**International Journal for Rapid Research in Engineering Technology & Applied Science**
Vol IX Issue III March 2023
ISSN Online:- (2455-4723)

# Review on EV Charging station Based Renewable Energy System

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**Abstract: As the number of electric cars on the road grows, there is a growing need for a reliable charging infrastructure that can keep up with the rate at which people are switching to this way of getting around. At the same time, local power grids are getting overloaded and need help from renewable energy sources like wind and sun that are naturally abundant and cheap. As a result of this trend, the world has recently seen the introduction of charging stations that are powered by renewable energy sources. In this article, we'll talk about research that has to do with how different types of alternative energy sources can be charged. We offer in-depth research on this industry's most important factors, such as price, resources, potential, strategy, and control. Also, the problems that this type of electric charging station faces will be looked into, made clear, and workable solutions will be suggested after this study is done. This study has two goals: first, to give the reader an overview of how electric vehicles can be charged using renewable energy; and second, to lay the groundwork for more research on this very important topic**

**Keywords: Author Guide, Article, Camera-Ready Format, Paper Specifications, Paper Submission**

## I INTRODUCTION

The rise in the number of people who drive electric vehicles (EVs) has led to a rise in the demand for electricity in every part of the world. The global market for electric vehicles has grown a lot in recent years. In 2010, there were only a few hundred electric vehicles (EVs) on the road. By 2017, there were about three million EVs on the road, and by the beginning of 2019, that number is expected to reach about six million [1]. Electric cars are a great alternative to more traditional ways of getting around (CVs). Because they don't release carbon while running, EVs have the potential to make a big difference in the overall climate effect and in pollution levels. As fossil fuels are used up more and more, the demand for alternative fuels like biofuels is expected to go down. Electric motors can be 80–95% efficient, which makes them a better choice than CV motors, which can be less than 20% efficient. Electric vehicles are also an important part of today's transportation system because they use a lot of new manufacturing technologies (e.g., an electric motor, a battery, and a charging facility). Still, the number of electric cars on the road is not growing as quickly as was hoped. Electric cars have a short range, and it takes a long time to charge them. This is often seen as the biggest problem with getting them on the market. Electric cars cost more to buy up front, but they cost much less to run and maintain and use a lot less energy. As the demand for electric vehicles (EVs) and charging stations for EVs continued to rise quickly, many research centres and energy supply companies began to think seriously about how they could help ease the strain that the growing number of EV charging points was putting on local electricity networks. Renewable energy sources like wind and solar are some of the best ways for local electrical networks to make up for this shortage, and they could also help the infrastructure for charging electric vehicles. Around the turn of the century, when it became clear that EVs were growing quickly, research on renewable energy-based charging infrastructure (RCI) began, with a focus on solar and wind charging infrastructure [7. It pictured a charging station that could meet the demand for electric vehicles (EVs) by using renewable energy sources and direct current (DC). This would make up for the problems with the charging infrastructure that was already in place. Traditional charging stations make the grid less reliable because they cause problems like harmonics, voltage fluctuations, and power outages [8. On the other hand, the RCI has a number of advantages, such as high efficiency, low system costs, and an easy setup. Also, it needs less power conversion than facilities that use alternating current (AC). [ The RCI has the potential to make a big difference in lowering carbon emissions and increasing the use of renewable energy sources in the energy sector. In addition to this, RCI could make it cheaper to charge electric vehicles [19]. But the RCI is hard to put into place because of things like the unpredictability of renewable sources (like how wind speed and sun irradiance change with the seasons and how cloud coverage on solar panels changes every day) and the way electric vehicles use power (such as battery capacity, number and types of EVs, stop time, charging start time, and the initial state of charge). At the moment, a lot of research is being done on the above topics. At the same time, other academics are working on different parts of putting RCI into action and running it. These include optimal planning, controlling, and sizing; pricing methods; and looking into the main factors that affect the direct connection of EV loads to the RCI. For example, only a few studies have looked at the infrastructure for charging electric vehicles. These studies did look at the research on broad technical aspects, but they didn't focus on renewable energy sources. Another study looked at the RCI experiments, but instead of focusing on how consumers like to use electric cars, it looked at how they like to use them. As far as we know, no study has done a full evaluation of RCI studies by looking at all of the important research topics.

Electric vehicles are becoming more popular as a way to get around in a growing number of countries around the world. But the lack of charging stations around the world makes it hard for drivers to switch to electric cars in large numbers. As more people buy electric cars, more charging stations for them are being put up in public places. If, on the other hand, electric cars are charged by a system that already uses fossil fuels, they will hurt both the distribution system and the environment. Charging would be a great solution because solar energy from photovoltaic (PV) panels and wind sources have a lot of potential to provide electricity. Also, it would be a big step towards a cleaner environment. Depending on the available energy sources (such as the amount of sunlight and the speed of the wind, for example), the charging station may not produce enough electricity (less than the amount needed) or it may produce a lot of electricity (over the power consumption). Most of the research done showed that connecting photovoltaic (PV) solar systems and wind energy conversion systems to the power grid is technically possible and has moved forward. Yet, using programmable dispatch loads or energy storage systems is the most promising way to balance out how much electricity is made from renewable energy sources. This is because these systems can still make electricity even when there isn't much power being made. Using energy storage systems to keep the power grid running smoothly is no longer a cutting-edge technology. Hydro-pumped storage systems, flywheels, dedicated batteries, and concentrated solar energy, to name a few, are some of the technologies that have been used. Flywheels and other types of energy sources have also been used. In the industry, new technologies include better communication, power converters, wireless sensors, and smart metres.

## ELECTRIC VEHICLES

### A. Vehicles & energy sources

An electric vehicle (EV) will be clearly defined as any car that gets its power from a battery. In a typical internal combustion engine vehicle (ICEV), gasoline or diesel fuel is burned to make the mechanical energy the car needs to move forward. Jorgensen says that a number of technologies for electric cars are already in use or are growing quickly. A hybrid electric vehicle (HEV) has a small electric battery that powers the transmission. This helps the internal combustion engine work as well as it can. The battery of a hybrid electric vehicle (HEV) can be charged electrically by the engine or by using regenerative braking, which uses the energy lost when stopping to charge the battery. HEVs are known for how little fuel they use, and this one runs mostly on liquid fuels. A plug-in hybrid electric vehicle (PHEV), sometimes called a HEV, is similar, but it has a bigger battery or can connect to the power grid. Connecting to the grid makes it easier to charge the batteries, and bigger batteries make it possible for all-electric modes to go farther. The electricity that is taken from the grid will be stored in a large battery. The electricity that is taken from the battery will power the electric car (BEV). Traditional ICEVs get between 15% and 18% of their fuel from the engine, while BEVs get between 60% and 70%. EVs hurt the environment much more than ICEVs do. Fuel cell vehicles, which are sometimes called FCVs, are another type of electric vehicle. These cars use an electric process to make power in a fuel cell stack. FCVs can get all of their power from the gas pump, or they can be made with hybrid batteries like those used in HEVs and PHEVs, which have a diesel or hydrogen fuel supply on board. If hydrogen is made by electrolyzing water using renewable energy or biomass sources, then fuel cell vehicles (FCVs) can be powered by these types of energy in the future. FCVs are part of the future economic plans for hydrogen. Most of the hydrogen in the world comes from burning fossil fuels, and making a hydrogen economy that is sustainable will be hard for a number of reasons. Even though hydrogen made through electrolysis has the potential to be a big source of renewable energy in the future, this article is not the right place to talk about the transition to a hydrogen economy because of its size. If sustainable biofuels can replace traditional transportation fuels like ethanol and biodiesel, then hydrogen electric vehicles (HEVs) can also be made from renewable energy sources. Both plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles

(BEVs) can get all of the power they need from the grid's renewable energy sources. This makes it possible for the internal combustion engines in PHEVs to run on biofuels. This study looks at PHEVs and BEVs because they can store energy from the grid (from this paper known as EVs).

**Charging & grid connections :** A plug-in electric vehicle's (EV) battery can be charged in one of several ways that are available from the electrical grid. A simple charging plan, also called an unconstrained charging plan, is a device that lets a vehicle start charging as soon as it is connected to the grid. One way to balance out the charge on the battery is to charge it at different times every three hours. The nighttime charging strategy is to stop charging in the middle of the night, when the cost of electricity is lower, so that the batteries are fully charged when the sun comes up. Intelligent charging of vehicles is controlled by the people in charge of the utility or device. The charging could be done either directly or indirectly. Dallinger and Wietschel say that indirect charging is better than direct charging most of the time. When smart charging is used, the car will start charging at the time when it will be most helpful. This could happen when the price of power is low, when people don't need much of it, and after the system has more power than it needs. The price can change based on things like what the driver picks, but the most important rule is that the car must be fully charged by morning. A V2G competent electric vehicle (EV) is one that can either store electricity or send it back to the electric grid. Kempton or Letendre came up with the idea of Power V2G first, and it is an interesting one. The authors said that V2G could be used to make money for its owners under certain circumstances, like when electricity is used to help the grid in a useful way. A power supply that can do V2G will be able to store the power made from renewable sources when demand is low and send it back to the grid when it is needed.

## II RELETED WORK

**Soumia Ayyadi (2020):** This research proposes a new method for anticipating the coordinated charging and discharging of Electric Vehicles (EVs), which will reduce the cost of charging EVs. This technique will be based on the day-ahead electricity price (DAEP), subject to the constraints specified by the state of charge (SOC) of the EVs, the EVs' maximum power charger, and the EVs' batteries being fully charged at the end of the charging time. In addition, the electric vehicle's initial state of charge (SOC 0) has been determined based on its daily driving miles, and Latin Hypercube Sampling (LHS) has been used to account for the uncertainty surrounding the EV's arrival time, departure time, and SOC 0 value. The optimal solution offered allows electric vehicle owners to create a profit of 14.79 euros, but in the uncoordinated situation, EV owners must pay 2.17 euros to charge their vehicles. In addition, a comparison of actual and estimated data reveals that the charging cost based on the actual SOC 0 values is 2.88 percent and 27 percent more than the charging cost based on the estimated SOC 0 values for coordinated and uncoordinated scenarios, respectively. This is owing to the greater accuracy of the actual SOC 0 values.

**Murat Akil (2021)** Since real charging data for Electric Vehicles (EVs) cannot be shared among distribution service providers, it is hard to estimate the energy profile of a group of EVs. This makes it hard to figure out the energy profile. For this study, a dataset was used that had information about both weekdays and weekends over the course of a single day. This information came from real electric vehicle charging sessions that took place in the Perth and Kinross area. This dataset includes the start and end charging times for electric vehicles. At 15-minute intervals, this data was used to get 5000 sets of vehicle session data for Monte Carlo Simulation (MCS). Every session was 15 minutes long. Based on the data that was collected, uncoordinated AC charge load profiles of bulk electric vehicles with a battery capacity of 50 kWh and a maximum power of up to 22 kW were made according to IEC 61851-1 standards. This means that there was no loss of power, no limits, and no timing. Because of this, the peak loading and peak loading times of 5,000 electric vehicles (EVs) on the distribution line were looked at during the week and on the weekends in the Perth and Kinross districts. This was done under the assumption that the charging wasn't coordinated. The results told distribution service providers in the city of Perth about the peak hours of EV load during the week and on the weekends.

**O. Alatise; (2021):** Chargers for electric cars will add to the amount of work that distribution networks have to do. Several studies have focused on home charging of electric vehicles (usually 3 or 7 kW single-phase), with expected power peaks happening after work hours (after 4 p.m.). However, work-based home charging of electric vehicles at higher power levels (22 kW 3-phase, 50 kW DC and higher) between 9 a.m. and 4 p.m. has received less attention. This is because the expected power peaks are likely to happen in the evening when people aren't at work. By letting people charge their electric cars at work, industrial employers who use a lot of electricity and run their own distribution networks can take some of the load off the central power grid. This document is a summary of the results of an exploratory study about charging electric vehicles at a 750-acre industrial/commercial complex with more than 5,500 employees, 6,000 parking spaces, about 10 MW of peak power demand, and 4 MW of combined heat and power generation. On the 11 kV distribution circuit, MATLAB/Simulink was used to do a load flow analysis. Using the IEC 60076–7 standard, there was also an investigation into how the increasing load from charging electric vehicles will affect the main transformer's thermal limits. Since the CHP is so important, the results show that the peak charging capacity in winter and the peak charging capacity in summer are very different. Some suggestions are made about how to best prepare future distribution systems for a rise in the number of charging stations for electric cars.

**Zhen Chen(2021):** The goal of this study is to come up with a way to charge electric vehicles (EVs) that takes into account the idea of an EV charging cooperation factor. This idea is part of the EV's goal, which is to lower the cost of charging the vehicle. This idea is called a "factor," and it is defined by the parameters and needs of electric vehicles (EVs). Some of these parameters and requirements are capacity, state of charge, charging power rate, amount of energy needed, and time to leave. People think that each EV can work in either a non-cooperative state or a cooperative state. When it is not cooperating, the charging cooperative factor has the highest value possible. This is because it works best this way. The fact that the value of the charging cooperative factor is less than the maximum in the cooperative stage means that the related EV will be able to give other EVs its charging time slots without hurting its own charging costs to help charge other EVs that need it. This sets up a way for electric vehicles (EVs) to work together. This means that EVs can help each other lower their charging costs by working together. The problem of charging electric vehicles (EVs) is looked at as a generalised Nash equilibrium problem, and a consensus network is used to solve the problem in a decentralised way. The results of the simulation show that the suggested distributed charging control could work well and save money on the cost of charging electric vehicles.

**Yanping Liu(2021):** Power electronics technology will be an important part of the evolution of the distribution network in the future. This will help modernise the system, allow multi-terminal flexible closed-loop operation, and greatly increase the power supply capacity. Even though there is a lot of support for electric vehicles, the random way people charge them is a risk to the reliability of the distribution system. In light of this, it is important to figure out how the ability to charge EVs affects the flexible infrastructure for distributing power. Testing is done in the IEEE 33 interconnection system. After that, operational limits are made based on how the flexible distribution network works, and the EV charging load model is made based on how EVs access the grid at different times. The results show that the adaptable interconnection may be able to improve the distribution of tides over time and reduce voltage changes.

**Wenlang Deng et al., (2017)** proposes a Dual-Stage Matrix Converter (ZS-NS-TSMC). It uses the Series Z - Source between the Rectifier and the inverter stage, which improves the shoot through capability of the Dual-Output Converter and the voltage transfer ratio greater than unity, achieved. It has the advantages of limited inrush current and unity power factor and adjustable output voltage amplitude. The system uses dual space-vector modulation scheme for controlling the two different loads of the inverter section.

## III SOLAR ENERGY

SE stands for the production of sunlight. This alternative form of energy is either good for the environment or can be used over and over again. The amount of energy from the sun that gets to the earth every hour is enough to meet the world's energy needs for a whole year. In this day and age, power is used every hour of every day. It's easy to use the sun's rays as a source of power. Because of this, solar energy is both very useful and good for the environment. PV technology is based on the idea of the photoelectric effect, which says that it immediately turns the solar energy that hits it into electricity. PV works well in both places with little and a lot of direct sunlight. PV technology is used. PV technology uses solar panels, which can be made from a wide range of photovoltaic materials. Most solar cells are made of things like mono-crystalline or poly-crystalline silicon, cadmium telluride (CdTe), gallium arsenide (GaAs), and triple solar cells made of indium gallium arsenide (InGaP). In general, solar cells are not a very important way to get electricity. Solar cells are put together into a multiplex cell module before being added to a photovoltaic array that can be several metres long. This makes it possible to make electricity on a much larger scale. The National Renewable Energy Laboratory (NREL) says that hundreds of solar arrays are attached to a complete power-generation framework. Direct solar generation can be done with photovoltaic (PV) cells, and indirect solar generation can be done by catching and concentrating solar power (CSP) into condensation, which is then sent to electrical turbines. The theory that light photons can push electrons into higher energy states is shown to be true by the photovoltaic effect, also called PV. Radiation from the sun can be used directly to make electricity. Even though photovoltaics (PVs) were first made for power generation, there are now many PV generating systems that can be used in everyday life. These include homes, boats, water pumps, electric cars, emergency phones, and remote sensing on the side of the road. Concentrated solar thermal systems, or CSTs, use something called "suntracking" to bring a lot of sunlight into a small area. Then, CSE is used as a heat source in a typical energy plant. Concentration can be done with a wide range of specialised tools. Core concentrative terms include: (a) Parable troughs, (b) solar dishes, (c) linear Fresnel's, and (d) solar towers. The main goal of solar intensity is to get high temperatures, and by extension, efficient high temperatures. Photovoltaic cells use the sun's power right away. In general, a charging controller or charging regulator is a device that controls the voltage and current so that batteries don't get too charged. This type of regulator is also known as a charging regulator or a charging controller. The voltage or amount of electricity that goes from the solar panels to the battery can be changed. Most "12-volt" panels produce between 16 and 20 volts, which means that if the batteries are not handled properly, overcharging will hurt them. Most batteries need somewhere between 14 and 14.5 volts to be completely charged. Batteries are used to store electricity for times when it can't be used, like at night when there is no electricity. The direct current that this system makes is changed with the help of an inverter.

**Grid-Connected (Gc) Pv Power System:** A photovoltaic (PV) system that generates electricity and is connected to the grid is called a PV system that is connected to the grid (fig 2). A photovoltaic system that is connected to the grid is made up of one or two solar panels, a power conditioning unit, and a network adapter. This includes solar panels on the roofs of homes and businesses, as well as huge power plants. The GC system doesn't often need a good battery solution because, compared to energy systems that work on their own, it is still very expensive. The GC PV system sends more electricity to the utility grid than is needed to run the associated load.

Residential rooftop systems that are connected to the grid and have a power output of more than 10 kilowatts can meet the needs of most consumers. The extra electricity would be sent to the grid, where it would be used by other people. A metre gives information back, which is used to track how much electricity is being sent. In this case, the customer may buy energy from the grid, but at a lower price than in the past because the wattage of their PV system may be lower than what they usually use. If the photovoltaic wattage is a lot higher than the average amount of electricity used, the panels will make a lot more electricity than is needed. In a situation like this, you can make money by selling the extra electricity back to the grid. According to the deal made with the local energy grid provider, the customer is responsible for paying for the amount of electricity used that is less than the amount of electricity produced. This would be a negative number if the amount of power made was more than the amount of power used. PV devices can only be connected if a consumer-to-utility interconnection agreement is signed. Before the power from photovoltaic panels can be sent to a power grid, it needs to be changed from a direct current to an alternating current. This is done with a power inverter. An inverter can be a big machine that works on its own, a small device that is connected to a single solar panel, or an AC module that is connected to multiple solar panels by a bigger inverter. The grid, as well as the waveform and voltage of the frequencies, are controlled by the inverter. Either the inverter has to figure out that there isn't enough power from the grid or it has to just cut power to the grid.

## IV ELECTRIC VEHICLE IMPACTS AND PERFORMANCE

**Economic impacts (EI):** There are two main parts to electric vehicles' EI. The vehicle's owner is the initial part of the system, followed by the power grid. It is hoped that the cost-effectiveness of EVs during their lifespan would increase as battery technology and mass production improve. If you're looking to save money, go for a PHEV instead of a BEV. Both of these options are more costly to implement than a regular internal combustion engine. Electric vehicles (EVs) have a lower total cost than their IC-engine counterparts due to the efficiency of electric motors.

Effects on the Environment If you want to know how network-powered upgrades to EVs affect the environment, the slowest output you'll hear about is the amount of carbon dioxide they release. Carbon dioxide emissions are cut by 85% when the power and transportation industries are combined [24]. They are discussing the emission intensity (in gCO2e/kWh) of the electricity used to charge EVs. The majority of these models use the normal grid intensity to show a situation in which EVs are routinely followed and maybe incorporated into the daily demand profile. Some studies suggest using a minimal intensity [25] approach. Energy from EVs is credited to the carbon footprint of the least efficient power plant. Reduced carbon dioxide emissions are one of the main benefits of electric vehicles, which are made possible by the electric motor's superiority to the internal combustion engine. This is true even if a large portion of the electricity we use comes from fossil sources.

**Grid impacts:** When the car is charged in a limited way, electric vehicles have an effect on power, performance, and the need for electricity from the grid. When a basic technique for charging is put into place, the peak loads go up. In addition, more money needs to be put into generating capacity and sending it to where it needs to go. When a car uses an adaptive charging strategy, the vehicles increase the overall load and use the base level charging devices. On top of that, it doesn't require any extra capacity to be put in place. Plugging electric cars into the grid also causes more wear on transformers, overloading, and problems with the quality of the power Losses or voltage in the delivery system are changed so that EVs and V2G don't have much of an effect on them. Even more, studies have set up delivery charge level plans to protect power quality or get rid of traffic problems that may come up because electric cars are becoming more popular (EVs). At low levels of EV penetration, electric cars have almost no effect on residential distribution transformers. However, as the number of EVs grows, the effect gets stronger. When there are a lot of electric cars on the road, the voltage limit is broken, the transformer is overloaded, and there are more line losses To increase the number of electric vehicles that can safely share distribution networks, these newer management strategies are needed.

## V CHALLENGES

**VEHICLE-TO-GRID (V2G)**

**Ancillary Services**

In PG, the balance between supply and demand must be kept, the balance between supply and demand must be managed, and ancillary services must be provided so that electricity can move from the supplier to the buyer. The two-way V2G model offers auxiliary services that are better than those that are already available. In order to give utilities a bigger and more important load, the transistors in the community will need to buy more PEVs.

**Voltage & Frequency Regulation**

The first phase of V2G is regulatory services. This is because there is a big market for power storage devices for vehicles and they aren't too hard to use. Frequency regulation is used to make sure that supply and demand are both met [37]. The frequency is controlled by turning on and off very large generators, which can be very expensive. V2G is a good alternative to changing the frequency because it can charge and discharge quickly. For reactive power, the voltage regulator is used to find a balance between supply and demand. PEVs come with quick-control signals that can be changed for each PEV individually. By choosing the right phase angle for the current, the charger will be able to use less inductive or reactive power. If the grid voltage goes down, charging of vehicles will stop and won't start again until the grid voltage goes back up to a safe level. When numerous PEVs are connected to the same low voltage system, there is a potential for transmission line overloads, voltage overloads, and stability problems.

In three different ways, the union controls how electricity moves through the distribution system so that the frequency stays the same everywhere. The ability to control the first, second, and third frequencies By charging the batteries of PEVs, it is possible to provide less regulation. However, if more regulation is needed, the batteries will have to discharge into the grid. Who gets primary, secondary, and tertiary frequency control is based on who bids the most. As the need for regulation grows, the cheapest solution is looked at and put into place first. The provision of the regulation is good for PEVs because it will cause the cost of the fee to go down.

Adjusting the Loads (Load Shifting): V2G can balance the load on the electricity grid by charging either when demand is high or when demand is low. In his study [47], K. Mets talked about both local and global smart charging monitoring systems. Using intelligent charging would lower both the peak load and the load curve. So that the grid doesn't get messed up, PEVs should be charged at night. The battery charger is built in a way that reduces the overall load while at the same time increasing the amount of energy it needs.

**V2G V2G:** has a lot of benefits, but if the amount of PEV goes up, it will overload transformers, cables, and transducers and make the power distribution system less efficient. This will hurt the overall efficiency of the system. This leads to a drop in production and may require more starts, which can change the voltage and create harmonics. The biggest things that make it hard to get into the V2G market are the lack of a widespread battery infrastructure and the high prices of the vehicles when they first come out.

**Battery Degradation**

The rate at which the battery wears out depends on how much energy is recovered, how long the cycle is, and how deep the discharge is. When bidirectional V2G is used, the battery life of auxiliary networks will drop by a lot. Since new technologies have come out, the price of batteries has gone up to a very high level. Using a battery that is in the middle of its state of charge (SOC) range is a good way to slow down the battery's decline [56]. The life cycle of a battery can be very different depending on things like its chemical makeup or how it was made. Li-ion batteries are now the best choice for V2G because they last a long time and can hold a lot of power. A Li-ion battery can be used for between 2000 and 2400 deep cycles.

## VI CONCLUSION

The way people get around in the future will be determined by how electric cars and renewable energy sources work together. The amount of carbon emissions and fossil fuels used will go down as the number of EVs and RCIs on the market goes up. But the natural changes they go through make it hard to set up infrastructures that run on renewable energy. When putting up wind turbines, you need to think carefully about both the location and the environment around it. It has been decided that cities are not good places for this because of the noise and the need for large spaces. Solar systems only make power during the day, so they can't meet the large daily demand for electricity. Wind and solar power are being looked at as possible ways to power charging stations for electric cars. But if it is used with electric vehicles, V2G charging stations, and energy storage systems, it could be used as part of a charging strategy for a micro grid. The issue of charging schedules is now the subject of a lot of research, which was brought to the attention of optimal planners. During the planning phase, some of them think about how V2G and renewable sources could work together. RCI planning is hard because renewable sources are available, traffic needs are hard to predict, location design is complicated, and there are other things that affect hourly power management, like renewable sources, grid peak hours, and V2G. All of these things make it hard to plan because they all affect each other. Research shows that not nearly enough studies have been done on the infrastructure for charging renewable energy sources to use real data to improve control strategies, scaling, and real-time control. Because there is a lot of interaction between the infrastructure and electric cars with a long range, a strategy for intelligent charging and discharging has been developed for control and management. The different charging price models show that only a small number of utility programmers support charging from renewable sources, and these programmers are only for residential customers. At public charging loads, new charging programmers need to be put in place for both heavy-duty vehicles and retail consumers.

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