. (2015) has expressed worry on this.

Because of recent developments in EV battery technology and charging infrastructure, EVs have a promising future in the battle against climate change. In light of recent changes, both the challenges and opportunities facing the research community are evaluated and investigated (Sanguesa et al. 2021).

The problem with fossil fuel exhaustion

This issue has been the subject of discussion in a number of review publications, and research that are relevant to it have been examined in Shariff et al. (2019) and Ravi Kumar et al. (2020). The majority of the world's population depends heavily on fossil fuels, particularly in the areas of transportation and the generation of power. As a direct consequence of this dependency, the depletion of fossil fuels will lead to a rise in the price of oil. The burning of fossil fuels may result in an increase in GHG emissions, which are a significant contributor to climate change. Because of its capacity to lessen dependency on crude oil and to cut emissions of carbon dioxide and other pollutants that are linked with transportation, EVs are now regarded as one of the most promising solutions for land transportation. The report offers a comprehensive review of a number of EV research topics that are all intimately related to one another (Shareef et al. 2016), with a particular emphasis on EV charging technologies and the many ways in which EVs influence the battle against the depletion of fossil fuels.

Concerns over the depletion of fossil fuels and the catastrophic consequences that this would have on climate change have led to a recent uptick in the development of hybrid EVs, often known as HEVs. The literature on the uses of an energy storage system (ESS) in EVs that are attempting to overcome the depletion of fuels is covered in the review paper (Kumar et al. 2020).

The issue of renewable energy production

EVs are widely recognized as one of the most prevalent forms of renewable energy transportation solutions. One of the most pressing concerns is that the expanding use of EVs places a significant demand on the power infrastructure. The integration of local power production, such as that from RESs, with charging infrastructure is one strategy that has shown to be effective in limiting the impact. Other strategies include: Because RES

cannot be controlled and are thus unreliable, it is very challenging to synchronize the charging of EVs with other kinds of grid demand and RES. This is owing to the fact that RES cannot be dispatched. Both the interaction with RESs and the subject of charging EVs in the presence of SG technology are discussed in detail in Liu et al. (2015).

In addition, the most common types of EVs and methods for calculating RESs were discussed in the study. The connections between EVs and RESs have been taken into consideration, which includes presenting important ideas, summarizing solutions, and comparing a number of different planned research endeavors. A number of key issues that still need to be resolved in relation to the interactions between EVs and RES, and some possible solutions have been discussed.

The issue of energy storage systems (ESSs)

The problem of rising energy consumption is contributing to the phenomenon of global warming, and as a result, the two phenomena are interacting with one another. The problem of rising energy consumption will be impacted by the phenomenon of global warming. Several reviewers (Liu et al. 2015) have responded to this topic and offered solutions.

Conventional ESSs have limitations with regard to cost, energy, and power density. As a result of these limitations, it is now necessary to have a power production unit in addition to the cost storage unit. Innovative power electronics technologies may assist EVs in making more efficient use of the energy they store (Ravi Kumar et al. 2020).

A summarized and detailed analysis of the problems and concerns raised in recent EVs reviews

Existing studies have discussed a number of solutions that have been used to EV-related challenges, such as scheduling techniques, the locations of EV charging stations, routing problems, the role of EVs and their effects on a variety of environmental and economic factors, and the role of EVs in upgrading energy management system (EMS) that utilize demand response (DR) for more sustainable grid operations and RESs.

Nevertheless, it is of value and essential to take into consideration the adaptability of various situations in which EV technologies are applied and developed for. Meaning that readers and researchers would be able to improve the designs of EV solutions as per the scenario they had if they knew what the most appropriate EV technologies were that performed better to handle a certain situation, such as an increase in energy share or a decrease in demand by the buildings sector. These kinds of technology need attention and examination. As a consequence, this would likely make a contribution to a number of subfields and areas of research within the energy industry. This review would exhaustively cover a vast and diverse range of subjects and problems, which might provide a larger variety of scholars insights and suggestions.

The above-mentioned assessments that focus on EV technologies will be summarized. The focus, keywords, and considerations and concerns for each article are shown in Table 1.

A graphical representation of the topics and concerns addressed by existing reviews is provided in Fig. 1.

Table 1 A summarized overview of existing assessments' focus, keywords, and main considerations and concerns

References	Focus	Keywords	Main considerations and concerns
Yong et al. (2015)	The investigation of the relationship between electrifying transportation and the problem of climate change	• EV impacts V2G	• The significant consequences and advantages of electric vehicles (EVs) on the economy and the environment have been examined The possibilities that electric vehicles provide to the installation of the smart grid have been taken into consideration
Liu et al. (2015)	The connection between electric vehicles and environmentally friendly transportation systems	• EVs interacting with RE EV charging issue with SG	• The impact of electric vehicles on the need for energy has been taken into consideration EVs charging at the same time as other loads on the grid and renewable generation is a problem
Shariff et al. (2019)	The transition to EVs as a means of mitigating greenhouse gas emissions, the current oil crisis, the depletion of fuels, and the increase in the cost of fuel products has been the primary focus of the study	• V2G technology EV role towards effective EMS	Electric vehicles and the infrastructure needed to charge them were of concern
Ravi Kumar et al. (2020)	Influence of electric vehicles on climate change and depletion of fossil resources	• EV impacts EV role towards effective EMS	• Energy producing and energy storing units Electric vehicles' efficient use of energy
Sanguesa et al. (2021)	Impacts on improved energy management and lower prices brought forth by electric vehicles and the batteries they use	• Battery technologies Charging methods	The significance of electric vehicles in lowering prices and raising awareness about climate change and the environment

Method applied

Review method

In this review, the PRISMA 2020 statement has been applied. PRISMA 2020 strategy is used for systematic reviews to perform statistics and analysis regarding the inclusion and exclusion criteria. In this article, the exclusion and inclusion criteria have been gone through its procedure. There are a number of keywords used such as "electric vehicle", "renewable energy sources", "electric vehicles", and "energy sustainability".

Used data sources

For this review article, a number of data sources have been used. The papers have been collected from relevant data sources including ScienceDirect, IEEE Xplore, and SpringerLink.

Results

There have been three phases for the papers included in this review each of which has excluded a number of papers depending on the criteria applied. At the first phase, a total of 326 papers. In the second phase, a criterion has been applied to exclude those papers

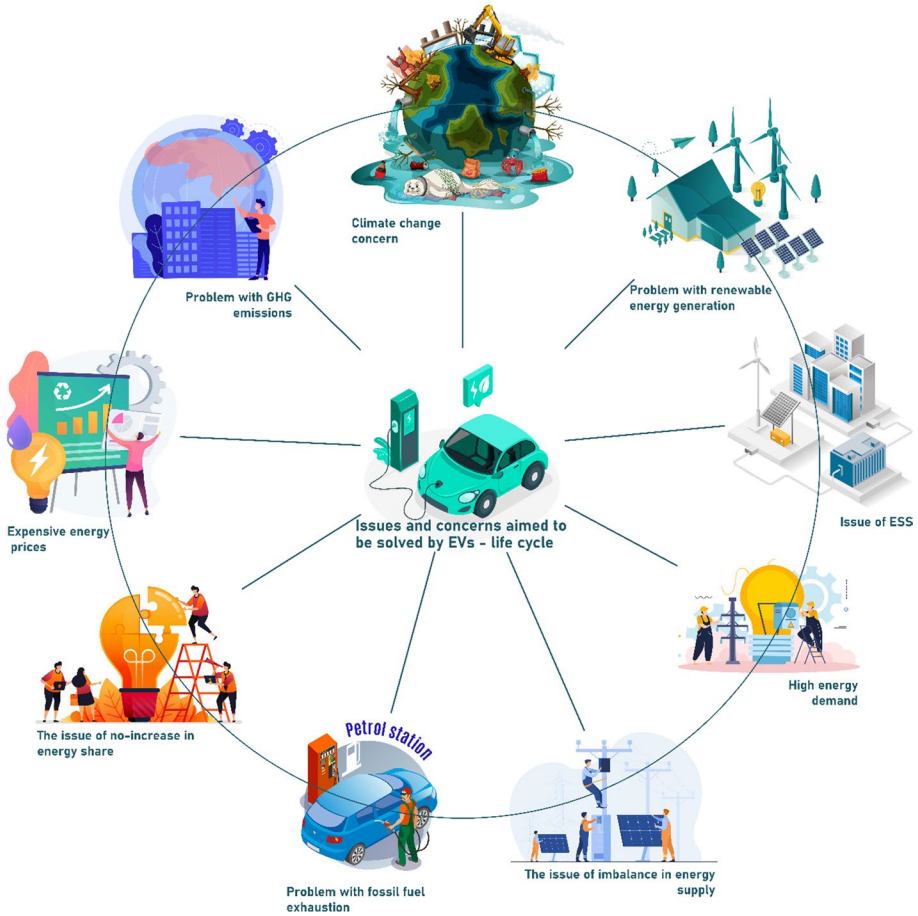

Fig. 1 Issues and concerns addressed by existing reviews. Images are licensed. Design is made by authors

which are irrelevant to keywords used. The result has yielded a total of 53 papers. The third phase has screened the papers to exclude papers that belong to tutorials, news, abstract, and comments. The result has yielded a total of 34 papers.

Research design and problem statement

As was mentioned earlier, recent studies have focused on EV technologies and their effects on the economic and environmental sectors. These studies have also highlighted other issues that are connected to these problems, such as the growing demand for energy, GHG emissions, the depletion of fuel, the high cost of energy, an imbalance in energy supply, and a few others. They have also provided approaches that contribute to providing a number of solutions towards the goal of resolving a number of problems and challenges that have been highlighted. However, there are a number of difficulties that should be considered for possible solutions in this respect to contribute cope with some worries and problems connected to EV technology that is used to boost the energy supply, which may contribute to reducing CO_2 emissions. These issues should be addressed for possible solutions in this respect to contribute cope with some concerns and problems linked to EV technology. The purpose of this review article is to determine whether or not EVs play a significant part in boosting the energy supply based on renewable

energy resources (RERs) in order to reach a sustainable energy target. As a result, the main emphasis is on determining what those EV approaches are that may be used to the RERs industry. In addition, what parameters are taken into consideration by EV tools for the purpose of enhancing the performance of RERs, which has been an objective? Another goal that has to be accomplished by the time this review article is finished is to examine and discuss the ways in which these EVs methodologies have been used to the purpose that was just described. In order to accomplish these goals, this review article will first examine the articles and the findings that were published on them. Next, it will do a variety of analyses that contribute to answering these issues in such a manner that the readers will profit from the information presented here.

Questions of the study

This review study addresses two primary research issues in an effort to provide answers to those concerns. They are emphasized in the following ways:

RQ1 What strategies are used to improve the energy supply that is based on RERs for electric vehicle technology?

RQ2 How have these strategies helped to improve the performance of RERs in order to allow electric vehicles to contribute to the objective of achieving a sustainable energy target for our eco-friendly environment?

Selection criteria based on use of keywords

The following is a list of the primary key terms that were used in the process of extracting the review articles included within this paper: (1) both "electric vehicles" and "renewable energy sources" are included in the title; (2) both "electric vehicle" and "renewable energy" are included in the title; and (3) both "electric vehicle" and "sustainable energy" are included in the title.

Conclusions drawn from the research that was analyzed

In this part, the literature that was reviewed will be provided in accordance with the subjects and methodologies that were used. There are a variety of carried techniques that have been implemented, depending on the need and objective that the associated energy system was created for. Other research studies have suggested created systems for the purpose of reaching a rapid EV charging station (EVCS) aim, and there are a few more that will be covered here. A number of systems have been built for the purpose of enhancing the operations of charging EVs, while some other systems have been designed for the purpose of selecting the optimum site for an EV charging station. Overall, these designed systems and proposed methods have been applied with the intention of improving EV technology that is integrated with RERs and attempting to ensure that a sustainable energy achievement can be made for our environmentally friendly environment.

Utilization of renewable energy sources (RESs) coupled with other approaches

It is noted in Shao et al. (2021) that the generation of hydrogen based on RE might offer an integrated electric power and hydrogen system as well as a route toward the use of

sustainable energy sources. As a consequence of this difference, the hydrogen energy system (HES) is distinct from traditional energy systems in the sense that the majority of hydrogen is carried via hydrogen tube trailers (HTs). Utilizing HT for transportation is one of the aspects that this research focuses on to improve the efficiency of the Integrated Electric Power and Hydrogen System (IPHS). The suggested technique manages the production of hydrogen and its distribution, taking into account the limited functioning of the electric power system (EPS) as well as the unpredictability of the supply of renewable energy. There have been a lot of case studies that have utilized the modified IEEE-RTS79 and shown how vital it is to take HES into account while optimizing EPS performance by utilizing the IPHS model and its solution technique. These case studies have been done with the help of a lot of different people. In order to assess the influence that the synergy between EPS and HES has on the generation, transportation, and flexibility of demand for hydrogen, numerical examples are employed.

RERs have emerged as an alternative worthy of consideration when it comes to the fight against climate change. However, there is a dearth of published material on how to assist governments in developing areas in making the transition to an energy industry based on RE. In this research, an attempt is made to combat the issue of illiteracy by conducting an investigation of the manner in which electricity is generated in nations that are considered to be developing. The objective is to determine the many ways that may be taken to achieve sustainable energy. A number of different technology combinations are analyzed in terms of their economic feasibility, environmental impact, and capacity for technical assistance. In contrast to other research, this one investigates how RESs may be combined with conventional fuels to create a more efficient energy system. The usage of EVs and the manufacture of hydrogen will be beneficial to energy networks based on RE. It will result in a lower total amount of carbon emissions (Bamisile et al. 2021).

Future grid operations might potentially benefit from increased energy efficiency as well as increased grid stability if an efficient energy management plan is put into action, along with the incorporation of RERs. Microgrid (MG) systems and DR were modeled for the purpose of simulating a residential EMS. Price-based tariffs have been adopted for residential loads in order to bring peak demand and energy costs down to more manageable levels. A probabilistic method is used in the process of describing the stochastic nature of RERs in order to include the uncertainty. The results of this study give a combined optimization method for the effective design and administration of grid-connected rural MG systems that include RE and EVs while taking DR plans (DRPs) into consideration. The amount of energy that may be saved in different types of homes by integrating DRPs with RERs is something that researchers are currently investigating. MG's EV mix includes components such as photovoltaic (PV) and wind turbine (WT). The reduction of both operating expenses and carbon emissions has been accomplished via the use of multi-objective optimization problems. The need for power has been rescheduled as a result of three different DRPs, including crucial peak pricing, real-time energy pricing, and time of usage (TOU). Evaluating the load of the EVs has also been done via the use of coordinated charging methods. Using a judgement matrix, it is feasible to reduce a problem with several objectives down to a problem with a single aim. The results of the artificial bee colony (ABC) method are found to be better than those of the

particle swarm optimization (PSO) algorithm when compared to one another. The ABC and PSO functions included in MATLAB were used in order to carry out the simulation. In order to find ways to reduce a variety of costs, the implications of the DRPs MG model were investigated. This was done using the mathematical model for MG, and it was done under a variety of loads and with a variety of numbers of EVs. The simulated results with a variety of test situations are created by doing an analysis of the trade-off between artificial bee colony algorithms and PSO algorithms. The findings of the simulations indicated that there was a considerable amount of competition among the different DRPs, EVs, and RERs (Habib et al. 2022).

Control mechanisms for charging and discharging the battery

Because of the inherent ambiguity of RE, it places a burden on the flexibility of the distribution network, despite the fact that it has a good effect on the grid in terms of both the economy and the environment. EVs have the potential to increase the flexibility of the system by interacting with the grid as a new variable demand and by stimulating the use of RESs. The purpose of this work was to examine how the flexibility of the distribution system may be assessed in light of the possible effect EVs could have on the grid. The techniques for controlling the charging and discharging of EVs, such as Grid to vehicle (G2V) and Vehicle to Grid (V2G) modes, have been investigated in order to reduce the impact that varying levels of renewable energy production have on the adaptability of the distribution system. Second, a simulation of the battery capacity and the transportation network is carried out in order to investigate the impact that EVs that are connected to the grid have on the adaptability of the distribution network. Third, a technique for assessing the flexibility of distribution networks based on the results of a feasibility study of an unknown region is proposed. In addition, the example demonstrates that the recommended approach may be used to analyze the flexibility of the time series associated with a distribution system in order to demonstrate that the proposed method is successful (Liu 2020).

Due to the rapid pace at which they have evolved, RERs have been able to make significant contributions to the improvement of global energy and environmental problems. Because of the significant degree of unpredictability associated with RE, it is very necessary for RE to be used, and high-percentage RE systems must continue to be active. The study proposes an absorption approach for renewable energy that modifies the charging operation of EVs using EV aggregators (EVA) in order to accomplish monitoring permeability of abandoned RESs' power from the supply-side. This strategy is based on an analysis of the interaction between supply and demand. In light of this approach, EVA and REG as well as the market characteristics of each are investigated. For EVA and REG, a master–slave game system that is based on the charging characteristics of EVs and the output characteristics of REGs was designed. In order to solve the model, a soft actor-critic method is utilized, and in order to optimize the benefits shared by all parties involved, REG pricing and EVA scheduling are calculated (Liu et al. 2021).

The energy hub, which is an essential component of multi-energy systems, plays a vital role in improving the adaptability, efficiency, and reliability of the system as a whole. The growing sophistication of human cultures, along with the effects of climate change, has increased the need for renewable energy and EVs. The unpredictability of the generation

of new forms of energy, which is caused by the variable levels of solar and wind power throughout the day, is the only thing standing in the way of their widespread use. In the research (Li and SaeidNahaei 2022), an optimal load dispatching design for an energy storage unit was examined. This was done with the goal of lowering the total costs associated with operating the energy hub, such as the costs associated with CO_2 emission. The energy center has a heat storage unit as well as EVs. The uncertainty associated with EV is modeled with the use of Monte Carlo simulation (MCS). In addition, the strategy that is described takes into consideration the DR methods in great detail. In Li and SaeidNahaei (2022), three possible schedules are investigated, each of which has distinct charge/discharge and DR characteristics. The data, shown both numerically and graphically, suggest that using a strategy that coordinates charging and discharging of EVs is the most efficient way to lower total costs. As a direct consequence of this, it is quite evident that the EVs' matched charge/discharge cycles have successfully resulted in lower monthly energy expenses for the consumers. The data also demonstrate that total consumer prices may be able to be lowered even more with the implementation of DR efforts.

The overabundance of RESs has resulted in an increase in the number of situations in which reductions have been used to stabilize the energy system. The lowering of renewable energy may inhibit development in the energy industry, which may have a detrimental effect not only on energy-efficient system operators but also on RE operators. An economic curtailment strategy promotes the use of EVs as a means of cutting down on overall energy use. When their loads are lowered, operators of charging stations participate in incentive-based demand response programs. By using an incentive system that is location-based and takes into consideration the constraints of the distribution network, it is possible to prevent overload in the network that distributes the energy. A response model for EVs is developed, and it takes into account the price elasticity and price, in addition to the limitations of space, time, and charging. According to the findings, it would seem that the approach that has been provided is able to make better use of energy in terms of both efficiency and cost than other conventional RE reduction methods (Park et al. 2022).

Frequency control

As distributed generators and RES become increasingly commonplace in microgrids, the importance of attenuation and low inertia on grid stability will increase. The output of RESs has a propensity to vary, which results in issues with frequency control, voltage spikes, and an oversupply of power due to the fluctuating nature of the RESs. RESs have a tendency to have an output that fluctuates. As a unique technique to adaptive control, on-line modification of integrated controller gains for PEV energy charging and discharging is proposed in this study. The purpose of the suggested microgrids frequency control that is provided in Abubakr et al. (2021) is to increase the system's resilience in the face of parameter uncertainties as well as interruptions caused by the existence of random load variations and flexible loads.

The incorporation of RES, such wind and solar farms, requires the use of alternating current (AC) microgrids in combination with EVs. The intermittent nature of the energy output from these RES may have a considerable impact on the frequency of the

microgrid. As a direct consequence of this, the outputs of the generators are regarded as unchanging disturbances. It was common practice in the past to disregard a microgrid's ability to maintain a constant frequency; as a consequence, the controller's ability to govern the frequency may be rendered ineffective. In order to find a solution to this problem, the authors of this research suggest a creative approach to coordinating the frequency management of photovoltaic systems, wind farms, and EVs. Proportional integral controllers (PI controllers) are what are needed to build the adaptive PI controller that was recommended. There is also an influence that must be taken into consideration, and that is a slight delay in the input–output pairs of the adaptive PI controllers. A simulation model is used to conduct tests on the controller that is being provided. The recommended coordinated control strategy provides a better frequency regulation performance than the fixed PI controller (Jampeethong and Khomfoi 2020). This is the case in situations when there are a large number of uncertainties, such as fluctuations in wind and solar power, N-1 outages, disconnection of RESs, demand variations, and the number of EVs.

In Kirihara and Kawabe (2021), it is suggested that a one-of-a-kind formulation for emission dispatch be devised. This formulation would solve for the optimal amount of EVs and RESs that would cut emissions while still ensuring temporary frequency management of the grid. In spite of the fact that earlier research on emission dispatch often ignored the additional risks that are associated with rising RES, the proposed formulation is differentiated by the inclusion of (a) reasonably long frequency stability constraint and (b) EVs and RES capabilities provided as aspects of the optimization values. These two factors make the recommended formulation stand out from other similar approaches. These two characteristics are coupled in order to provide a convergent solution to the problem of emission dispatch. This offers a more realistic possibility for reducing emissions over the course of the long run.

The actions of the consumer market

Rapid expansion of EVs and unpredictability of renewable energy may hamper E-Mobility during peak hours. In order to explore the intricate interactions that exist between the electrical system and the charging stations, a stochastic game is utilized. It is believed that this will help prevent a scenario as serious as the one that now exists. Previous study doesn't take into account the preferences of customers when it comes to the parameters of their billing since such preferences are too fluid. Because the preferences of customers about their bills might change over time, it can be challenging to anticipate the criteria that will be employed in the future. Another kind of stochastic game is used here to stand in for the actions of customers. The QoS index is a measurement that determines how the charging process influences the parameters that customers choose to charge with. The recommended approach results in a quality-of-service improvement in terms of pricing and waiting times, as well as a decrease in power expenses of twenty percent when compared to the standard procedure. In the context of unpredictability surrounding the generation of electricity from renewable sources, charge service providers can find our results useful as a reference for making decisions that maximize efficiency (Chung et al. 2021).

The increasing proportion of RESs, which may be very variable, places a substantial strain on power networks. The rapid increase in the penetration level of EVs, which results in uncoordinated charging loads, presents significant challenges for operators. EVs might become not a hindrance but rather a key resource in the drive to incorporate RESs into the grid. In the first part of this study, a rating system for EV drivers based on their charging routines will be presented. In order to maximize the utilization of RESs, a new incentive program for EVs based on blockchain technology has been suggested. The system that has been presented is one that is secure, anonymous, and decentralized. Using the recommended inducement scheme, this study has described a plan to encourage customers of EVs to recharge their vehicles at times that are convenient for them, create more renewable energy, and do so while minimizing the effect on the prices of utility services (Chen et al. 2021).

Charging station for EVs

It is very necessary to provide charging stations in residential areas as the number of individuals buying EVs continues to rise. However, if EVCS are exclusively supplied by the grid, this may have serious repercussions for the reliability of the grid, in addition to the possibility of an increase in CO_2 emissions. EVCS are subject to a variety of constraints, some of which may be alleviated by the use of hybrid RE systems (HRES). In this article, the optimal HRES configuration for EVCS is selected by the use of a weighted multi-criteria design. It is possible to ascertain the regional RE supply and the demand for EVCS electricity with this method. In conclusion, the HRES energy generation strategy for EVCS is established by taking into account a variety of criteria, including environmental, economic, and technical considerations. An experimental phase is also built into the design so that the validity of the design may be further verified. As a consequence of this, the HRES that is used in the EVCS energy production planning is supported by both a numerical analysis and an actual testing of the demand being totally satisfied (Bastida-Molina et al. 2021).

Charging schedule for EVs

It has been shown that a microgrid may operate in two stages with an improved penetration rate of RESs and EVs (Azarhooshang et al. 2021). The operation has taken into account both the day-ahead and real time energy marketplaces, and it utilizes a multi-layer EMS. As a consequence of this, EMS is introduced into microgrids in a manner that is consistent with their hourly activities in the market for the next day. This is done in order to lower the operating costs of the microgrid for distributed generation, energy storage systems, and EVs. The use of stochastic programming is necessary in order to accurately reflect the unpredictability of the demand, as well as RE, electricity pricing, and EVs characteristics. The MCS is combined with a mechanism for quick reversal, and this is how the process is carried out. As a consequence of this, multi-layer EMS, coordination, RESs and EVs operating inside microgrids, day-ahead planning, and an actual schedule plan have each contributed to the plan that has been provided.

As the number of EVs continues to rise, there is a possibility that charging stations could become overcrowded. It is possible to use the grid ESS to charge the batteries of EVs. Because individuals have variable requirements for the amount of energy they use,

V2G and G2V EV charging and discharging schedules may be challenging. An EV control system (EVCS) was given a charge–discharge energy scheduling approach by using a strategy for chance-constrained programming. As a consequence of this, under the possible impact of the unpredictability of PV output, the energy distribution may be beneficial to charging stations as well as EV users. An algorithm has been proposed, and an analysis has been performed using that approach in order to give a blueprint for optimizing the contract capacity in order to lower the cost of charging stations. This ensures that energy consumption remains within contract limitations at all times and that price for electricity and the priority of charging vs. discharging are taken into consideration throughout the implementation of the recommended methodology of TOU modification. The findings from PV prediction reveal that the cost of charging an EV might be lowered by around fifty percent as compared to the uncoordinated techniques. The provided methodology may assist charging station operators in assessing contract capacity and executing energy dispatch plans based on the projected size of EVs and distributed energy resources (Li et al. 2020). This would be done in order to encourage the expansion of the energy industry as a whole as well as the EV industry specifically.

As a summary of findings in review studies, a structure to present the studies' focus, methodologies, tools, and conclusion has been provided in Table 2 to give the reader with a great and easy overview.

Analysis

According to RQ 1

The EV related strategies have been varied. One of these strategies is the "charging and discharging strategies" with the biggest number of approaches that have been used to EVs technologies that manage RERs for energy sustainability. Following closely behind in second place is the topic of "charging schedule approaches for EVs". This suggests that the loading and unloading of EVs is the most significant problem that the articles under consideration attempt to address. The list of other methods has included: "the actions of the consumer market" and "frequency control". The list has recorded 25, 16, 8, and 4 per cent for charging and discharging strategies, charging schedule approaches for EVs, the actions of the consumer market, and frequency control, respectively. These applied strategies and further strategies are highlighted in a graphical illustration as shown in Fig. 2.

According to RQ 2

With regard to the topic of the second research question, we will list here a set of points that were concerned with previous studies, according to what was extracted from the reviewed literature. Improving RES to let EVs to contribute to achieving a sustainable energy can be done via one of the followings—as extracted from reviewed articles:

- By leveraging HES,
- taking into account the preferences and actions of customers in relation to EV charging in order to arrive at effective judgments connected to REG is a beneficial practice that enables the charging of EVs to contribute to the production of sustainable energy,

Table 2 A summary of reviewed papers according to focus, methodologies, tools, and conclusion

References	Studies' focus	Methodologies	Supportive tools and mechanisms	Conclusion
Shao et al. (2021)	Utilizing HT for transportation is one of the aspects that this research focuses on to improve the efficiency of the Integrated Electric Power and Hydrogen System (IPHS)	The proposed method manages the production of hydrogen	• Optimizing • EPS performance IPHS model	There have been a lot of case studies that have utilized the modified IEEE-RTS79
Bamisile, et al. (2021)	To determine the ways that may be taken to achieve sustainable energy	A number of different technology combinations are analysed in terms of their economic feasibility, environmental impact	An investigation has been conducted	The usage of EVs and the manufacture of hydrogen will be beneficial to energy networks based on RE
Habib et al. (2022)	To evaluate the load of the EVs	A probabilistic method is used in the process of describing the stochastic nature of RERs to include uncertainty	A number of tools and methods have been included such as artificial bee colony (ABC) method, particle swarm optimization (PSO) algorithm, and MATLAB	Results give a combined optimization method for the effective design and administration of grid-connected rural MG systems that include RE and EVs while taking DR plans (DRPs) into consideration
Liu (2020)	To examine how the flexibility of the distribution system may be assessed in light of the possible effect EVs could have on the grid	The techniques for controlling the charging and discharging of EVs, such as Grid to vehicle (G2V) and Vehicle to Grid (V2G) modes have been explored	EVs charging—discharging, G2V and V2G modes	A simulation of the battery capacity and the transportation network is carried out in order to investigate the impact that EVs that are connected to the grid have on the adaptability of the distribution network
Liu et al. (2021)	To explore if the benefits shared by REG pricing and EVA scheduling can be calculated and optimized	An absorption approach for renewable energy that modifies the charging operation of EVs using EV aggregators (EVA) has been proposed	A master–slave game system and a soft actor-critic method have been used	This proposed strategy has been based on an analysis of the interaction between supply and demand where the market characteristics of REG and EVs have been investigated
Li and SaeidNahaei (2022)	To lower the total costs associated with operating the energy hub, such as the costs associated with CO_2 emission, and to model the uncertainty associated with EV	An optimal load dispatching design for an energy storage unit was examined	Monte Carlo simulation	Findings suggest that using a strategy that coordinates charging and discharging of EVs is the most efficient way to lower total costs

Table 2 (continued)

References	Studies' focus	Methodologies	Supportive tools and mechanisms	Conclusion
Park et al. (2022)	To explore the use of EVs can be considered as a means of cutting down on overall energy use	Incentive-based demand response programs	A response model for EVs is developed	It seems that the approach is able to make better use of energy in terms of both efficiency than other conventional RE reduction methods
Abubakr et al. (2021)	To increase the system's resilience in the face of parameter uncertainties	On-line modification of integrated controller gains for PEV energy charging and discharging is proposed	–	The proposed system could address the interruptions caused by the existence of random load variations and flexible loads
Jampeethong and Khomfoi (2020)	The incorporation of RES, such wind and solar farms, requires the use of alternating current (AC) microgrids in combination with EVs	The paper has proposed an approach to coordinating the frequency management of photovoltaic systems, wind farms, and EVs	PI controllers	A simulation model is used to conduct tests on the controller
Bastida-Molina et al. (2021)	To provide charging stations in residential areas as the number of individuals buying EVs continues to rise	The optimal HRES configuration for EVCS is selected by the use of a weighted multi-criteria design	A numerical analysis is carried out	An experimental phase is also built into the design. Hybrid renewable energy systems related energy generation strategy for EVCS is established
Azarhooshang et al. (2021)	To lower the operating costs of the microgrid for distributed generation, energy storage systems, and EVs	EMS is introduced into microgrids in a manner that is consistent with their hourly activities in the market for the next day	Stochastic programming and Monte Carlo simulation	Multi-layer EMS, coordination, RESs and EVs operating inside microgrids, day-ahead planning, and an actual schedule plan have contributed to the proposed plan
Li et al. (2020)	There is a possibility that charging stations could become overcrowded. It is possible to use the grid ESS to charge EVs batteries	An EV control system was given a charge–discharge energy scheduling approach by using a strategy for chance-constrained programming	Chance-constrained programming	an analysis has been performed using that approach in order to give a blueprint for optimizing the contract capacity in order to lower the cost of charging stations. The findings from PV prediction reveal that the cost of charging an EV might be lowered by around fifty percent as compared to the uncoordinated techniques

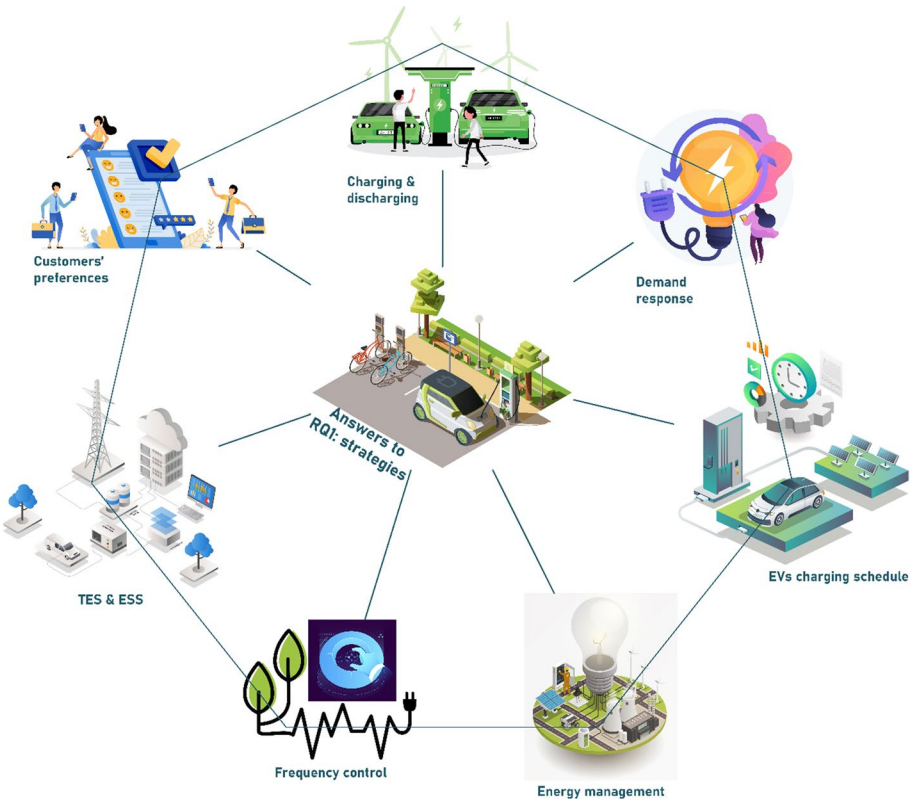

Fig. 2 Answers to RQ1- Analysis according to strategies used. Images are licensed. Design is made by authors

- via the reduction of emissions while simultaneously guaranteeing the temporary stabilization of frequency fluctuations and imbalance,
- by doing research and determining how to achieve the greatest possible penetration of PEVs into the distribution system while keeping the total cost to a minimum,
- the use of EV has been accomplished by keeping an eye on the uncontracted portion of demand, and/ or
- through the process of selecting the most efficient operating sites for charging stations.

Discussion

This section is provided in two sub-sections first of which encompasses benefits and lessons learned from the reviewed papers, second of which lists a number of limitations the reviews are still facing.

Benefits and lessons learned from the reviewed literature

In this discussion, the most often reported benefits of using the applied techniques of EVs towards RERs improvement in order to create a green and clean atmosphere through the realization of a sustainable energy goal have been worked out and evaluated from the papers that were studied. This was done in order to create a green and clean environment via the achievement of a sustainable energy goal. There are a

number of benefits, significant points and features, and impacting points and advantages that are listed herein. These may give readers and researchers who work in the area of energy and EV technology with information on EV charging, SV charging scheduling, optimum EVCS site selection, and RERs use integrated with EMS, DR, and TES.

1. The uncoordinated switching of EVs, which may lead to additional problems like as uncertainty with RESs, has been assisted to be solved by the suggested approach (Chung et al. 2021).
2. By using the recommended controller and optimization technique, it is possible to obtain less frequency fluctuations, increased resilience, enhanced system stability over a wide range of parametric uncertainties, and less rapid response during transients. All of these benefits may be realized (Ahmed et al. 2021).
3. Because of this method, the cost of acquiring energy for EVA can be brought down, the link between renewable energy, EVs, and the power grid can be strengthened, and the utilization of RE can be brought up to a higher level (Liu et al. 2021).
4. According to the findings that have been provided, the use of EV charging / discharging programs have successfully lowered the customers' overall expenses associated with their usage of energy (Li and SaeidNahaei 2022).
5. The findings show that the proposed method is useful and has a number of advantages, including a significant reduction in cost savings and the delivery of more workable and confident solutions that microgrid drivers can use to improve their operations. Additionally, the results demonstrate the effectiveness and benefits of the method proposed for dealing with uncertainties (Zandrazavi et al. 2022).
6. It is possible that the use of EVCS in combination with dispersed RESs might contribute to the stabilization of RE output. This has the potential to be an excellent tool for attaining ecologically sustainable energy production as it will effectively increase the RERs of the energy supply in general (Li et al. 2022).
7. When there are a large number of EVs charging at distributed stations, the scheduling of EV charging schemes has significantly helped to improve the reliability of the renewable energy supply and has made a significant contribution to addressing the difficulties linked to loads (Tao et al. 2021).
8. An EVCS has been given the ability to have charging/discharging energy scheduling applied to it. As a consequence of this, under the possible impact of the unpredictability of PV output, the energy distribution may be beneficial to charging stations as well as EV users (Li et al. 2020).

In Table 3, the above-mentioned benefits are listed for a more clarification and presentation according to their topics.

Limitations of a number of reviews

A number of limitations found in the reviewed papers have been summarized and discussed. Listed in Table 4 is a set of those limitations that the reviewed papers still face and need to be improved and addressed for future research works.

Table 3 A list of benefits retrieved from the reviewed literature

No.	References	Benefits	Category
	Chung et al. (2021)	The uncoordinated switching of EVs, which may lead to additional problems like as uncertainty with RESs, can be solved	Actions of the consumer market
	Ahmed et al. (2021)	It is possible to obtain less frequency fluctuations and enhanced system stability over a wide range of parametric uncertainties	Frequency control and frequency fluctuations
	Liu et al. (2021)	Energy cost for EVA can be brought down	Control mechanisms for charging and discharging the battery
	Liu et al. (2021)	Link between renewable energy, EVs, and the power grid can be strengthened	Control mechanisms for charging and discharging the battery
	Liu et al. (2021)	RE utilization can be brought up to a higher level	Control mechanisms for charging and discharging the battery
	Liu et al. (2021)	RERs have been able to make significant contributions to improvement of global energy and environmental problems	Control mechanisms for charging and discharging the battery
	Li and SaeidNahaei (2022)	EV charging / discharging programs can reduce customers' overall expenses associated with their energy usages	Control mechanisms for charging and discharging the battery
	Zandrazavi et al. (2022)	A significant reduction in cost savings and the delivery of more workable and confident solutions that microgrid drivers can use to improve their operations	EV charging
	Li et al. (2022)	EVCS with the help of RESs could contribute to RE' output stabilization	Utilization of RESs coupled with other approaches
	Tao et al. (2021)	Charging EVs at distributed stations could improve, scheduling of EV charging schemes has significantly helped RESs supply's reliability	Charging stations for EVs
	Li et al. (2020)	Under possible impacts of PV output unpredictability, the energy distribution may be beneficial to charging stations and EV users	Charging schedule for EVs

Conclusion

In this article, a review of the technologies and applied techniques to the purpose of boosting RERs combined with numerous ways towards attainment of a sustainable energy goal has been undertaken. These technologies and methods pertain to EVs. In order to achieve this goal, a variety of research investigations and created systems that have been provided in the literature and analyzed there have been analyzed and surveyed. In this study, a variety of problems have been discussed, as well as many kinds of EV technologies and approaches that make an effort to improve RERs in order to provide a better environment in which a sustainable energy objective may be realized. The PRISMA 2020 for conducting a systematic review was used to conduct the screening of the reviewed articles included in this study. PRISMA 2020 statement has been used to apply a screening procedure for records retrieved from databases sources and registers.

Table 4 A listed set of limitations of the reviewed papers

No.	References	Limitations
	Shao et al. (2021)	To assess the influence that the synergy between EPS and HES has on the generation, transportation, and flexibility of demand for hydrogen, numerical examples need to be employed
	Bamisile, et al. (2021)	It has combined the RERs with conventional fuels to create a more efficient energy system which is still under investigation
	Habib et al. (2022)	The results depend on the output of mathematical modelling for simulation scenarios
	Liu (2020)	Few examples are used to demonstrate that the recommended approach may be used to analyse the flexibility of the time series associated with a distribution system in order to demonstrate that the proposed method is successful
	Liu et al. (2021)	The method has been evaluated based only on the charging characteristics of EVs
	Li and SaeidNahaei (2022)	Evidence related to the EVs' matched charge/discharge cycles have been applied for the monthly basis. It is needed for a wider range of time-based analysis e.g., annually, to be investigated
	Park et al. (2022)	It lacks limitations of space, time, and charging
	Jampeethong and Khomfoi (2020)	There are few considerations in regard to case in situations when there are many uncertainties, e.g., fluctuations in wind and solar power, N-1 outages, disconnection of RESs, demand variations, and EVs quantity
	Bastida-Molina et al. (2021)	EVCS are subject to several constraints, some of which may be alleviated by the use of hybrid RE systems
	Azarhooshang et al. (2021)	It is of necessity to accurately reflect the unpredictability of the demand, RE, electricity pricing, and EVs characteristics
	Li et al. (2020)	This ensures that energy consumption remains within contract limitations at all times and that price for electricity and the priority of charging vs. discharging are taken into consideration throughout the implementation of the recommended methodology of TOU modification

The answers to the research questions posed in this article have been gleaned from the findings that have been published in the studies that have been evaluated. There has been some work done on an analysis based on RQs. In addition to that, the section under "Discussion" includes a discussion of a number of significant achieved characteristics and benefits. Additional major observations made at the conclusion have been documented and discussed in preparation for subsequent study.

In order to determine the chronological order of changes and advancements in EV technology, its effects on the environment, and other relevant problems and concerns that have been extensively discussed, this article has examined current and existing evaluations according to many criteria, such as their subjects, concerns, keywords, and the date of publication. As a direct result of this, two distinct forms of analysis have been developed. As a direct consequence of that, the structure of this study has been designed to address the gap that was noted. Nevertheless, this review has a number of limitations including the time-line that has been selected at which the papers reviewed locate. The period has been set to be during the 2000s and beyond. As for the period before 2000s, there are no reviewed papers. Therefore, some reported results and conclusion during that period might be not included.

Some concluding observations

The use of EVs combined with the exploitation of RESs has alleviated various problems and challenges in the direction of the goal of reaching a sustainable energy level in the very near future. In this part, we are going to describe and draw conclusions about a few elements and sides resulting from the integration and enhancement of existing tactics connected to EVs that were researched in the literature.

- It is abundantly obvious that the charging–discharging strategy for EVs has led to a reduction in the usage of RERs for the purpose of energy supply (Li and SaeidNahaei 2022). Both of the RERs leading to the intended aim of sustainable energy will get a boost as a result of this.
- As battery-powered EVs become more generally accessible on the market, this process has opened up chances for the energy policy and the mobility policy to become more linked. Because of this, there are now worries over the future of energy production and delivery (Costa et al. 2022), as well as the future of automobility.
- In terms of frequency regulation, the provided EVs charging and discharging control techniques have boosted the frequency regulation better than other competing control approaches. This is the case because these control methods are superior to other competitive control methods. As a result, such strategies have shown to be more effective in terms of conserving RERs-based supply with the goal of achieving energy sustainability in the presence of EVs (Abubakr et al. 2021).
- The integration of EVCS with distributed RESs has the potential to reduce volatility in RE production. This is helpful and has the potential to be a potent instrument that can improve RERs in general energy supply, and as a result, this might contribute to the achievement of sustainable energy in an environmentally friendly setting (Li et al. 2022).
- As a consequence of this, the production of energy has significantly contributed to the modification of the existing transportation systems, which rely on fuels, into a plan of employing innovative strategies that have included an increase in the number of RE sources in order to fulfill the requirement for energy.
- An EVCS energy scheduling approach was used in the research that was given in Li et al. (2020), which was part of the contribution that was made by the method that was offered (Tao et al. 2021). As a result of the unpredictability of PV generation, the energy dispatch can be to the advantage of charging stations and EV customers. The consistency of the energy supply will improve as a result of this. As a consequence of this, this could be able to precisely regulate the imbalance in the energy supply caused by RERs. Therefore, as a result of this, the circumstances necessary for a sustainable energy environment will be created.
- It has been demonstrated through experimentation that efficient management of the charging and discharging of PEVs would significantly contribute to mitigating the negative impact on energy system stability that is caused, for instance, by the intermittent production of wind energy. This results in a more effective usage of RERs across longer time periods, which contributes to the creation of an environment that is ideal for generating sustainable energy in the very near future (Zhao et al. 2022).

Abbreviations

ABC	Artificial bee colony
AC	Alternating current
DR	Demand response
DRPs	DR plans
EMS	Energy management system
EPS	Electric power system
ESSs	Energy storage systems
EV	Electric vehicle
EVA	EV aggregators
EVCS	EV charging station
EVs	Electric vehicles
G2V	Grid to vehicle
GHG	Greenhouse gases
HES	Hydrogen energy system
HRES	Hybrid RE systems
HTs	Hydrogen tube trailers
IPHS	Integrated Electric Power and Hydrogen System
MCS	Monte Carlo simulation
MG	Microgrid
PEVs	Plug-in electric vehicles
PHEVs	Plug-in hybrid electric vehicles
PI	Proportional integral
PSO	Particle swarm optimization
PV	Photovoltaic
RE	Renewable energy
REG	Renewable energy generation
RERs	Renewable energy resources
RESs	Renewable energy sources
TOU	Time of usage
V2G	Vehicle to Grid

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AMAG wrote the paper. HK designed the conception of the paper and wrote the paper. HA contributed to the idea of the paper. NMAH reviewed and enhanced the paper's flow. All authors read and approved the final manuscript.

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