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Renewable Energy Based Grid to Vehicle and Vehicle to Grid Charging Station

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Abstract: Chargers must be efficient so that electric cars (EVs) and plug-in hybrid electric vehicles (PHEVs) can be charged at the right rate as they become more popular. It would also make charging more expensive, because more people would use the traditional power grid. It's because of this that more people are going to use local, renewable sources of energy instead.PV panels, which convert sunlight into electricity, can be added to the traditional power grid. As well wind converter designed to convert the energy of wind movement into mechanical power this could make the traditional grid more efficient. A place to recharge In this thesis, PV and the grid are used to power EV loads. However, Because of the PV's intermittent nature, which is very dependent on where you live and the weather, it is well-known that it isn't very stable. To make up for the PV's inconsistency, a battery storage system is used. An electric car charging station powered by solar panels and wind that are part of a system that is connected to the grid. Most of the time, hybrid charging stations are supposed to be, efficient, and safe to use. Meet the needs of electric vehicles in a variety of situations by giving them more options. This thesis talks about how to be more efficient at the top. PV power generation on site is planned and implemented to meet the needs of the project. Using BSS, electric cars can have a more varied load, which lessens the strain on the grid. This method works. Improves overall performance, reliability, and cost by a lot. Efficiency in converting power in both directions interleaved buck-boost converters are added to BSS to make sure it works. By using BSS, conversion losses can be kept to a minimum. This structure could help to reduce the waves that are already there. Electricity will be better if you improve its quality to get the most out of a PV system while keeping it as environmentally friendly as possible. MPPT and an interleaved boost converter are used when the weather isn't always clear. This way, the output stays the same. PV power will always be available. In the same way, to deal with the changing power needs of car chargers, Converters should be put together in a way that meets the needs of electric cars while also keeping the balance between the levels of power that can be generated.

Keywords: SOLAR, DFIG, MPPT, GRID ,WIND MILL, EV,

I Introduction

Electric vehicles are gaining popularity because they emit less pollution and are less reliant on fossil fuels [6]. By integrating smart grid charging stations with distributed renewable energy sources, energy efficiency and carbon reduction can be achieved [7]. It is possible to have a Microgrid that is both linked to the grid and separated from it, where dispersed energy sources and storage devices are used locally by a variety of load types. However, widespread adoption of high-capacity EV charging stations increases demand for charging infrastructure, which in turn increases demand on the power grid [8]. Power converter topologies and local renewable energy sources are used to help people who have trouble using a lot of energy. Tesla and Nissan are two of the companies that make electric cars. They build the infrastructure for charging stations. As a result, electric-vehicle charging stations that use renewable energy cut charging costs and emissions while improving the synchronization of utility grid [9].

Renewable energy sources utilized in distribution networks, in conjunction with the electrification of charging stations in smart grids, offer a means of increasing power conversion efficiency and reducing emissions.

The Microgrid is made up of a collection of dispersed energy sources and storage devices that are used locally by a variety of load types and are function in either a grid-connected or islanding mode.

There are a lot of ways to charge electric cars, from hybrid (renewable energy, BSS, and the grid) to dedicated (electricity generated by the vehicle). This raises the question of whether or not charging electric cars with a hybrid system is better than with a single source of power. Electric cars can be charged at a lower cost by using free electricity from renewable sources like wind and solar. This can also help reduce the amount of fuel used to run the grid, which can help save money. In addition, if the grid doesn't have enough electricity to meet the needs of the electric cars, they can be charged directly from the grid or with the help of Renewable Energy Sources (RES). Energy buffers can also be used with batteries. Batteries can be used to store extra energy from renewable sources like wind and solar. Electric cars may also benefit from extra services provided by the energy they use. As a side note, it's important to note that stand-alone renewable systems have a lower penetration rate than those that are connected to the power grid. [13]. the reliance on the main grid as a reliable source/load capable of compensating for the volatility in renewable energy sources. Solar energy is the preferred renewable energy source for EV charging since it may be produced during high-cost power grid tariff hours. Thus, solar-powered EV charging stations may help lower the cost of electricity. The photovoltaic module has a basic construction, a compact footprint, is lightweight, and is easy to carry and install. Additionally, the photovoltaic system doesn't take long to build and can be connected in a variety of ways based on how much electricity it can charge. To be used as a source on site, it is easy to find. Photovoltaic energy production is, on the other hand, very dependent on the temperature and and sunlight in the area. In other words, PV electricity isn't continuous during the course of a single day of operation. It's also short-lived, meaning it happens at timed periods (minutes to hours). When PV panels are connected to loads without using an auxiliary system, this has an effect on the charging system. As a result, storage devices may play a critical role in stabilizing and moderating the unpredictability of solar energy production. This thesis suggests the use of an energy storage device in conjunction with a photovoltaic system to provide constant power to the EVs load regardless of PV power variations. Integration of storage devices with photovoltaic panels and power grid maximizes the use of renewable energy, resulting in reduced operating costs and increased efficiency.

II RELATED WORK

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 generalized Nash equilibrium problem, and a consensus network is used to solve the problem in a decentralized 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 modernize 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.

III PROPOSED WORK

Optimized charging times for electric cars (EVs) to cut down on peak demand for smart grid integration. Optimizing based on the soc, EV charging state, and substation load scenario has been shown in order to cut down on the amount of electricity used at peak times. In this case, the distributor and the customer work together. As shown in Figure 1, a typical electric vehicle (EV) is hooked up to the grid. "vehicle-to-grid" is the term for the way that EVs can exchange energy with the grid both ways (V2G). When ICT is used with the electric car charging system, this goal can be reached. When people model how electric cars work with the electricity grid, they used to think about them as a one-way flow [6,7].

There are two ways to think about electric cars: as loads on the grid and as generators and storage that are spread out across the country. Peak load shaving, the idea of storing energy in an electric car battery and giving it back to the grid when there is a lot of demand, was the original idea.

In order for an electric vehicle (EV) to last for a long time, it needs a source of power. There are three types of electric cars: PEVs, HEVs, and PPHEVs. All three emit less pollution if the energy used to charge them comes from clean sources like solar or wind power. If the electric cars are charged with fossil fuel or gas-based electricity, the emissions aren't zero and aren't even close to zero. PV, wind, tidal, geothermal, or hydropower is all good sources of RES that can power electric cars. PV is a great source of electricity for electric cars because of these reasons:

Transferring power from one generation to the next is called "transitive charging." In order to get all EV aggregators (big and small) to trade energy with each other, more research is needed on "peer-to-peer" or "transactive" charging systems. Using transactive trading instead of traditional ways to schedule and trade energy has a lot of good things going for it. One of them is that it doesn't have to be connected to the grid to work. This lets the price signal from a central power station stay mostly the same.

When the "Layer1" problem is solved, the main server can figure out how much electricity can be drawn from EV charging stations 24 hours a day. Peak loads at substations can be cut down by setting the maximum permissible loads for electric vehicles at each charging station for all 24 hours of the day. This can help.

In order to build an EV charging system, you need to figure out how the power moves between the system's main sources and the cars. The power flow management can help you figure out what kind of bi-directional power electronic systems you need and how big they need to be. The research then tries to figure out how to manage power flow and whether or not managing power flow can be used to charge a device.

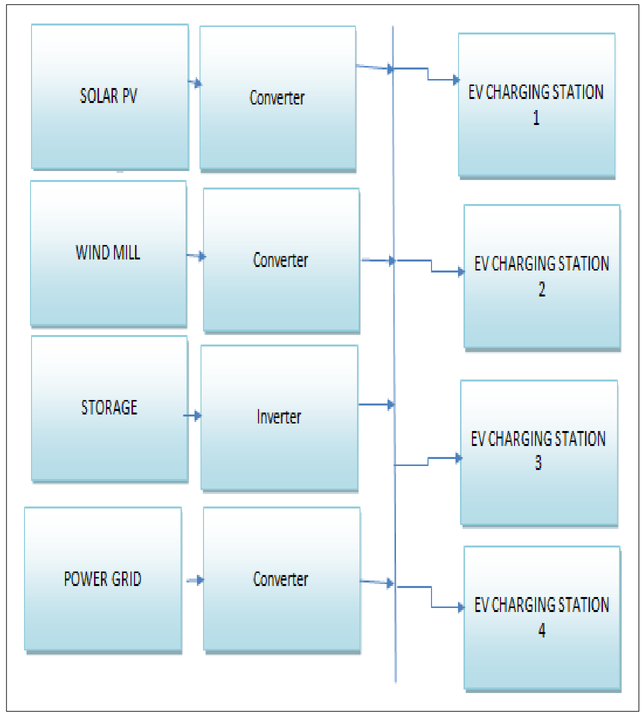

Fig.1 proposed flow diagram

While providing the linked load with the power it needs, the battery storage and PV combination comes up with a variety of ways to solve power flow problems at different times. In the past, it has been common to use heuristic principles to figure out how the grid/PV/BSS/wind power flow will work, based on things like demand and PV irradiance. The proposed method, on the other hand, is complicated by the fact that the price of electricity changes all the time. When the dynamic grid tariff system was put in place, simple heuristic criteria for PV/BSS operation led to operating cost solutions that were very different from the least expensive operation. The goal was to make the hybrid system's contribution to the grid the best it could be. Using this method, it is assumed that the PV/BSS output power does not have a dispatch cost. As a result, battery degradation costs and the best way to run the device are often overlooked. Charge schedules and predictions of how many electric vehicles will be on the road have been suggested as ways to manage the flow of power. As much as possible, low voltage electricity has been used to charge EVs to keep the load stable and reduce the difference between peaks by changing the charging start time to keep the charger power rate at a level that meets the needs of the users. In addition, the charging process can be made easier to avoid peak loads. Optimization Will Be Based On Minimizing the Summation of Total Electricity Cost from Power Grid

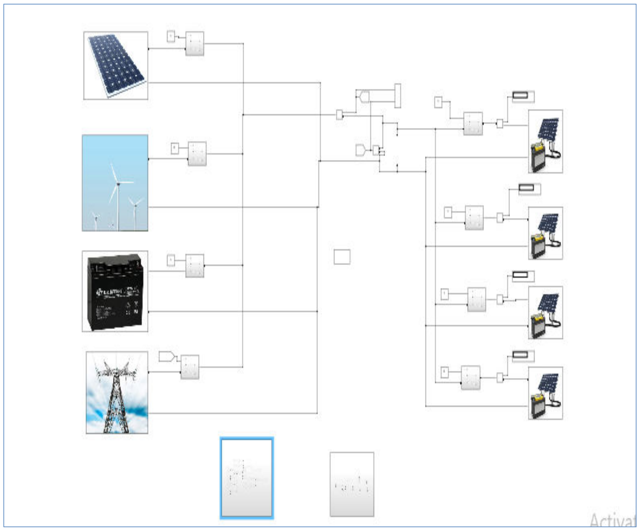

Fig 2 MATLAB Simulink model

Battery life, safety, and reliability are all important if the battery is charged and discharged properly. In this paper, the bidirectional power converters are used to figure out how to manage the power of a PHEV battery in a different way. Up to 10A can be used to charge a battery with this system. It can also send power back to the single-phase 230V, 50 Hz power at a rate of 10A. Two parts make up the system: a single-phase AC-DC converter and a DC-DC converter. A single-phase bidirectional AC-DC converter is used to change AC voltage to DC voltage. To charge, the DC-DC converter goes into buck mode. To discharge, the converter goes into boost mode. The charging and discharging of the battery shows how the battery works.

Uncoordinated charging of electric vehicles can result in a massive electric load on the grid, resulting in increased power system peak load and distribution grid congestion .The production of renewable energy and the coordination of EV charging have been investigated in order to avert such a scenario. To be more precise, the study examined EV-based solutions for providing ancillary services in conjunction with wind integration and energy storage in conjunction with photovoltaic integration.

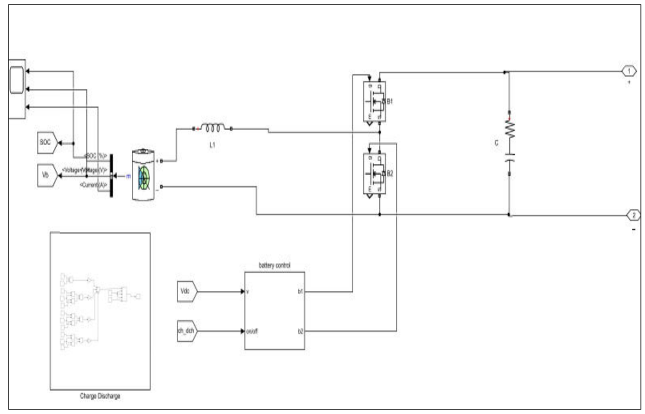

Fig 3 Battery subsystem

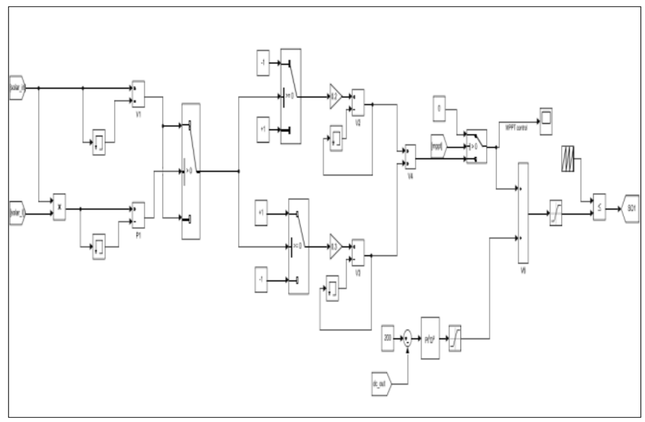

Fig. 4 MPPT Control

There is a model of a wind turbine in this block that can change its pitch. The way to measure how well a product does. Wind speed, rotational speed, and pitch angle all have an effect on the turbine's Cp, which is a measure of mechanical power (beta). The value of Cp is at its highest point when beta is 0. When you look at a wind turbine power characteristics display, you can see how the wind turbine works at a certain angle of attack. First, you need to know how much speed the generator is going per unit of its base speed. Sync speed is the speed of any generator, whether it is synchronous or not. It is the foundational speed of any generator. When there is no load on a permanent-magnet generator, it runs at its "base speed." The angle of the blades (beta) in degrees is the second thing you need to tell the machine. The wind speed in m/s is the last thing you need to add. There are units for measuring how much power the generator produces, and these units are called generator rating units (or "output")

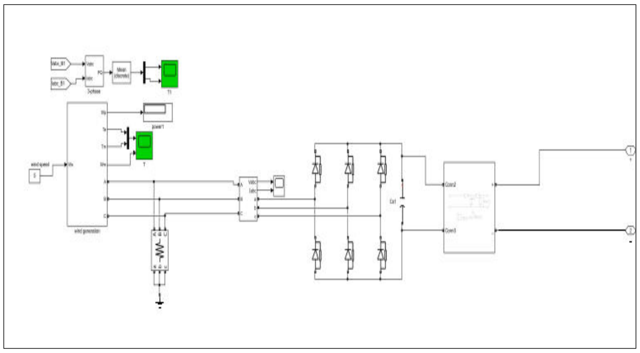

Fig 5 Wind Turbine Model

which is written in degrees. There are three inputs to a generator: wind speed and a third input called "third input." When wind speed is taken into account, the generator's body is hit by lightning at that third input value.

SIMULATION RESULTS:

Fig.7 SOC charging at 40%

In the simulation 4 SOC condition check to check the SOC of the battery in the first case If soc between 0 to 25% , it will charge showing in fig 7

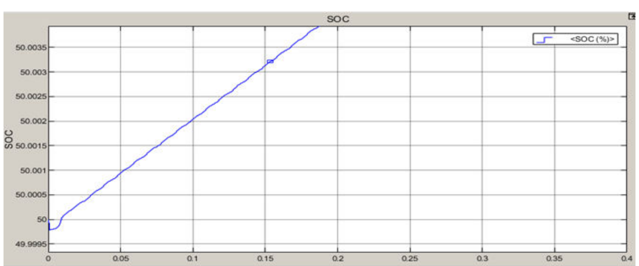

Fig.8 SOC charging at 50%

In the third case If soc between 50% to 90%, it will charge showing in fig. 8

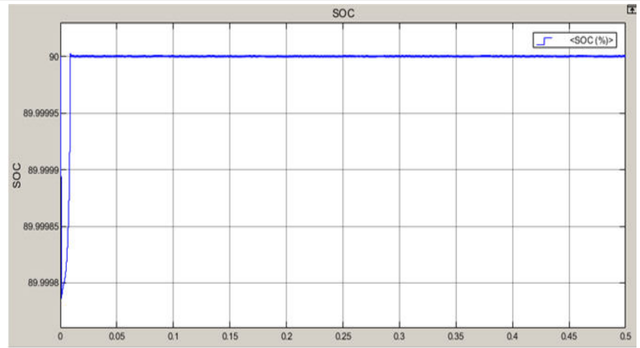

Fig.9 SOC charging at 90%

In the third case If soc between 50% to 90%, it will charge showing in fig 9

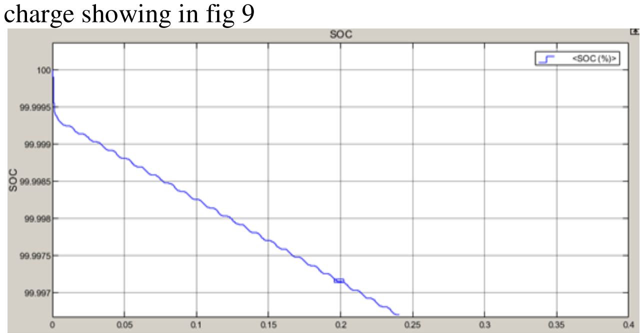

Fig.10 SOC discharging at 100%

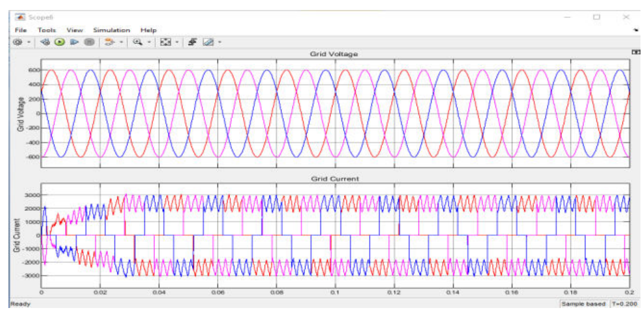

Fig 11 grid voltage and current

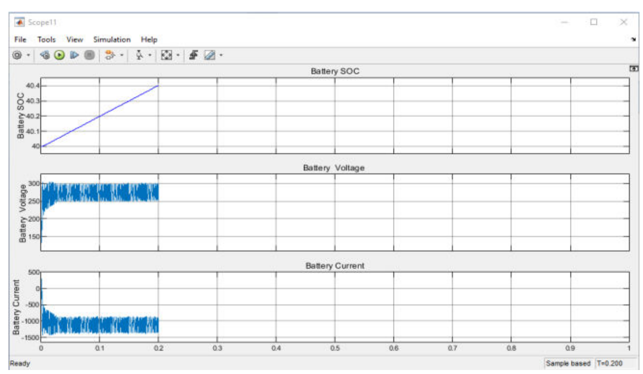

Fig 12 battery SOC, Battery voltage and battery current for EV1 Station

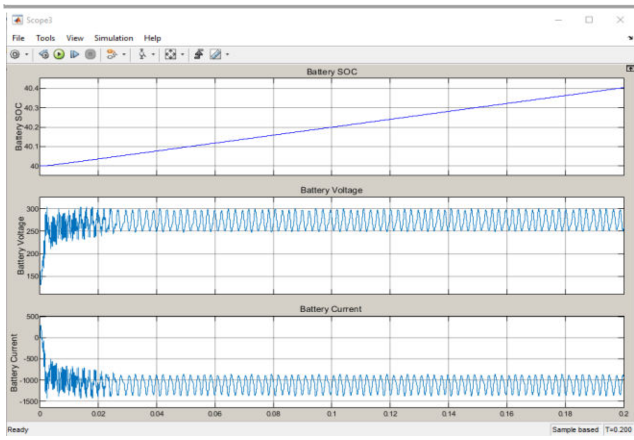

Fig 13 battery SOC, Battery voltage and battery current for EV4 Station

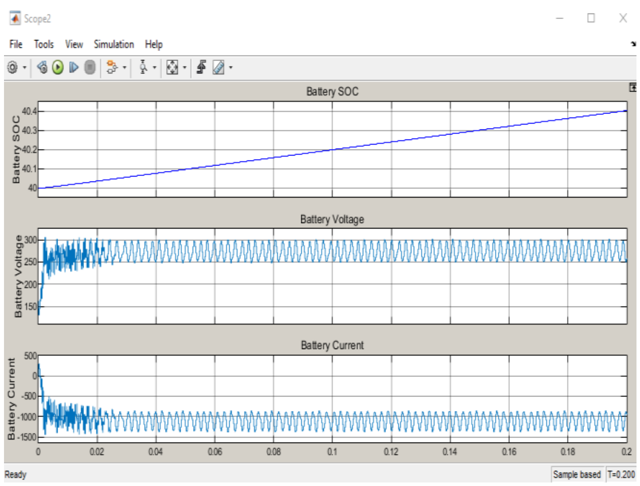

Fig 14 battery SOC, Battery voltage and battery current for EV3 Station

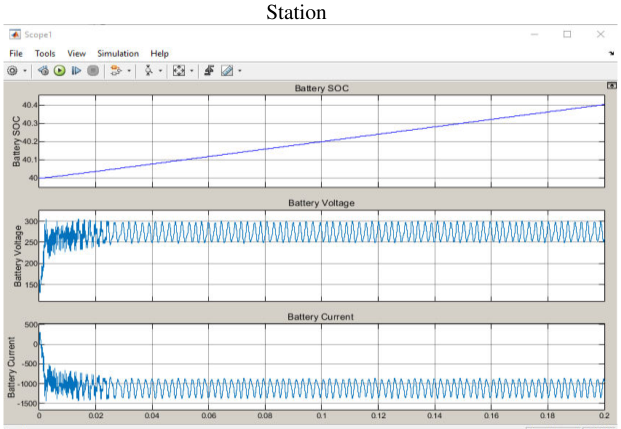

Fig 15 battery SOC, Battery voltage and battery current for EV2 Station

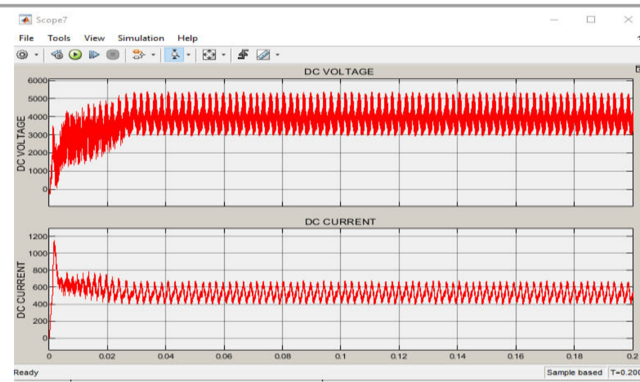

Fig 16 DC voltage and current

Fig showing generated DC voltage and current from the Simulink model

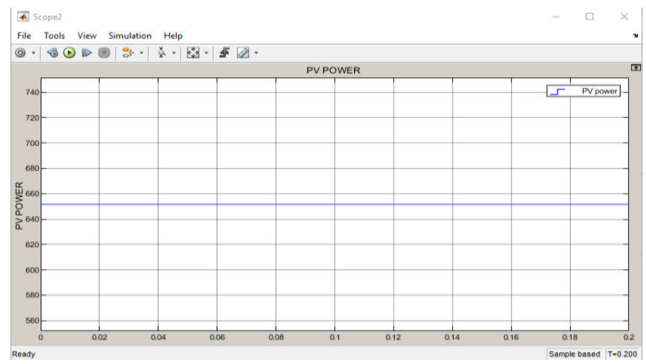

Fig 17 PV power

Fig showing the Te electrical torque, Tm electrical torque,Wm rotor speed

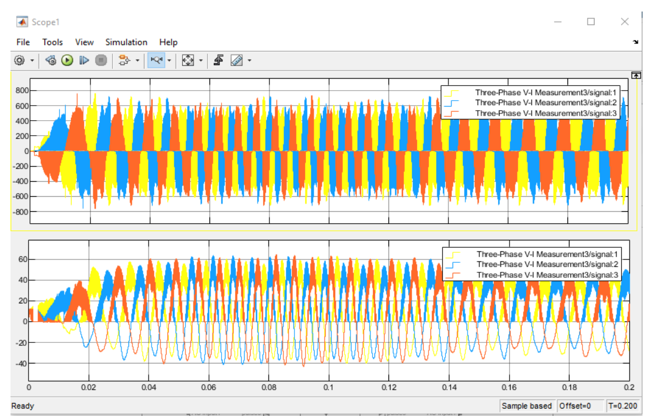

Fig 19 three phase voltage and current measurement of wind generation system

IV Conclusions

The development of the electrical vehicle for the last few years has become an emerging and moving towards eco-friendly technologies and the usage of the energy and storage sources has been improving over the years. The research has focused on the storage system and controlling system of the electrical vehicle. For this research study, a specifically rated battery and renewable energy have been selected as sources, and converters like boost converter and optimization algorithm have been simulated four different EV station designed with different SOC condition to regulated continuous charging supply to EV. It also involves the design of three-level inverter using MATLAB Simulink Concerning EV batteries being distributed in smart environments, there are technical issues that need to be addressed: energy management strategies and control of the integration of EVs with grid is the key to using EVs as shared storage, which needs to be carefully examined. People putting electric cars on station before starting charging, the EV battery needs to be connected to the device needed to determine if there is any residue in the system to start charging the battery, so we need a competent inverter.

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