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Article

A Survey on Infrastructure of Vehicles-To-Grid: A State-Of-Art Challenges and Solutions

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Abstract: The increase in the emission of greenhouse gases (GHG) is one of the most important world problems. Decreasing of GHG emission is a big challenge in the future. Transportation sector uses a significant part of petroleum production in the world and it leads to an increase in the emission of GHG. The result of this issue is that population of the world befoul environment of transportation system automatically. Electric Vehicles (EV) have a potentiality to solve a big part of the GHG emission and energy efficiency issues such as stability and reality of energy. The energy actors and their research team determine some targets for 2050; hence, they hope to decrease the world temperature to 6°C in the best and 2°C in the normal condition. Fulfillment of these scenarios needs suitable grid infrastructure, but in most of the countries, the grid does not have a suitable background to apply those scenarios. In this paper, some problems about energy scenarios, energy storage systems, grid infrastructure and communication systems in supply and demand side of the grid and its solutions have been investigated.

Keywords: Vehicle to grid, grid to vehicle, electric vehicles, batteries, harmonic distortion, IEEE bus standards

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1. Introduction

The world population is growing rapidly so as an outcome greenhouse gas (GHG) emission and energy consumption increases year by year. There is not a traditional fuel for transportation systems at hand which is both clear and efficient (mostly fossil fuels), while in other hand electric fleet systems can work with lower GHG emission and energy loss. Therefore, exchanging fuels seems the best idea to get the best result here. To make this happen at first step, the electric grids, which are used, must be smart (Mostly done in North America, Europe and pacific Asia) [1]. Electric Vehicle (EV) is one of the electric transportation technologies; therefore, EV and Smart Grid has been integrated to execute our plan. EVs should connect to the smart grid in the form of (vehicle to grid) V2G or (grid to vehicle) G2V. In V2G technology, EV and grid share energy from vehicle to grid and inverse in G2V. Hence, it could be said that EVs are the subdivision of electric fleet systems and grids. The result of this integration is to have critical specific features such as having high storage and low GHG emission. According to the factors, the entire energy arena actors have developed energy strategies. They have changed transportation system to electric fleet system to meet the targets made by IEA 2030 and 2050. The Paris agreement (UNFCCC, 2015a) contributed to decrease GHG emission in the world, so this agreement declares that countries should come up with plans to decrease global average temperature up to 2^{0}C. IEA 2DS trajectory sets the goal, which is reducing GHG emission from 33 GtCO2 approximately up to 15 GtCO2 in 2050, which is roughly 45% of the CO2 emitted in 2013. Besides, in 6DS IEA trajectory GHG emission approximately is 55 GtCO2. Some predictions of IEA and UNFCCC until 2030 and 2050 on EV plan are as follows [1]:

- About 1 billion Electric Vehicle, demonstrate above 40% of total LDV stock, which is in trajectory 2DS.
- More than 400 million electric 2-wheelers vehicle will be produced in 2030.
- All of the cars will have electric 2-wheelers by 2050.
- The EVI member are 16 governments today.
- Between 2014~2015, new enrolment of EV (BEV, PHEV) increased by 70% (more than 550K sold in worldwide)
- Annual vent of 2015 in comparison to 2014 increased more than 75% in EVs in these countries: France, Germany, Korea, Norway, Sweden, The UK and India.
- Cost of the PHEV batteries decreased from USD 1000/kWh in 2008 to USD 268/kWh in 2015 and the target of 2022 is USD 125/kWh.
- Density of the PHEV batteries increased from 60Wh/L in 2008 to 295Wh/L in 2015 and the target of 2022 is 400Wh/L.

Some countries take actions to get IEA 2030 and 2050 targets. For example, Ireland created a roadmap from 2011 to 2050. In this plan, 800K tons of oil and 4M CO2 emission will be reduced by 2050 per annum. [2] Considering mentioned materials, the grid supported by V2G can play a big role on grid Stability, Reliability, Storage of the grid and reduction of GHG emission produced by transportation system. In the other side of the energy sector, renewable energies such as wind and solar are very important because they produce energy with zero GHG emission and the grids supplied by both energy type are flexible than grids supplied by only fossil energy [3-5]. All type of the renewable energy are available in special situations because they are not stable energy sources. However, all of them can be constructed in every size and everywhere. V2G, smart grid and micro grid are supplementary to each other and also can expand one another. All of the renewable energy conversion procedures include AC to DC or inverse. DC type of energy supplies batteries and EVs energy storage system plays a big role in grid when it needs energy exchange. EVs can save energy when the demand side of the grid strongly decreases for example a decrease between 11PM to 5AM. Hence, reducing energy level immediately in power plants (in every condition) is not economical. Fossil ICE efficiency in the best condition and with last technology is 18%~20%. However, the fossil power plant efficiency is 38%~40% and CHP energy efficiency is 60%~75% [6]. It clearly shows that EVs benefits is not limited only in having zero GHG emission. Thus the EVs are supplied with electric energy, which is generated by 38%~75% which it depends on energy generating condition. [7-12].

This paper, covers discussions about the energy scenarios, storage systems and infrastructure of the grid related to V2G technology. The scenarios, policies and targets of the governments and agencies for the world with lower GHG emission and high-energy efficiency have been suggested. They change the grid target and duty, but the collection of infrastructures cannot respond to the requirements mentioned in scenarios. According to the scenarios (created for grid upgrades), storage systems (such as batteries and chargers) and infrastructures of grid should be changed by the latest technologies in each section.

2. Energy scenarios

Each energy plan has some scenarios. The energy efficiency and GHG emission are target of the each energy scenarios in the world and scenarios about V2G technology depends on own location, so everywhere have different requirements and energy stocks. The road maps created by IEA give result of the general scenarios for 2050. Table 1 gives the number of EV and PHEV that will be sold in 2050. It is clear that EVs have lower GHG emission than PHEV. According to 2050 road map, the North America, Europe and Pacific countries will have lower PHEV then China and

Table 1 Electric vehicle will be sold in 2050 by IEA scenario

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Location	EV	PHEV
North America	8800K	3800K
Europe	6400K	3100K
China	9400K	11400K
India	8600K	9600K
Pacific	2400K	1300K

India. It means that their fossil energy consumption in transportation sector will be lower than India and China.

For example, china's government tries to reduce GHG emission more than other countries. However, the mentioned countries update their grid from cyber security, smart and micro grid side of the grid [13]. Energy efficiency is possible, if the mentioned parameters are used together. Today energy providers give energy with different types of energy such as oil, Gas (LPG, CNG, and LNG) or electric. Energy using method is very important and it must be observance in all part of the energy consumption. Energy using percentages in some place could be as follows: electricity 30%, heat 40%, and transport 30%. In addition, they can be supplied with renewable energy by CEESA 2050 scenario [14]. Control of the supply and demand is the primary parameter of the energy quality, so reduction of the GHG emission and efficiency of energy is possible by assuming supply and demand accurately [15-17]. Control of those, give facilitates of integrating renewable energy network with grid and EVs, but it needs data from metrology, supply and demand of the grid, infrastructure of grid and some additional mathematic method to provide great and predictable data [18-20]. The V2G technology should be economical, so all of the mentioned items should have reasonable relation between technical benefit and economic condition of investor. Performance of the V2G technology depends on grid infrastructure and type of the electric vehicle storage system. Quality and size of them influence performance grid directly [21-22]. Hence not all of them are completely controllable but they are predictable. Predictable means that the management team can modify demand time schedule [23-25]. According the scenario (can be different in each location), the design of the grid have to developable, flexible and manageable more than grids used currently, so grids after design will be created more complex and comprehensive. Scenarios of the grid have some algorithms to use in normal and critic situation and all sections of the grid have connection with another section of the grid that is very important to control of the grid and one of the grid designing protocols [26-28].

3. Storage Systems in V2G Technology

3.1 Batteries use on the electric vehicles: Energy storage types are different in each situation. For example, hydro power plant is used water pumping for saving energy. Type of the energy storage categorized with the some environmental and advanced parameters, such as GDR or technical aspects. Both of them most considered together [29-30]. The type depends on rating of power, charge and discharge, density of power and energy, response time, efficiency, self-discharge and lifetime. EVs battery most be solid and have mentioned parameters [31]. Today, four types of the batteries are better to be used in Electric Vehicle such as Li-on, NiCd, NaS and ZnBr. However, the specific of those are different in each material. Mentioned property of the EV batteries were given in Table 2 [32]. Cost of the each type of battery are different, but technical side of this issue clearly shows that the Li-on batteries are the best choice for EVs in every situation. Li-Ion batteries with some alloy such as Fe, Mn give best performance. In latest measurements, the EVs can travel between 250~350 miles with Li-on battery. Generally $\boldsymbol{LiFePO_4}$, $\boldsymbol{LiCoO_2}$ and $\boldsymbol{LiMn_2O_4}$ types of batteries are used in the EVs. All of them are produced in anode and cathode type [29-32-33]. Table 3 illustrates the type of Li battery and its specifications.

Table 2 Type of Batteries and they specifications [32]

	NiCd	NaS	ZnBr	Li-ion
Power rating (MW)	0~40	0.05~8	0.05~2	0~0.1
Discharge time	s~h	s~h	s~10h	Min~h
Power density (W/I)	75~700	120~160	1~25	1300 ~ 10,000
Energy density (Wh/I)	15~8	15~300	65	200~400
Response time	<S	<S	S	<S
Efficiency (%)	60~80	70~85	65~75	65~75
Lifetime in year	5~20	10~15	5~10	5~100
Lifetime in cycle	1,500 ~ 3,000	2,500 ~ 4,500	1,000 ~ 3,650	600 ~ 1,200
Cost $ (kW)	500 ~ 1,500	1,000 ~ 3,000	700 ~ 2,500	1,200 ~ 4,000
Cost $ (kW/h)	800 ~ 1,500	300 ~ 500	150 ~ 1,000	600 ~ 2,500

Table 3 Some type of Li battery and specifications [33]

Type of Li-ion	Practical energy density (Wh/kg)	Cycle Life	Safety
$C/LiCoC_2$	110~190	500~1,00	Poor
$C/LiMn_2O_2$	100~120	1,000	Safer
$C/LiFePO_4$	90~115	>3,000	Very safe
$LTO/LiCoC_2$	70~75	>4,000	Extremely safe
$LTO/LiFePO_4$	~70	>4,000	Extremely safe

The batteries performance depends on alloy used on it, so to know the grade of the battery quality, manufactures of EV or users of Li battery check the result of tests due on it. Current, voltage, mechanical strike and temperature are important parameters to be considered on all tests on the batteries, so these parameters are fluctuant during the day.

3.1.1 Mechanical strike influence: Mechanical strike is an unavoidable problem, when the EVs have normal or abnormal condition. In normal condition, EV battery abuse mechanical strike from effect of the road, but the EVs batteries have unreliable behaviour in case of an accident. Thus, it must be pass some tests such as T4, FMVSS 305 tests or the battery should be confirm some standards such as SAE j2464 [34-35]. The battery is strongly sensitive; when the SOC ratio is up to 80%. Figure 1 shows how much mechanical strike and thermal are important. All of them influence life and all other aspects of the battery [36-40].

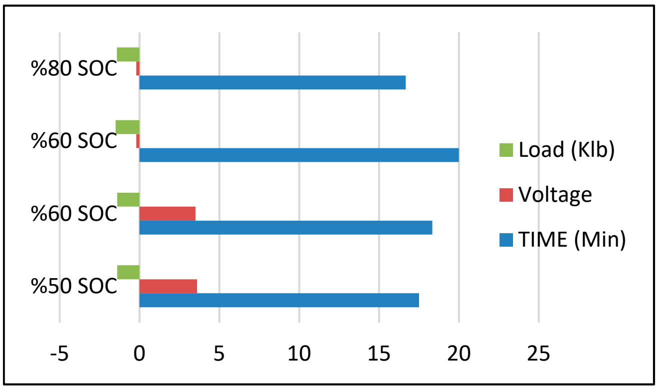

Figure 1 Effect of mechanical strike [41]

3.1.2 Temperature stability influence:
Temperature stability should be considered in all situations, so the battery have different behaviour in each temperature. It does not work perfectly in overdue temperature such as -20°C or 120-130°C,

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in this situation the runaway threat is closer than normal condition. Hence, the EV battery must be protected against the temperature (Battery heat and cool system) and mechanical strike issue.

3.1.3 Control on the storage systems:

Grid integration contribute grid to use power efficiency in each branch of the electric grid. Storage system needs more control than other part of the grid, so the health of the storage systems is critical and sensitive. Storage control system is not limited for grid storages, EVs battery are part of the grid storage, hereby it can control all EVs storage and grid storage system, because EVs are short time energy storage for the grid. Local governments achieve storage system without any payment. It is one of the economic benefit of V2G technology for grid. Control system and EVs storage systems make grid without shock when demand is strongly decrease or increase. If the infrastructure of the grid response control of the V2G technology and some environmental condition. Control of the grid need scenario, plan and data about the grid future, so the grid should be predict data depends on old data, plan and scenarios [36-38-42-45].

3.1.4 Longevity of the EVs battery:

Lifetime of the Li-ion batteries is a complex issue and it depends on mentioned parameters such as charge, discharge, thermal condition and some other parameters. Hence electric grid can assume batteries life and capacity by controlling the grid fully [39-40-46-47]. EVs batteries are using in order to AM and SM, however they have used in both side of the grid. This option gives economic encourage and eventually cost of the electric power and energy system can change in each location [48-55].

3.2 Charging Systems: Charging system in electric grid is a bidirectional system, which grid support V2G technology. The charging system quality has a special point; it is almost determined as the efficiency of V2G system. Figure 2 shows basic V2G technology procedure and clearly explains that technology [56-57]. Charging system is almost covered the core of V2G. Charging systems are changed in each grid, it

depends on infrastructure of the grid. Some charging systems support only DC or AC and both of them. Therefore, the chargers produce considered infrastructure of the grid with various power electronic parts. IEC 62196-2 TYPE 1, 2, hybrid, SAE J1772 TYPE 1, 2, Combo and CHAdeMO are types of the charger connectors. All of the connectors work in some critical options. For example, CHAdeMO only works in a DC system [58] Table 4 gives some charger connectors and type of the charge model.

Table 4 EV charger connectors power type [35]

Type of port		AC	DC
IEC 62196-2	AC Type 1 : 120V	*	Hybrid version
SAE J1772	AC Type 2 : 240V	*	Combo version
CHAdeMO			*

Base of the energies like power plant or renewable energy have to convert to DC type of energy, if the grid has connection with storage network. While increasing number of DC convertors ratio of the THD is automatically increase on grid. Creation of DC lines in infrastructure of the grid is beneficial for grid which are used in smart grids and V2G technology, for example DC line is improve charge stations performance in public places by solar energy or using wireless charging system. Power electronic converters always change energy alongside loss of energy, especially when it is change from DC to AC. Infrastructure of the electric grid and THD issues are critical problems and Nowadays countries try to reduce both problems. Table 5 mentions that balance of the energy is a big future challenge. Number of EVs, Chargers, Population, and space of the location have a crucial role on the load spread balance. All of them are important for control and

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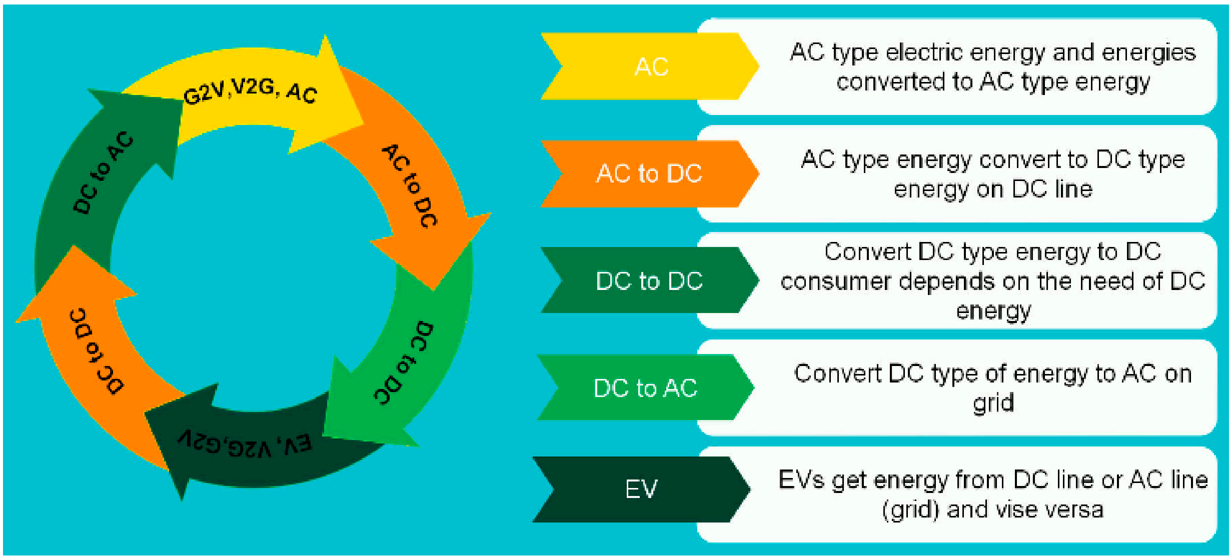
modelling of the grid. Computing their data accuracy contributes to predict the future of the grid. Nowadays, energy consumption should be efficient. Hence heating, cooling, transportation systems are eager to use electric type of energy as much as possible. Solution of the grids modelling are different in each location. Creating energy node in the urban and redistributing energy and DC reserve line to supply DC base energy equipment are ways to reinforce the infrastructure of the grid. Support of the infrastructure and EV induced in creating positive opinions in people's minds. People are looking all facilities of the V2G technology [59-67].

Table 3 Some numeric location data related of V2G technology

	U.S	China	Japan	U.K	Netherland
EV (k)	404	312	126	49.67	87.53
Chargers (k)	28.15	46.65	16.12	8.716	17.78
Fast chargers (k)	3.524	12.1	5.99	1.158	0.465
Population (M)	324.6	1373.5	126.8	65.11	17.10
P. Per Square of KM	35	145	346	255	412
Area Square of KM	9,833,520	9,596,961	377,972	242,495	41,543

Figure 2 Procedure of V2G technology



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3.2.1 Potentials to build charge station by renewable energies:

Creating a sensible effect on the people's life is important. It is one of the effective factors. Charging systems must be available on EV driver's home or office. In fact, the charging system convert energy and transfer from EV or grid to storage system. Storage side of V2G technology (home, office, parking and some public place) might be one of the VPP. VPPs can support grid and they efficiency is in medium-high level, such as WPP, Solar energy, CHP. Renewable energies can generate energy everywhere and every scales [68]. Table 5 shows VPP majority. It means that EVs complete energy circle by V2G technology. In this circle EVs do transmission line and temporary storage duty. If both home and office be equipped with VPP and V2G technology and personnel EVs always could be connected to grid. All of them have some benefit to the energy sector they were mentioned below:

- Low GHG emission in supply and demand side
- Reduction of the grid shock strongly
- Reduction of energy cost so helping home and office economy
- Reduction of fossil, coal and nuclear energy contribution

Table 4 VPP availability division by users

	Home	Office	Parking	Urban
Solar PV	*	*	*	*
Micro turbine	*	*		*
Regular turbine		*1		
CHP		*1		
Battery	*	*	*	*

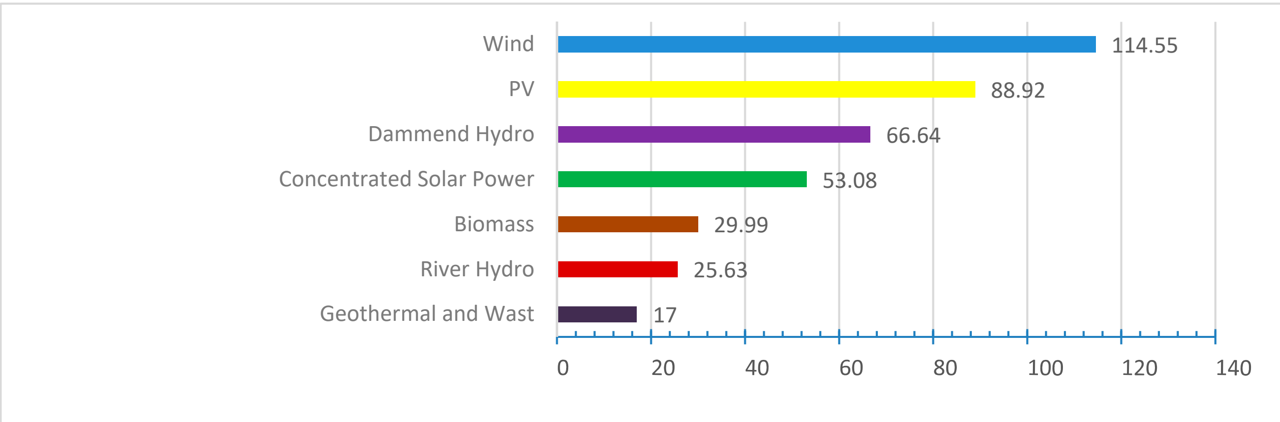

Figure 3 South east Europe renewable electricity in the year 2050 [TW/H] [85]

*1: its availability depends on the condition.

Ratio of the mentioned benefits depend on metrology, cost of energy and supply/demand profile and grid data in the location. Metrology is a power of the renewable energy, such as solar and wind. Solar power is available until sun radiation exists. And wind energy is available until air flow exists. After predicting renewable energy availability in the respective location, next step is to compute efficiency and cost benefit to compare with the previous condition. However, sun and wind probability are influenced with all calculation of the benefits [68-70]. Renewable energy benefit, supply/demand on grid, storage capacity and cost of it must be computed to give clear view of the energy efficiency. How much energy was transferred with EV? How much energy was saved with EV and local storage system? How much GHG emission was decreased? In this situation, the provider can get the ratio of energy usage by renewable energy and other sources of energy. In

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addition, with the systems collectivity (V2G technology, Renewable energy and smart grid), reduce fossil energy automatically in the grid, but its ratio decreases slowly. For example someone creates an energy plan with 20%~80% wind energy in his/her own scenario [73-75]. VPPs generate energy with a high efficiency. It means low GHG emission. In this situation EVs or departments receive a tax discount from their own governments. At this point, they must prove their data to get a tax discount. It needs operating with accurate calculation and a developable control system, otherwise all the benefits and losses are indemonstrable and the data is under the haze. [76-77]. Some data has transferred between V2G technology installed place and control center [78]:

- EVs battery status
- EVs location
- EVs supply/demand status
- EVs GHG emission
- Charge station status
- Grid supply/demand status
- Cost of energy on grid, EV, Homes or other energy producer and storage

Some projects related V2G are accomplished and all mentioned parameters are considered in projects. For example Taiwan, U.S (Florida), Netherlands and China [79-82]. Priority of source to supply charging center is local energy production. Electric Storage system and their charging system in V2G technology and same technologies (which energy transfer between them is bidirectional) are the important part of the grid, so the reason of having this technology is electric storage systems, which have good energy responsibility. According to the mentioned advantages and disadvantages, it seems that, the Lifepo4 type of li batteries is a best choice between various types of the batteries.

4. Infrastructure

4.1. Strategy: Strategy of V2G technology works according to some plan and targets. Besides, the targets are zero GHG emission and energy efficiency such as stability, reliability. Some parameters cause changes in plan. Infrastructure, energy sources, budget and some other parameters in each country are determined with the energy plan, which is necessary to develop V2G technology. Energy sources and ability to generate renewable energy are determined with benefits and market share of the V2G technology. Renewable energy developments, V2G technology and smart grid are impelled alongside [83-84]. Figure 4 gives renewable electricity targets of South East Europe in the year 2050.

4.1.1. Pricing of energy:

Energy sector pricing system is different from other sectors. Supply / demand and determining cost of the energy by time and other grid priority give balance and discipline on all of the grid. However, in the energy systems supply/demand balance is the second important factor. Balancing is a means to distribute energy correctly in the electric grid. Density of population is not constant in each location, but specification population is clear for governments. Hence Location and Density of population, Time of supply/demand, measure of supply/demand and balancing of supply/demand [87] influence the price of the energy. Location and Density of population determines grid demand average in all electric grids. High population density mostly is located in down town of the cities or capital of the country. In this condition density of the transmissions lines are increased, so ratio of the loss energy is increased. For example, when energy demands are in high level and the energy generation is low, the cost of energy in these locations is in the highest level [88-91]. The time of the energy using is important, sometimes all customers of the grid use energy. In this condition electric grid work with full capacity. It is not an acceptable situation. Hence, the electric supervisors are encouraging people to use electric energy except for the demand peak time (18:00 – 22:00) [92, 89].

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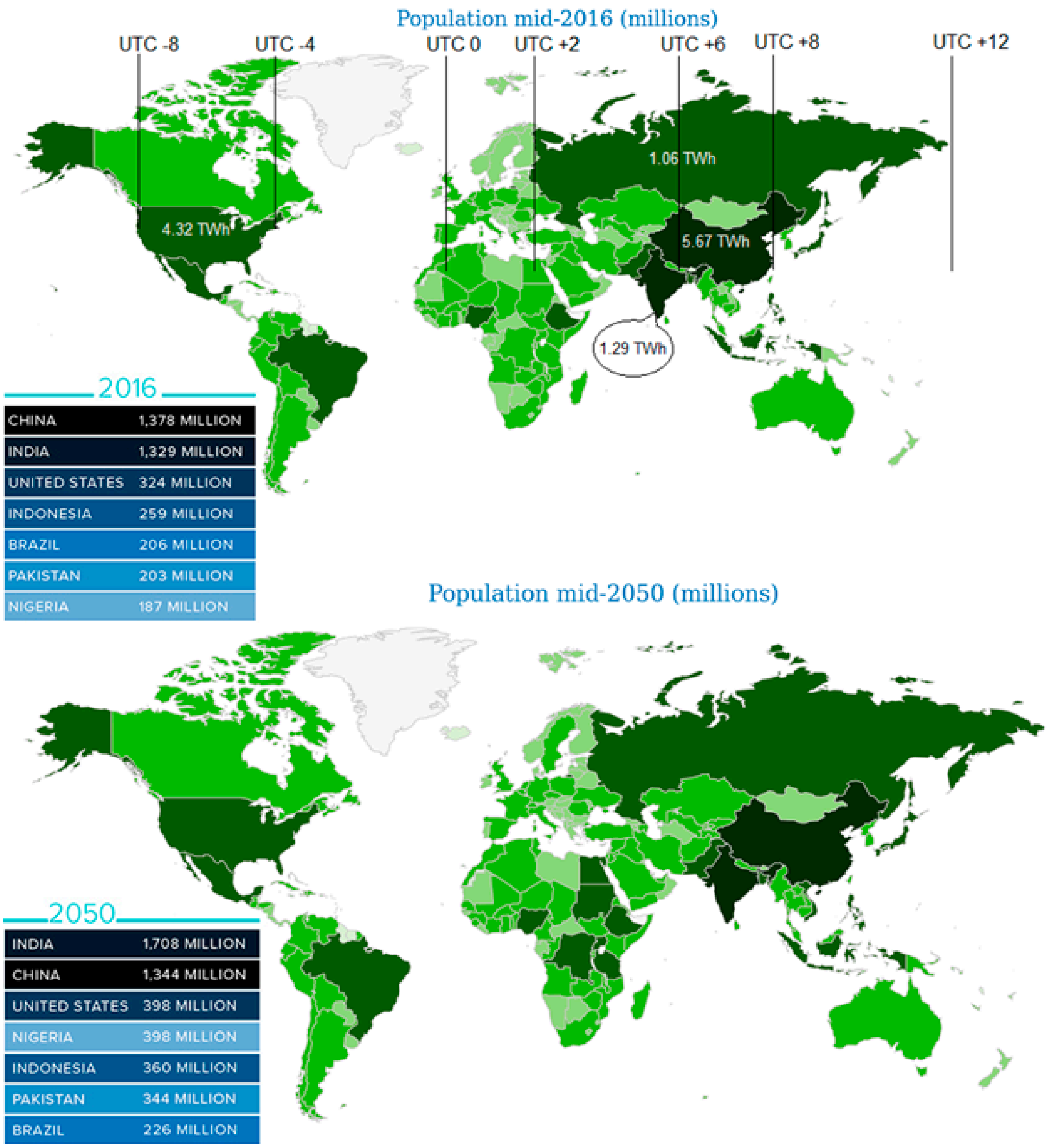

Figure 4 The world population from 2016 to 2050, some countries time zone and energy generation difference

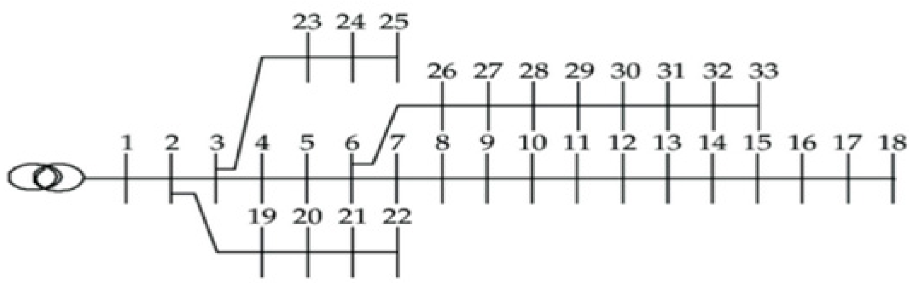

Figure 5 IEEE 33-BUS grid

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Today everyone can generate energy in own house or office. It's depend on environmental condition. With the V2G technology, someone can transfer energy customer to customer and grid. Generate energy contribute the grid and the supervise pay cache for energies are generated from customers [93]. Supervisors have to balance energy on the grid, so unbalance grid can damage the grid. They use some methods such as building switching centres to balance energy in the grid [94]. Figure 5 illustrates time zone difference, population and energy generation in some countries. It clearly shows that the mentioned issues influence the electric grid directly. Social infrastructure in the countries such as economy, psychology, appliance and cognitive science should be prepared to use EVs. People of the world have to use EVs because fossil energies is going to extinct and people who use fossil transportation system are increasing. In other hand type of energy, consumption differs in each area depending on sunrise and set where some countries grid work synchronize. The management group must organize it with considering local time and other local abilities [106-110]. V2G technology helps to reduce mentioned problems by EVs. Governments can create prefect charging design, pricing and grid infrastructures control plan with the challenging mentioned problems in background and future targets. One of the good control systems must be teste in international sample electric grids and each part of the network must be tested in international standards grid patent such as IEEE 33 Node, IEEE 34 Node and IEEE 300-Bus Network. Figure 5 shows an IEEE 33-bus grid system. Grid coordination under the mentioned standards gives wide developing facility such as grid behaviour predict, charging, scheduling and risk management [96-100].

4.1.2. Control system communications:

One of the control systems duty is online observation, so the EVs are mobile devices and they can be on supply or demand side of the grid (charge/discharge). It gives some favourably strong points from people. EVs users can see online exist charging centres and their status. In the online system, all variable parameters change in each condition. It gives facility to provide fine pricing and managing system. The control system communicates with WAN, HAN, NAN, SCADA, DSL, GSM, SATELLITE, GPS. In fact, they have chain connection with other parts of the grid. They were illustrated in Figure 6, it also depends on local and situation, for example use GSM, DSL and Satellite connection way to connect some data centres with other part of the grid [101-105]. All of them are available everywhere. Data of the EVs are sent to EVs controller operator to control all EVs on each location but in some situations, the grid works in uncertain conditions and uncertain condition gives different behaviour from the grid. Some methods contribute to calculating energy cost in uncertain conditions such as ENTRUST algorithm.

4.2 Grid Modelling: Infrastructure of model the grid is a base of the V2G technology.

Mentioned topics are impelled in best efficiency and GHG emission targets. Thus, to reform in some section of grid is too hard and needs to be investigated deeply. Fossil Power planets, Renewable energies and V2G-G2V (subsets of Renewable Energies) are the inputs of grids. Today, the policy and planning of the countries is to make grids supplied by renewable energy and it is subsets to consume green and efficient energy. All energies injected to grid should manage, so all type of energies have special specifics. For example, convertors of the renewable energies such as DC to AC and reverse generate THD or energies on the storage system should be controlled in supply/demand side. Electric distribution are the last node of the grid electrification. In this section, grid supply all demands side of grid and Energy distribution condition depends on the location. Grid modelling with V2G technology is same smart grid, so the gird in both systems work unidirectional. The grid can supply with both type of AC and DC electric energy [111]. Most of the electric devices work with AC type of electric power. In this situation energy, providers have to provide AC type of energy and DC type of energy achieve from DC/AC convertors. Different types of energies is one of the cause of the energy loss. Today to have one of the DC lines from source to

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consumer is compulsory. In such a condition AC type of energy have THD problem. The DC type of energy can response wide customer of the grid. Different chargers, different convertors, different sources is sample of the energy type problems. AC and DC customers are also connected and energy exchange will have loss energy and increase THD but DC line have some critic advantage such as

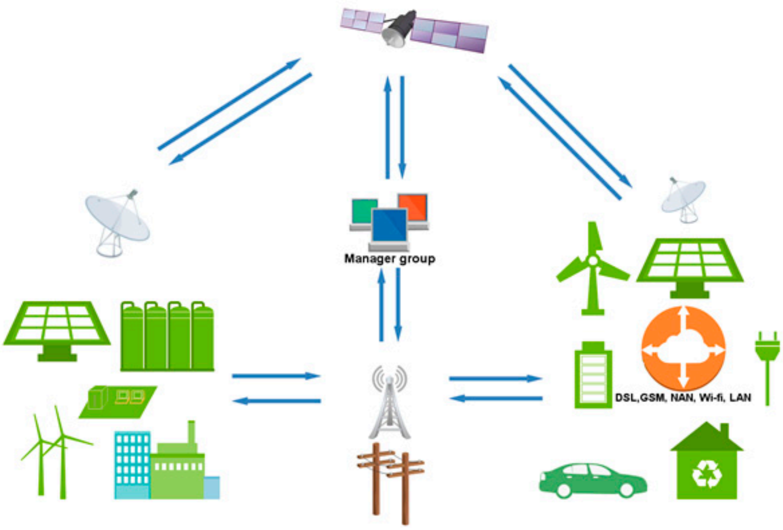

Figure 6 Communication system in electric grid.

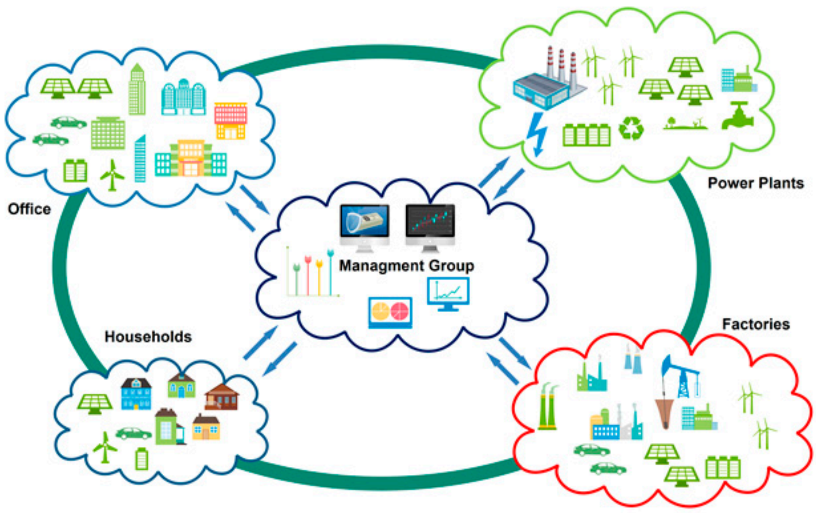

Figure 6 All grid energies connect to other sources and customer

reducing energy loss, response local renewable energy source and the other sources which works with DC type of energy that can work hybrid. For example, Egypt and India tested the DC line in some projects [112-121]

4.2.1 Frequency control: Electric power frequency is one of the most important parameters in the grid. The grid frequency is not controllable when supply and demand is not balanced; usually demand side of the grid overcomes the supply. In V2G, technology charge and discharge influence the grid frequency, especially in charge condition. EVs have batteries with large capacity and quantity of the EVs is high which means overall energy exchange is homogenized but it is not true in all time. All of that have negative effect on the grid frequency. Hence, solution of the frequency issue is control all parameters and equipment of the grid and demands such as (quantity of the EV's active or EV's

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energy capacity). Power systems must be controlled with special control nodes depending on area, demand and sources [122-126].

4.2.3 System Integration: One of the smart and unidirectional power system must be integrated system. So all parts of it should be connected and work synchronize. Process of the integration need to make capacity and limit some factors depending on the grid design. Each part of the materials mentioned in this paper play big role on the power system integration. Why the power system integration is important?. Because V2G technology upset of the power system and V2G work correctly when supply/demand condition is fine. For example, status of the charging station, battery status of the EVs and grid supply/demand power are some aspects of V2G technology related to power system integration. Figure 6 gives the facts clearly. The Power system is integrated to give low energy loss, high efficiency so with this technology gap of the supply/demand is reduce and power of the control system is increased. For example home or office interference to generate energy by some local renewable energy sources [74-127-131]. The power system infrastructure should be designed according to some parameters such as accessibility, reliability and being able to be developed. Result of this action is that the grid can be updated with some technologies such as V2G and the subset technologies. Grid should support the energy traffic, which is achieved by newer technologies such as V2G or energy storage systems. The grid designers must care about communication between grid and people. Therefore, in emergency situations, the grid management group may increase and decrease supply/demand by people. It is only a recommendation which would work by grid infrastructure.

5. Conclusion

In the infrastructure of the world electric grid, some revisions have been done. However, all energy scenarios after increasing GHG emission in the world have changed according to some agreements and conferences such as UNFCCC 2015a in Paris. The infrastructure of each system should be changed when the enrolment scenarios change. Ratio of revisions depends on old infrastructure conditions and future targets, which are mentioned in context. Storage systems is one of the sensitive parts of latest grid models such as micro and smart grids but their development does not satisfy and response the grid requirements. Hence, the batteries need to be more developed to comply more charge/life cycle and more safety. In the other side of the storage systems, charger of the batteries almost generate THD in the grid and THD is a disadvantage for charge systems. At a glance, all mentioned problems force infrastructure of the grid to work without good quality. Today, after the development of the lithium type of batteries and power electronic systems, the researchers who are working on V2G technologies can take some actions easily so the new battery and power electronic systems provide fast charging, high life and charge cycle with lowest THD influence in supply and demand side of the grid. With those benefits, the grid can work properly so lack of energy and temperate storage are solved. The life/charge cycle, energy density and safety problems are solved with some polymer type of the lithium batteries. THD of charge equipment can be improved with DC line, so in this technology most of the chargers with heavy THD generation eliminate. Problems of infrastructure of the grid can be detected quickly with synchronized communication system. The V2G technology received a big acceptance from people but it need great market share to develop this technology. Psychology of the people is important, so people must have satisfaction and great view from EV. Hence, officials have to achieve people's acceptance and create encouragement plan. For example, the tax of EV is zero in some country or explain the benefits of the V2G technology by Li batteries, mobile energy station and ultra-capacitor.

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Nomenclature

GHG:	Green House Gas	IEEE:	Institute of Electrical and Electronics Engineers
ICE:	Internal Combustion Engine	WAN:	Wide Area Network
EV:	Electric Vehicle	HAN:	Home Area Network
PHEV:	Plug-in Hybrid Electric Vehicle	NAN:	Neighbourhood Area Networks
HEV:	Hybrid Electric Vehicle	SCADA:	Supervisory Control and Data Acquisition
V2G:	Vehicle to Grid	DSL:	Digital Subscriber Line
G2V:	Grid to Vehicle	GSM: Global System for Mobile Communications	
GDR:	Generalized Demand-side Resources		
IEA:	International Energy Agency	GPS:	Global Positioning System
UNFCCC:	United Nations Framework Convention on Climate Change	THD:	Total Harmonic Distortion
IEC:	International Electro technical Commission	VPP:	Virtual Power Plant
SAE:	Society of Automotive Engineers	WPP:	Wind Power Plant
GTCO2:	Giga Tone Carbon dioxide		
2DS:	2°C Scenario	Fe:	Iron
6DS:	6°C Scenario	Li:	Lithium
W h/L:	Watt hour per litre	Li-ion:	Lithium-ion
TW h:	Tera Watt hours	NiCd:	Nickel–Cadmium
KWh:	Kilo Watt hour	NaS:	Sodium–Sulfur
EVI:	Electric Vehicles Initiative	ZnBr:	Zinc–Bromine
AC:	Alternating Current	$LiFePO_4$:	Lithium Iron Phosphate Oxide
DC:	Direct Current	$LiCoO_2$:	Lithium Cobalt Oxide
CHP:	Combine Heat and Power	$LiMn_2O_4$:	Lithium ion Manganese Oxide
CHAdeMO:	CHArge de MOve	LDV:	Light-Duty Vehicle
SOC:	State Of Charge	ϕ_{tp}= Previous hour solar elevation angle	
AM:	Automotive Mode	ϕ_p=Current hour solar elevation angle	
SM:	Storage Mode	R_0= Clear sky insolation $(W-m^2)$	