Emerging technologies

Introduction

As an emerging technology introduced after the industrial revolution, EVs have already existing for over 100 years. The first practical electrical car was created by Thomas Parker in 1884. Another famous example of early electric cars was Ferdinand Porsche's electric car, which was manufactured in Germany in 1899. Compared with the steam and gasoline engines at that time, electric vehicles were quiet, easy to drive, and did not emit a strong-smelling pollutant. Before Henry Ford developed the Model T with a new mass production process, EV makers experienced a degree of success in the 1920s, when 28% of total vehicles produced in the U.S. were electric. However, the promotion of EVs slowed due to the high price of electric cars and the rapid development of conventional vehicles. From the beginning of the 21st century, research on EVs has been accelerated due to environmental pollution and energy-related issues. With the engagement of government and industry, infrastructure and EVs technology have been improved. Global sales of EVs reached one-million in 2016, and the sales of global light-duty EVs and plug-in hybrid electric vehicles exceeded five million in 2018. Famous auto-makers such as Volkswagen, Mercedes, and Ford, have addressed their ambitions of promoting EVs.

EVs mainly include pure electric vehicles (PEVs), hybrid electric vehicles (HEVs), and fuel cell electric vehicles (FCEVs). A pure electric vehicle, also called a battery electric vehicle (BEV), is entirely powered by a traction battery.

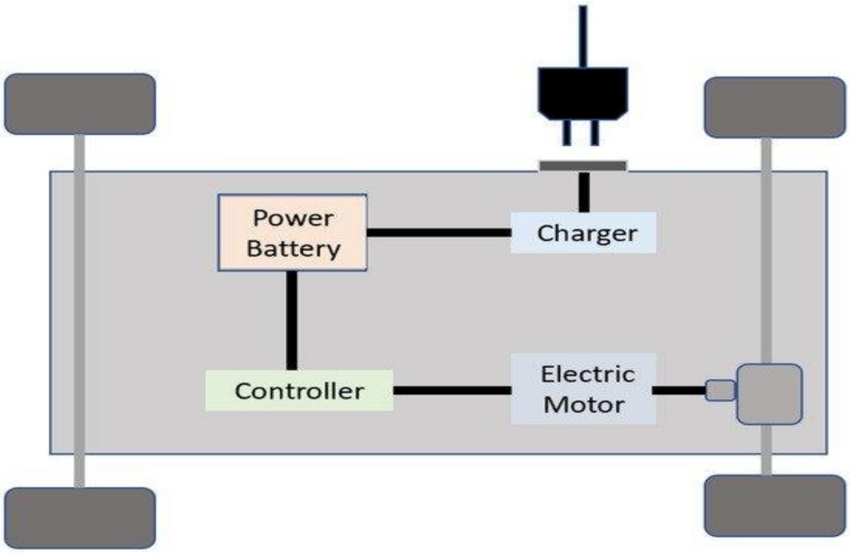
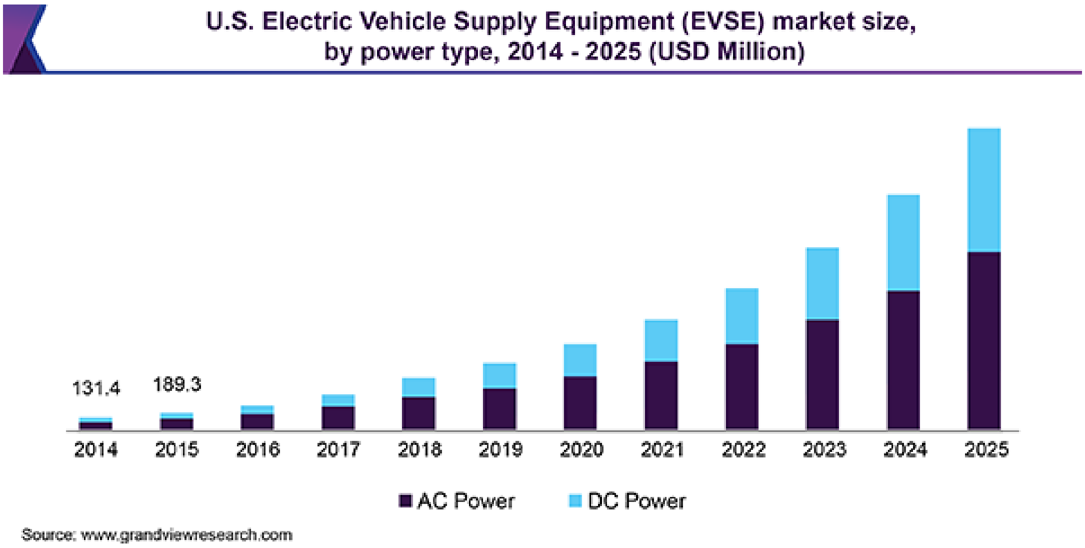


Figure shows the simple design of a BEV. An HEV has two power sources and it combines an internal combustion engine system with an electric propulsion system. The existence of an electric power system is intended to achieve better fuel economy or better performance than that of conventional vehicles. An FCEV refers to an EV that uses a fuel cell, instead of batteries, or in combination with a battery or supercapacitor to power an electric motor. Although technically mature HEVs account for the largest proportion in the EVs market, they are not completely free from fuel oil. In addition, the market share of FCEVs is still tiny. At the end of 2018, the global FCEV stock reached 11,200. The adoption of FCEVs is mainly suffering from the high cost of vehicles and infrastructure distribution. By comparison, BEVs are the optimal choice for addressing the environmental problems and the energy crisis because they have zero emissions and do not consume oil.

The global Electric Vehicle Supply Equipment market size was valued at USD 14.1 billion in 2018, registering a CAGR of 33.1% from 2019 to 2025. EVSE is supply equipment used for charging electric vehicles in various residential and commercial locations such as homes, corporate offices, highways, parks, hotels, and bus depots. Market growth is favored by increasing initiatives by both public and private sectors to encourage the adoption of electric vehicles (EVs). Several governments have started offering financial incentives, including subsidies and tax benefits, to encourage people to buy electric vehicles which are contributing to the rise in demand for electric vehicle supply equipment.

In countries such U.S. and China, which are the largest producers of electric energy, the utilities are charging lower tariffs for electricity consumed by EVSE, which is driving the market. Moreover, in recent years, there has been an increase in government initiatives such as the provision of contracts across the globe for the development of charging infrastructure. Besides, the growing emphasis of private organizations such as The Coca-Cola Company and General Motors Company for developing charging stations for its employees' cars is resulting in the growing demand for electric vehicle supply equipment. Moreover, electricity companies such as Pacific Gas and Electric Company (PG&E) and San Diego Gas & Electric Company are integrating electric vehicle supply equipment by collaborating with EVSE players to meet the demand for charging infrastructure.



Various public transport agencies, such as the Warsaw Public Transport Authority of Poland, GöteborgEnergi of Sweden, and GVB of the Netherlands, are emphasizing on collaborations with bus manufacturers such as VDL Bus & Coach, AB Volvo, and Mercedes Benz for the development of bus charging stations. Besides this, various government agencies are providing funds for the development of charging stations.

Electric Vehicle Supply Equipments

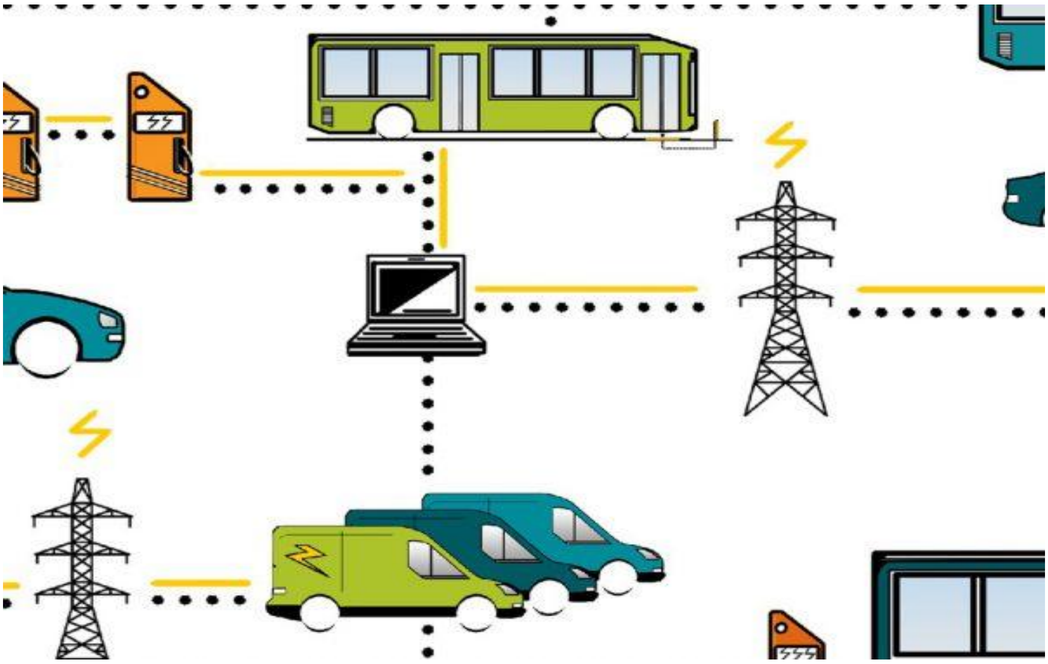
EVSE stands for electric vehicle supply equipment and its function is to supply electric energy to recharge electric vehicles. EVSEs are also known as EV charging stations, electric recharging points or just charging points. EVSEs can provide a charge for the operation of electric vehicles or plug-in hybrid electric-gasoline vehicles.

Electric vehicle supply equipment (EVSE) supplies electricity to an electric vehicle (EV). Commonly called charging stations or charging docks, they provide electric power to the vehicle and use that to recharge the vehicle's batteries. EVSE systems include the electrical conductors, related equipment, software, and communications protocols that deliver energy efficiently and safely to the vehicle.

- EVSE equipment is classified as Level 1 (120 volts AC), Level 2 (240 volts, AC), and DC Fast Charger (480 volts DC and higher).
- NEMA Members encourage the development of the EVSE market and educate the market on the features and values of EVSE infrastructure around the world by:
- Including EVSE requirements in codes, rating systems, and Standards
- Advocating for unified industry positions on legislative and regulatory issues that are favorable to EV and EVSE adoption at local, state, and national levels
- Collaborating with EVSE sales channel partners, including contractors and installers, on such issues as training programs
- Aligning efforts with major stakeholders in the EV market, including auto manufacturers, electric utilities, and state and federal government regulatory agencies

Smart vehicles in smart grid

Smart grid technology provides the means to match up supply and demand at a local level. A critical part of a smart grid is to have forms of flexibility in the energy system. The millions of Electric Vehicles (EVs) predicted over the next few years offer flexible demand that could be optimized in order to deliver the smarter outcomes for electricity network operators and consumers.



Regen predicts that in a high growth scenario in the UK, by 2035 85% of new car sales would be battery EVs and further 10% plug-in hybrids. In Europe, around 50% of new car sales could be EVs by 2035. These new vehicles will increasingly be battery only EVs (rather than hybrid), which will have a larger impact on the electricity networks – creating an estimated 5 GW of peak demand (10.3% of current peak demand) by 2040 in the UK.

Using 'smart' chargepoints able to transmit and receive data and respond to external signals to control levels of charging, will be crucial to managing the impact on the electricity network. EV charging will mainly be at home or in the workplace, spreading this further to other locations and different times of day will help manage the impact on the network. We have identified a range of chargepoint management types which provide varying levels of flexibility.

Overall a mix of these strategies will be employed depending on the local network conditions and consumer requirements. An overarching management of chargepoints by electricity network operators (DSOs), will make sure circuits are within their limits and help keep the lights on. This will be done by creating local flexibility markets to manage demand on the network, or through direct intervention with charging, with a controller device on the chargepoint and at the local substation in the short term, and perhaps through the smart meter communication infrastructure in the long term.

Managed charging on a street with varying levels of constraint on chargepoints

Using bi-directional chargepoints, Vehicle to Grid (V2G) enabled EVs could provide services to the electricity network including price arbitrage, demand side response, local constraint avoidance, and frequency response services. Regen is involved in a trial of V2G on the Isle of Lewis in Scotland, as part of 20 other projects which received a total of £30 million funding from government to look at the technology and commercial opportunities.

Far from being a risk to electricity network security, with the right smart chargers and optimization, EVs can provide new energy services and opportunities for consumers to benefit from. Third party aggregators and electricity suppliers are already looking to EVs as an important source of flexibility within a smart grid. Regen will be keeping a close eye on this market as it evolves over the coming months and years.

Vehicle-to-grid technologies

‘’Vehicle-to-grid is a technology that has the power to transform the energy system’’

The electric vehicle revolution will do more than reduce carbon emissions. Vehicle-to-grid technology (**V2G**), can give you ultimate control over your energy, and even make you money.

‘Vehicle to grid’ technology, also referred to as 'V2G' enables energy stored in electric vehicles to be fed back into the national electricity network (or 'grid') to help supply energy at times of peak demand. It’s just one technological advancement in a slew of new initiatives like ‘smart charging’ and ‘demand side response’ that are aimed at changing the way individuals, and businesses, use energy in the future. In short: the electric car revolution is tied into a whole new way of consuming energy.

This game-changing tech is about far more than potentially making EV owners money, it also plays an important part in helping to ‘balance’ the national electricity network. And it feeds into a national initiative called demand side response (DSR): a programme that aims to rebalance our energy needs around the country by changing how we produce, supply and use energy.

DSR works on all levels. On an individual scale, smart meters are being rolled out to help homeowners control and reduce their energy use. While on a macro level, businesses and large public sector organizations are being encouraged to save energy costs, reduce carbon footprints and adopt new ways to use lights, appliances, air-conditioning, and fridges etc. As part of this initiative, they're also being empowered to:

- Increase their onsite generation of renewables like wind and solar PV
- Adjust the times they use energy (in order to help national network balance energy demand)
- And even feed excess energy back to the network.

Benefit

We’re hurtling towards a place where ‘two-way’ electric car chargers can enable homeowners with electric cars to sell their energy back to the national network. It’s a smart idea when you consider that over 90% of cars are parked at any one time2 – which is a lot of energy just sitting there doing nothing. This technology will give you the opportunity to manage your energy your way, and potentially become energy self-sufficient, reducing everyone's reliance on energy companies. Get solar panels fitted, then adopt vehicle to grid technology and your home could become a private mini-power station.

Vehicle-to-grid technologies for unidirectional and bidirectional

The number of charge-discharge cycles affects how long a battery lasts. Power flow to and fro battery might reduce the life of the battery. People go for V2G and **V2H** only if the potential of earning is more than the expense. Bidirectional converters are not that popular as **unidirectional** EV chargers.

Unidirectional V2G or V1G

Many of the grid-scale benefits of V2G can be accomplished with unidirectional V2G, also known as V1G or "smart charging". The California Independent System Operator (CAISO) defines V1G as "unidirectional managed charging services" and defines the four levels of Vehicle-Grid Interface (VGI), which encompasses all of the ways that EVs can provide grid services, as follows:

1. Unidirectional power flow (V1G) with one resource and unified actors
2. V1G with aggregated resources
3. V1G with fragmented actor objectives
4. Bidirectional power flow (V2G)

V1G involves varying the time or rate at which an electric vehicle is charged in order to provide ancillary services to the grid, while V2G also includes reverse power flow. V1G includes applications such as timing vehicles to charge in the middle of the day to absorb excess solar generation, or varying the charge rate of electric vehicles to provide frequency response services or load balancing services.

V1G may be the best option to begin integrating EVs as controllable loads onto the electric grid due to technical issues that currently exist with regards to the feasibility of V2G. V2G requires specialized hardware (especially bi-directional inverters), has fairly high losses and limited round-trip efficiency, and may contribute to EV battery degradation due to increased energy throughput. Additionally, revenues from V2G in an SCE pilot project were lower than the costs of administering the project,indicating that V2G still has a ways to go before being economically feasible.

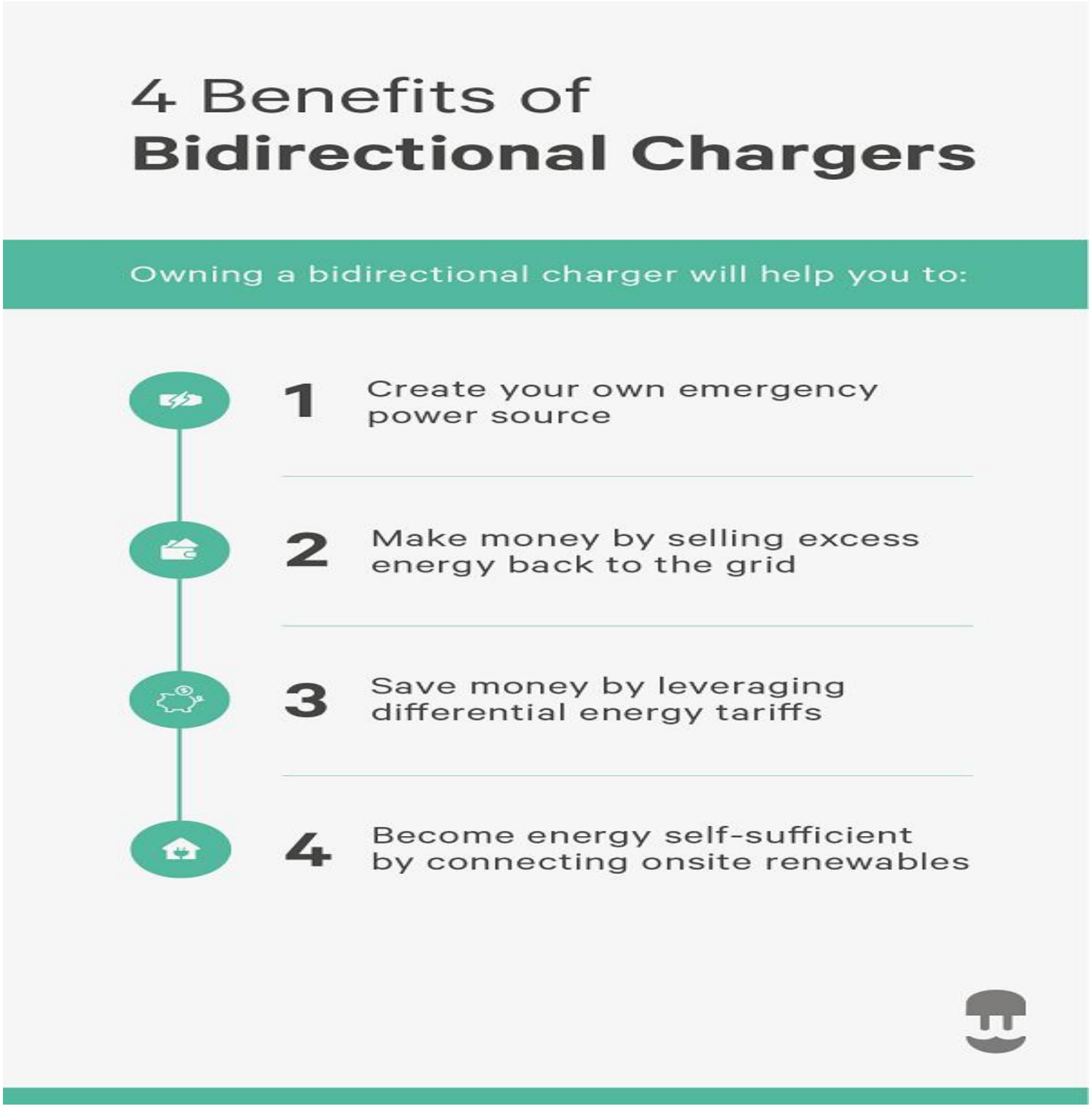
Bidirectional local V2G (V2H , V2B, V2X)

Vehicle-to-home (V2H) or vehicle-to-building (V2B) or vehicle-to-everything (V2X) do not typically directly affect grid performance but creates a balance within the local environment.The electric vehicle is used as a residential back-up power supply during periods of power outage or for increasing self-consumption of energy produced on-site (demand charge avoidance).

Unlike more mature V1G solutions, V2X has not yet reached market deployment, apart from Japan where commercial V2H solutions have been available since 2012 as back-up a solution in case of electricity black-out.

Bidirectional V2G

With V2G, the electric vehicles could be equipped to actually provide electricity to the grid. The utility or transmission system operator may be willing to purchase energy from customers during periods of peak demand, or to use the EV battery capacity for providing ancillary services, such as balancing and frequency control, including primary frequency regulation and secondary reserve. Thus, V2G is in most applications deemed to have higher potential commercial value than V2B or V2H. A 6kW CHAdeMO V2G may cost US$7,000.



Need of charging station selection (CSS) server

Requirement of charging station Infrastructure

Charging infrastructure will play a pivotal role on EV deployment, and, in the absence of a proactive plan and schedule, is a major impediment to mass market adoption. Infrastructure limitations are particularly pertinent to BEVs due to their sole dependency on electricity. The charging infrastructure includes all of the hardware and software that ensures energy is transferred from the electric grid to the vehicle. It can be categorized by location, power level and charging time strategy. Charging locations combined with an acceptable charging time strategy increases BEV functionality and decreases public charging requirements. The approximation of the electric vehicle supply equipment (EVSE) needed at different types of locations (e.g., Home, Work and Commercial Parking) is proposed based on an optimal charging strategy.

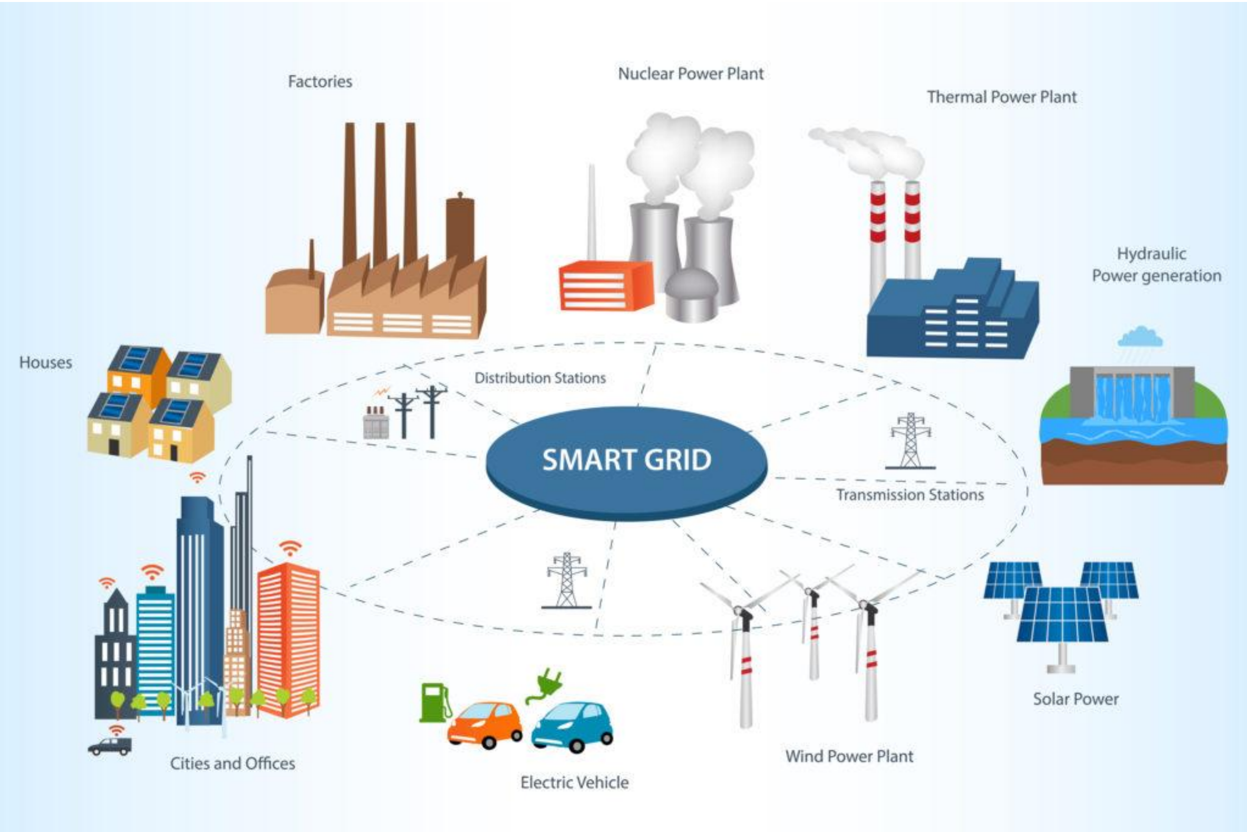
Indian current scenario

Large scale introduction of Plug-in electric vehicles (PEVs), including plug-in hybrid electric vehicles (PHEVs) and Battery Electric Vehicles (BEVs) have the potential to improve Indian energy and environmental landscape of personal transportation. Central government should start enforcing necessary measures to install EV charging infrastructure. Initial step could be to encourage international market players to make case studies on potential locations and adequate quantity of Electric Vehicle Supply Equipment (EVSE). With a projection of EVs, the effects on current, energy production, transmission and distribution scheme, road traffic density, emission level and parking space requirement need to be analyzed. Operation and maintenance of installed infrastructure should be maintained properly. Instead of direct involvement of Govt. body, private players should be tendered in order to maintain the smooth work flow. Central management through Charging Station Selection server (CSS) will play a vital role in information transfer between EVs-Server-Control centres.

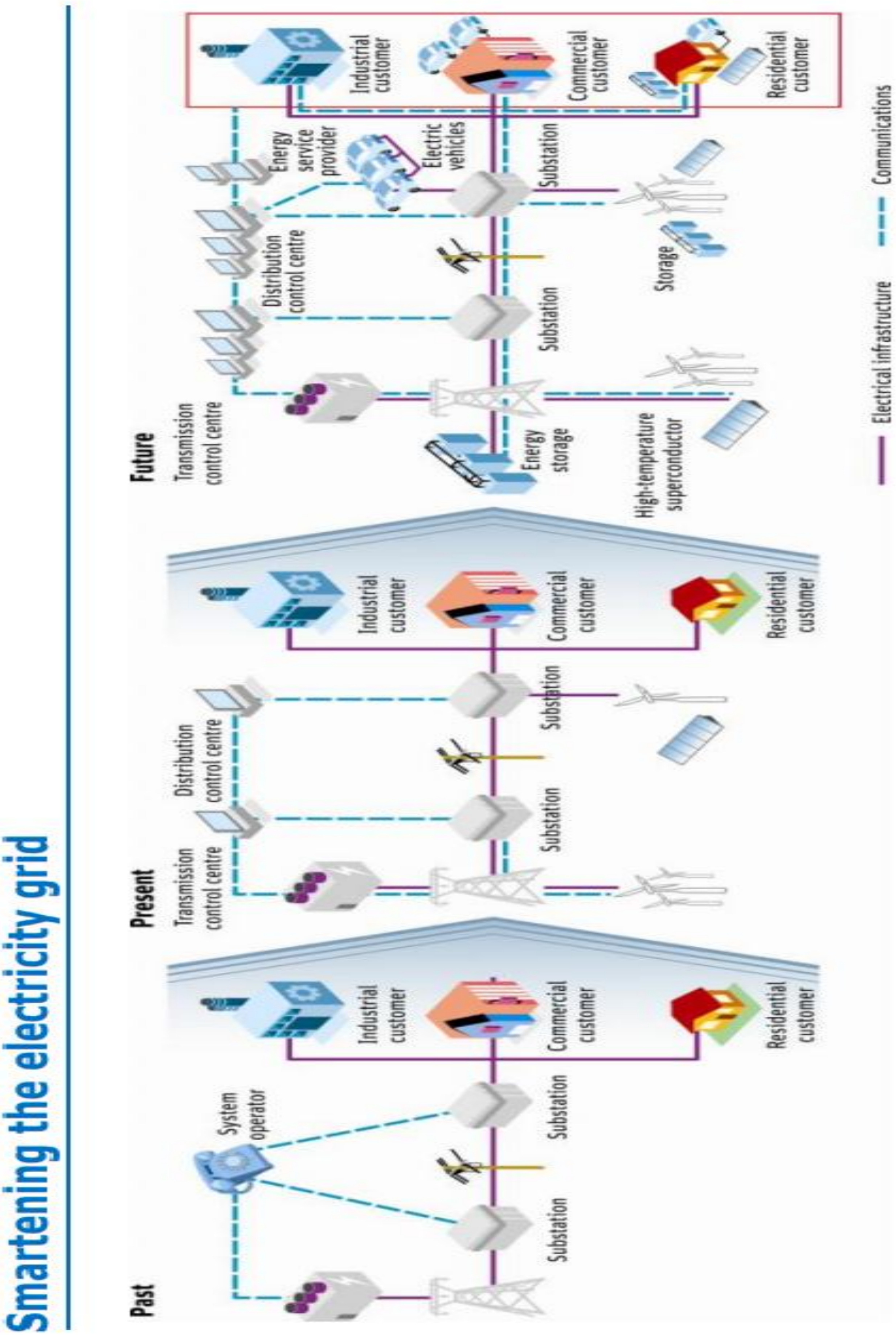
Algorithm for charging station selection

Charging Station Selection server (CSS) traces the instantaneous location of a vehicle and taps the range available with it. It proposes all the charging stations covering the limit.CSS communicates with other vehicles to determine the road traffic and gives an approximate time and charge remaining, until a specific charging station is reached. It also suggests an alternate route to the nearest charging station in case of heavy traffic. The driver chooses the charging type and blocks a slot considering least waiting time. The CSS uses mobile network to communicate with the vehicle and CSs. It also proposes the current metering scheme at particular CS and compares with other CS price. It also can be done through a demand based metering system where EVs will be charged according to peak time and peak load.

Smart grid technologies



A smart grid is an electricity network that incorporates a suite of information, communication and other advanced technologies to monitor and manage the transport of electricity from all generation sources to meet the varying electricity demands of endusers.2 Smart grids allow for better co-ordination of the needs and capabilities of all generators, grid operators, end-users and electricity market stakeholders in operating all parts of the system as efficiently as possible, minimizing costs and environmental impacts while maximizing system reliability, resilience and stability (IEA, 2011a). The process of "smartening" the electricity grid, which has already begun in many regions, involves significant additional upfront investment, though this is expected to reduce the overall cost of electricity supply to end users over the long term. Smart-grid technologies are evolving rapidly and will be deployed at different rates around the world, depending on local commercial attractiveness, compatibility with existing technologies, regulatory developments and investment frameworks. The evolutionary nature of this process is illustrated stylistically in below Figure.



There are a number of different types of smart-grid technology, all of which make use of information and communication technology (hardware and software) such as internet and radio, cellular and cable networks (Table 1). Smart grids involve the gathering, by means of sophisticated metering systems, and exchange of large amounts of information in real time at different levels of the supply chain. Sensors can be installed on each device on the network (such as power meters, voltage sensors and fault detectors) to gather and transmit data, while two-way digital communication between the device in the field and the utility's network operations centre, which enables the utility to adjust and control each individual device remotely. A key feature of the smart grid is automation technology, which lowers the cost and increases the efficiency of load-management operations (for example, automatic adjustments to the operation of the power system in response to a sudden breakdown of one component). Importantly, information flows between suppliers and end users can also be bi-directional, allowing both parties to adjust their behaviour in response to changes in pricing at short notice.

Table : Principal smart grid technologies

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Technology area (level of maturity)	Hardware	Systems and software
Wide-area monitoring and control (developing)	Phasor measurement units (PMU) and other sensor equipment	Supervisory control and data acquisition (SCADA), wide-area monitoring systems (WAMS), wide-area adaptive protection, control and automation (WAAPCA), wide-area situational awareness (WASA)
Information and communication technology integration (mature)	Communication equipment (Power line carrier, WIMAX, LTE, RF mesh network, cellular), routers, relays, switches, gateway, computers (servers)	Enterprise resource planning software (ERP), customer information system (CIS)
Renewable and distributed generation integration (developing)	Power conditioning equipment for bulk power and grid support, communication and control hardware for generation and enabling storage technology	Energy management system (EMS), distribution management system (DMS), SCADA, geographic Information system (GIS)

Transmission enhancement (mature)	Superconductors, FACTS, HVDC	Network stability analysis, automatic recovery systems
Distribution grid management (developing)	Automated re-closers, switches and capacitors, remote controlled distributed generation and storage, transformer sensors, wire and cable sensors	Geographic information system (GIS), distribution management system (DMS), outage management system (OMS), workforce management system (WMS)
Advanced metering infrastructure (mature)	Smart meters, in-home displays, servers, relays	Meter data management system (MDMS)
EV battery charging infrastructure (developing)	Charging equipment (public and private), batteries, inverters	Energy billing, smart grid-to-vehicle charging (G2V) and discharging vehicle-to-grid (V2G) methodologies
Customer-side systems (developing)	Smart appliances, routers, in-home display, building automation systems, thermal accumulators, smart thermostat	Energy dashboards, energy management systems, energy applications for smart phones and tablets

The various smart-grid technology areas – each consisting of sets of individual technologies – span the entire grid, from generation through transmission and distribution to the different categories of electricity consumer. Not all the different technology areas need to be installed to increase the "smartness" of the grid, which can be accomplished incrementally over time. Companies manufacturing smart-grid equipment or developing software include technology giants, established communication firms and new start-ups. EV-charging infrastructure could form an important part of the smart grid of the future. This includes physical charging facilities (connectors and meters), as well as billing, scheduling and other intelligent features for smart charging during off-peak periods. As the share of EV charging in overall electricity load increases, the grid would need to incorporate other assets in order to enhance the capacity to provide power-system ancillary services (reserve generating capacity and peak-shaving facilities), and, potentially, power discharging hardware and software to enable EV batteries to be used as storage devices.

Applications/ Benefits

Applications

Smart grid plays an important role in modern smart technologies. Following are the most common applications of smart grid technology.

Future Applications and Services	**Real Time Market**
Business and customer care	Application data flow to/ from end-user energy management systems
Smart charging of PHEVs and V2G	Application data flow for PHEVs
Distributed generation and storage	Monitoring of distributed assets
Grid optimization	Self-healing grid: fault protection, outage management, dynamic control of voltage, weather data integration, centralized capacitor bank control, distribution and substation automation, advanced sensing, automated feeder reconfiguration.
Demand response	Advanced demand maintenance and demand response, load forecasting, and shifting.
AMI (Advanced metering infrastructure)	Provides remote meter reading, theft detection, customer prepay, mobile workforce management

Benefits

- Integrate isolated technologies: smart grid enables better energy management
- Protective management of electrical network during emergency situation
- Better demand, supply/ demand response
- Better power quality
- Reduce carbon emissions
- Increased demand for energy: Requires more complex and critical solutions with better energy management
- Renewables Integration

Smart meter

A smart meter measures your gas or electricity use, just like a traditional meter. But unlike a traditional meter, a smart meter sends its readings to your supplier automatically. Once your smart meters are installed, you won't need to read your gas and electricity meters any more.

A **smart meter** is an electronic device that records information such as consumption of electric energy, voltage levels, current, and power factor. Smart meters communicate the information to the consumer for greater clarity of consumption behavior, and electricity suppliers for system monitoring and customer billing. Smart meters typically record energy near real-time, and report regularly, short intervals throughout the day. Smart meters enable two-way communication between the meter and the central system. Such an advanced metering infrastructure (AMI) differs from automatic meter reading (AMR) in that it enables two-way communication between the meter and the supplier. Communications from the meter to the network may be wireless, or via fixed wired connections such as power line carrier (PLC). Wireless communication options in common use include cellular communications, Wi-Fi (readily available), wireless ad hoc networks over Wi-Fi, wireless mesh networks, low power long-range wireless (LoRa), ZigBee (low power, low data rate wireless), and Wi-SUN (Smart Utility Networks).

How smart meters work

Smart meter

In-home display

Smart meters work differently, depending on whether they're measuring your electricity or gas. A smart electricity meter is connected to the mains, and monitors how much power you're using in real time.

A smart gas meter, on the other hand, is battery-powered and 'asleep' most of the time. It wakes up every half an hour to send a reading via the electricity meter.

The smart electricity meter connects to a nationwide secure smart network, similar to a mobile phone network. It's called the DCC, as it's run by the Data and Communications Company. The DCC then sends information about how much gas and electricity you've used directly to your energy supplier. That's us, if you're one of our members.

Your smart meter also sends the same information to the In-Home Display (IHD) in your home, so you can monitor your energy usage in real-time and manage how much gas and electricity you use.

In-Home Display (IHD)

This is an energy monitor you can keep on your kitchen worktop or anywhere else inside your home. It is different from the actual smart meter.

The handy In-Home Display communicates with your smart meter to show you how much energy you are using and what it's costing you. Some can even tell you how much carbon dioxide (CO_2) you're producing.

Smart meter look like

A smart meter looks a lot like the standard gas and electricity meter that you would have already.

Smart meters come in different shapes and sizes however they tend to have buttons which when pressed, will allow you to cycle through the several displays.

Many people confuse the In-Home Display for a smart meter. The display tends to look different depending on who your supplier is but they all have a large display screen. You can navigate it by pressing buttons or using the touch screen functionality.

Advantages of smart meters

1. ***No need to submit meter readings***

   Smart meters automatically send out readings to your supplier so you don't have to worry about remembering to submit them. No more standing in the rain and no more torchlight!

2. ***You can closely track your usage and spend***

   The In-Home Display can show you exactly how much energy you're using as well as the associated cost. It encourages good energy habits and some homes are already showing energy savings of 5-20%. Great for budgeting!

3. ***Accurate bills- no more estimates!***

   The smart meter sends your readings automatically so you will always be billed for what you use.

If you have a standard (non-smart) meter and forget to submit a reading, your supplier will have to estimate how much energy you've used over the billing period. They estimate based on the typical amount of energy you have used in the past or how much they think you will use. Sometimes the supplier's estimates are inaccurate, especially if they don't have a lot of information about your usage.

With a smart meter, not only will you avoid inaccurate shock bills but also you can also avoid building a large final bill at the end of your tariff.

4. ***Highlights faulty appliances***

   The In-Home Display shows how much energy you're using at any given time, allowing you to notice any sudden spikes which may be associated with a faulty appliance. By identifying these promptly you can ensure it is dealt with quickly and safely.

5. ***Saving the planet!***

   Smart meters improve your awareness of energy consumption. By changing behavioral habits and informing decisions to buy more energy efficient appliances there is less pressure on the electricity grid. Smart Energy GB estimate a 24% decrease in emissions from homes and businesses by 2030.

6. ***Greater selection of tariffs on offer***

   As we move towards a smart future, smart meters are becoming more widespread. Many suppliers favour smart meters and so are offering exclusive tariffs to households with smart meters.

   Smart meter exclusive tariffs are amongst some of the cheapest on offer, giving you plenty of choice. The energy market is your oyster!

7. ***Prepay friendly***

   If you have a prepayment meter you can also upgrade to a smart meter. With a smart prepay meter you easily track how much credit you have left on your meter and even top up from your smartphone or computer. No more worries about going off supply.

   The other great thing is that, if you're eligible, you can easily switch to a credit tariff. A smart meter can be switched between prepay mode and credit mode remotely so your supplier will not need to fit a new meter in your home.

Disadvantages of smart meters

1. ***Older smart meters become "dumb" once you switch***

   Currently, if you have a first generation smart meter (SMETS1) when you switch supplier your smart meter may temporarily become "dumb".

This means that your meter will continue to record your usage however it will lose its smart functionality and it will no longer be able to automatically send your readings to the new supplier. If you need help, just read our guide on how to read your meter manually.

The Data Communications Company (DCC) is responsible for leading the enrolment and adoption of first generation (SMETS1) smart meters. As of the 29th of May 2019, they will begin connecting SMETS1 meters to communicate through the same network so if you already have a SMETS 1 meter, there's no need to get it changed.

2. ***In-Home Display may be inaccurate***

   When you switch with a SMETS 1 meter, the In-Home Display should continue to display energy use and enable you to retrieve readings without needing to access the meter however their ability to communicate with the smart meter may be inconsistent and in some cases, they stop working entirely.

3. ***Poor signal***

   First generation smart meters communicate using mobile networks.

   In the same way, your mobile signal can sometimes be a bit patchy in some areas, the same applies to smart meters.

   The UK's communications regulator Ofcom, report that 8% of households don't receive data from mobile networks. With the current mobile network, these homes would not be eligible for a smart meter at all. If you have a weak mobile signal, it can prevent the meter from sending readings to the supplier.

   The new dedicated wireless smart meter network that has been set up by the DCC will provide coverage to at least 99.25% of premises in Great Britain.

4. ***A smart meter will not reduce bills alone***

   Whilst having a smart meter is showing a reduction in bills, it can't reduce your usage by itself.

   The theory is that by being aware of your usage and spend, you are more inclined to reduce your usage. The reality may be different from home to home, especially if you don't pay attention to your smart meter.

5. ***Some suppliers can't support smart meters***

   Unfortunately, not all suppliers offer or support smart meters.

Comparison

Advantages	Disadvantages
No need to manually submit readings	If you have SMETS 1, it may lose smart functionality after you switch
Easy to monitor your energy usage and spending using in-home display	In-Home Display may be inaccurate
Accurate bills- no more estimates!	They won't reduce your bills alone
Can highlight faulty appliances or potential safety issues	Smart meters may not work if you have a poor signal in your area
Positive impact on the environment	Some suppliers can't support smart meters
Greater selection of tariffs on offer	

Smart charger

According to studies, India will have close to 1 lakh Electric Vehicles by 2020. To support this huge network, there is a requirement for smart chargers. Apart from public charging stations, India needs to work on mass charging stations at work places and parking towers. To minimize peak load charging, smart chargers have to cut off power to particular vehicles once it reaches a 70%-80% of charging and divert the same to other cars. Most of the offices in India are small and distributed. So we can have a common parking tower for all the offices at a particular zone where smart charging can be implemented, which will otherwise minimize the individual implementation cost.

Smart Charging System

A smart charging system makes optimal use of the energy that is available in a certain time period. In such a system the electric vehicles, charging stations and charging operators share their real-time data. By using this data connection, the smart system knows how much energy and power is required for a given time period. And how much energy is available for the same time period. On the basis of these data, it can monitor the energy demand and plan how much energy it wants to send to the charging station and each of its charging points.

Example of a smart charging system

When you come home from work at 6 PM you plug in your electric car and the charging starts directly. When the battery is fully charged at midnight, the car stays connected to the charging point and will not do anything. At the moment when the charging starts, the demand for energy is at its highest. Suppliers of energy need to deliver the maximum amount of energy at that moment. You can imagine it is smarter to charge not every electric vehicle at the same time.

When you suddenly need to go somewhere you want your car to be charged at least a bit. That is why you can tell the software via an app that you want your car charged for 20% directly, while the other 80% charging capacity needs to be done before next day at 8 AM.

The charging system knows when there is a high demand in energy and will not charge your car during those peak times. When the demand for energy is low, the charging of your car will start. This way the average power is limited, so we are less dependent on the capacity of energy suppliers and the local electricity grid. This is called *peak shaving*. Instead of a peak in energy demand at a certain time, the demand spread out over a longer period of time.

Purpose

Smart charging devices enable the safe usage of maximal charging power. This makes charging much faster compared to using traditional power sockets.

As opposed to traditional (or dumb) charging devices that aren't connected to the cloud, smart charging allows the charging station owner to monitor, manage, and restrict the use of their devices remotely to optimize energy consumption.

Benefits

Smart Electric Vehicle charging is rapidly increasing in popularity. But what does the term really even mean? And why can't we just charge our electric cars using regular power sockets? Smart charging ensures a smooth and secure charging experience and acts as a platform for smart energy services. It also allows you to save money while cutting emissions. We listed the top five benefits of our smart charging devices and features.

1. Charge faster

Smart charging devices enable the safe usage of maximal charging power. This makes charging much faster compared to using traditional power sockets.

2. Charge safer

Smart charging is significantly safer because smart devices automatically test the connection between the car and the device before starting the charging event. Safety can be increased with dynamic load management if there are several charging points in the same property. Charging events can be remotely stopped if needed.

3. Monitor your electricity consumption

Neighborly disputes about your increased electricity consumption can be solved by connecting the charging device to a charging service, which automatically collects consumption data. This way charging costs get charged directly from the EV owner. To help users with company cars, the service can report the costs of both public and home charging automatically to the employer.

4. Optimize charging time

With smart charging, timing can be optimized based on the price at the local electricity market like Nord Pool Spot. This saves money and also benefits the environment and the electricity grid, as prices follow electricity demand. With charging time optimization EV charging balances the supply and demand of electricity and lowers the need for electricity generation.

5. Find charging stations

When a charging station is connected to a charging network, drivers can see whether the station is free or in use — and reserve it if necessary. In addition, drivers can share their home charging stations and earn extra income while helping others. The owner of the device can decide how to restrict access — to himself, his friends, or anyone using the network.