ISSN No:-2456-2165

A Design and Simulation of Vehicle to Home (V2H) Technology to Match Power Demand

Md. Rakib Ahsan
Dept. of Electrical & Electronic Engineering
American International University-Bangladesh
408/1, Kuratoli, Khilkhet, Dhaka 1229,
Bangladesh

S. M. Imrat Rahman
Assistant Professor, Dept. of Electrical & Electronic Engineering American International University-Bangladesh
408/1, Kuratoli, Khilkhet, Dhaka 1229, Bangladesh Dhaka,
Bangladesh

Abstract:- Global electricity demand is at the peak point. Therefore, we are thinking about multiple energy sources to balance the claim of it. Because of being digitalization, the electricity demand of Bangladesh is higher than ever. However, there is so much distortion and discord in supplying electricity in 24 hours. Then people come to use a generator or other temporary energy source in this condition. Moreover, solar energy can balance the domestic demand by powering electric vehicle (EV) battery and after using the car, we can use the rest of it. Thus, the system is known as vehicle to home technology(V2H) and it seems an alternative approach to generator or IPS. This paper here disclosed a full model of V2H technology along with the collaboration of solar energy of MPPT system. The whole simulation model and results are analyzed by MATLAB Simulink software.

Keywords:- *Solar energy, load shedding, generator, IPS, MPPT, EV, V2H, MATLAB.*

I. INTRODUCTION

A vehicle-to-home (V2H) technology is a new concept to supply electric power when it is load shedding or discord of electricity. To implement this system here need an electric vehicle that has a rechargeable li-ion battery and is connected to the home load. Furthermore, to energize the battery in this model we used solar technology along with a solar MPPT system. Since the electric energy demand is increasing then there needs more generation of power. However, using non-renewable energy sources is much more about power generation than they come to last. Then we are going to develop the system to absolve more energy from non-renewable energy like solar, wind, tide, and so on. If we observe the following figure 1, we are able to notice that solar energy is providing the highest energy than other renewable energy in the Bangladesh scenario [1]. However, it is very challenging to store the energy of solar as the cost of the battery is higher than the other resources of the solar system. Then an electric vehicle could be a solution to store the rest of the energy in the battery to run it. In this model, the remarkable part is after using the vehicle we may use the rest of the energy to our household needs when there is a lack of supply or load shedding. This method can help you avoidthe cost ofbuying a generator. On the other hand, it is very environmentally friendly than a generator.

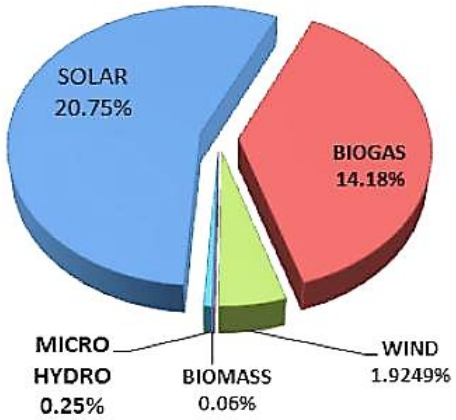

Fig. 1: Scenario of renewable energy o Bangladesh [1]

Figure 2 shows the compression of standard quality and air quality in Dhaka city of Bangladesh. If we observe the right side respective from the left side then it seems very alarming which is gradually increasing as well. Afterward, if we are able to familiar with electric vehicles and solar energy regarding this model then we are able to reduce a good number of CO, NO2, SO2, O3, PM 2.5, PM 10 emissions [2].

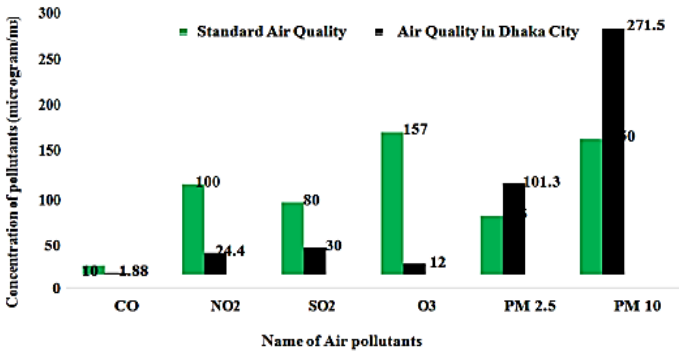

Fig. 2: Air pollution rate in Dhaka city [2]

II. SCENARIO

Energy is very needy in everyday life; it is inextricably related to a country's well-being and economy. According to LightCastle Partners' investment forecast, power industry spending would increase dramatically between 2031 and 2040, perhaps resulting in an energy crisis [3]. Bangladesh's power supply imbalance has resulted in significant economic losses, estimated to be between 2% and 3% of the

ISSN No:-2456-2165

country's GDP [4]. The utilization of outmoded facilities that are used during peak hours and whose running costs put downward pressure on industry profits must be addressed with caution. The government has made significant initiatives to encourage private sector investment in power, including several tax breaks and advantageous ownership regulations. And based on the billion-dollar agreements that have been completed in the last year, they appear to be working [5]

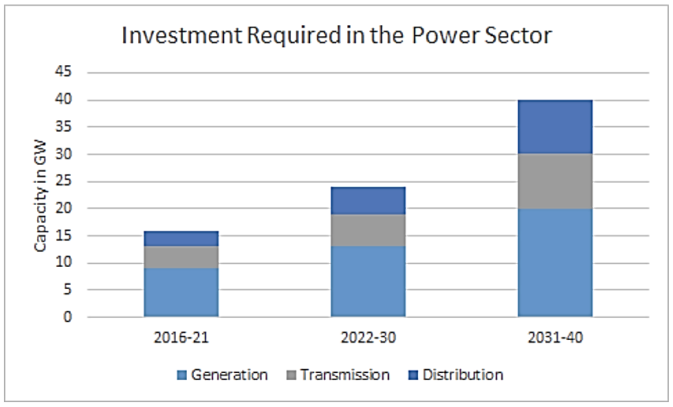

Fig. 3: Investment scheme in the power sector from 2016-2040 in Bangladesh [3,4]

Since the power demand is high therefore the investment is also increasing. figure 3 represents the demand scenario by increasing gradually [6]. Father more, the following table is showing the capital market share of Bangladesh. Here is two continuity of the capacity of the public sector, private sector, and captive power as well. Lastly, the total is showing the enhancement of it.

	2016-2017		2017-2018	
	Capacity (MW)		Capacity (MW)	
Public Sector	7304	47%	8845	46%
Private Sector	5973	39%	7557	39%
Captive Power	2200	14%	2800	15%
Total	15477	100%	19202	100%

Table 1: Capacity of market share of Bangladesh from 2016-17 and 2017-18 [6]

Eventually, then, non-renewable energy has taken a great part to contribute to the power demand and therefore the software and hardware technology has improved to collaborate with the energy system. Likewise, an electric vehicle is also capturing the marketplace instead of a typical vehicle [7]. The EV will be charged by the electric energy as well. Then there is a great scope to combine both renewable energy and EV to invent a smart power balancing system. Lastly, V2H will be a dynamic approach it. Figure 4 is showing the sale of the hybrid vehicle. In the year 2017-18, the amount is at the acme. Therefore, it is showing the future scope of the hybrid vehicle all over the country [8].

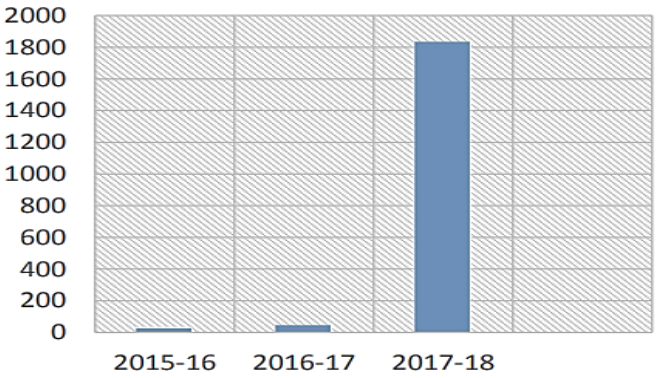

Fig. 4: Number of increasing electric vehicles in Bangladesh

III. MODEL DESCRIPTION

The V2G system has been designed with the necessary components which are shown in figure 5. From the left corner the solar plate is absorbing energy with the help of the maximum power point tracking system (MPPT) and the help of DC-DC converter it shifts to the electric vehicle. Since it is DC power than to supply in the home or building load it needs to invert AC power. Then, here added an inverter to constitute DC to AC [9].

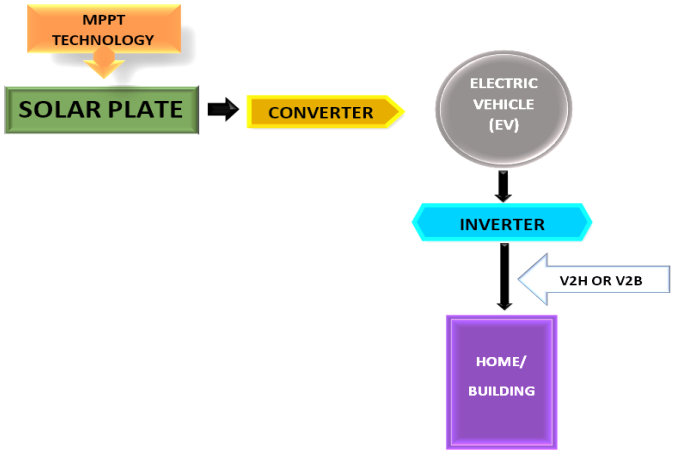

Fig. 5: Vehicle to Home(V2H) operation

a) MPPT

Maximum Power Point Tracker is theabbreviation for Maximum Power Point Tracker. The bulk of current solar inverters use this circuit (usually a DC-to-DC converter). Its job is to optimize the amount of energy available from the linked solar module arrays at all times [10]. A solar module is a limited-energy DC supply with internal impedances that change during the day, mostly due to the amount of solar irradiation impinging on the module face and the temperature of the cells [11].

b) SOLAR ENERGY

In an hour and a half, the quantity of sunshine that touches the earth's surface is enough to power the whole world's energy usage for a year. Photovoltaic (PV) panels or mirrors that concentrate solar radiation are used in solar

ISSN No:-2456-2165

technologies to convert sunlight into electrical energy. This energy can be converted into electricity or stored in batteries or thermal storage [12].

c) CONVERTER

DC-DC converters are high-frequency power conversion circuits that smooth out switching noise into regulated DC voltages using high-frequency switching and inductors, transformers, and capacitors. Even when the input voltages and output currents change, closed feedback loops maintain a consistent voltage output. They are often far more efficient and smaller than linear regulators, with 90% efficiency. Noise and intricacy are their drawbacks [13].

d) ELECTRIC VEHICLE (EV)

An electric motor replaces the internal combustion engine in all-electric cars (EVs), often known as battery electric vehicles. The car's electric motor is powered by a massive traction battery pack that must be hooked into a wall outlet or charging equipment, often known as electric vehicle supply equipment (EVSE). The car does not have a tailpipe and does not have the traditional liquid fuel components such as a fuel pump, fuel line, or fuel tank because it operates on electricity [14].

e) INVERTER

Converting a voltage source from a battery into an AC signal is a popular inverter technique used in electronics. They typically run at 12 volts and are found in applications such as automotive, lead-acid technology, and photovoltaic cells, among others [15].

f) LOAD

Any component of a circuit that uses power or energy is referred to as an electrical load. The most obvious examples of electrical loads in a domestic setting are light bulbs and appliances.

IV. SIMULATION AND RESULTS

The whole simulation of the model is done by MATLAB Simulink software. Fig. 6 shows the whole connection of each and every component of this mode. To complete the model, here used 2 parallel strings and 12 series-connected modules per string. On the other here used lithium-ion battery as the car battery. At first, the battery is getting the power from the PV plate throughout the MPPT system. A DC-DC converter is used to supply the electric power to the battery. There is also a DC-AC inverter which helps to supply the rest of the energy to the home load. After running the simulation all the results have been analyzed. In the following discussion, they have shown.

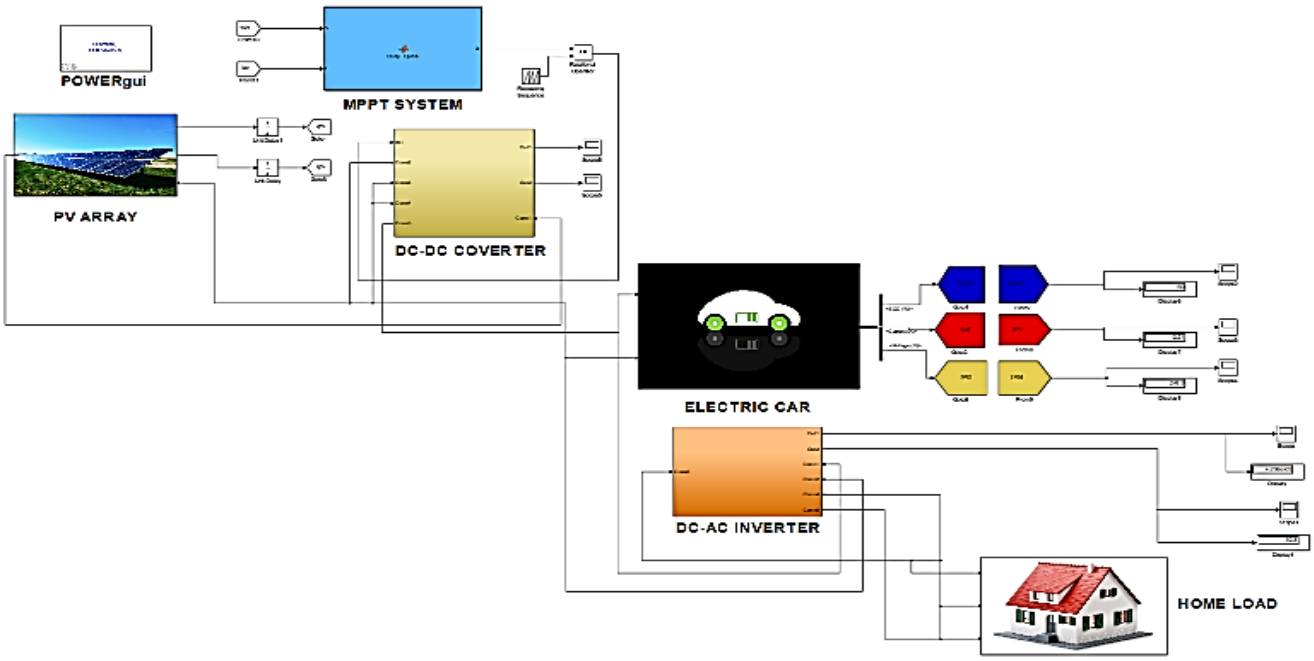

Fig. 6: MATLAB Simulink model of the proposed V2G system

A. *BATTERY CHARGING*

Figure 7 shows the charging curves of the battery of an electric car. Since it is getting a charge from the solar plate then the curve is peaking upwards as collecting energy.

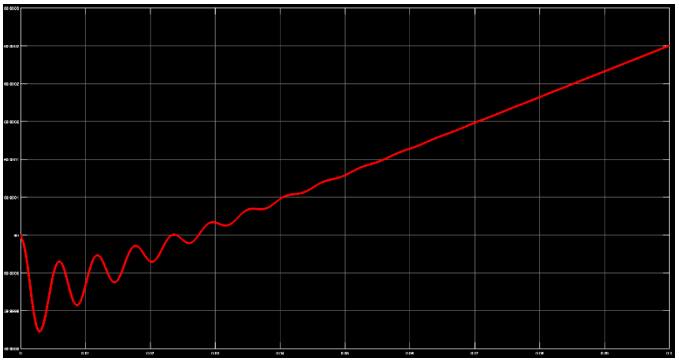

Fig. 7: Battery charging curve by MATLAB SIMULINK

Likewise, we know that when the battery gets charged then the current becomes negative and voltage becomes positive. Figures 6 and 7 show the current and voltage curve. From figure 8 we can see the blue curve is going downwards and from figure 9 it is very easy to understand that the voltage curve is going upwards as well.

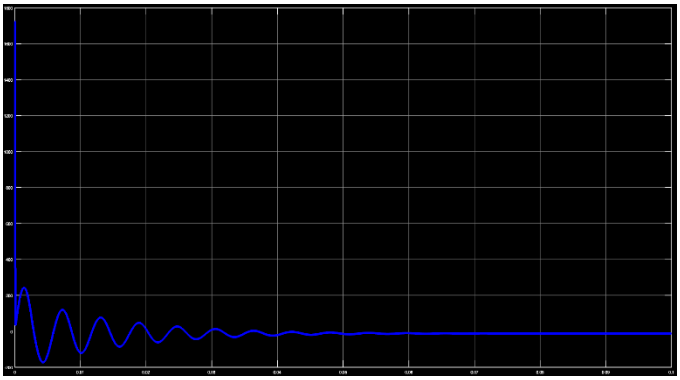

Fig. 8: Current scenario when the battery is charging

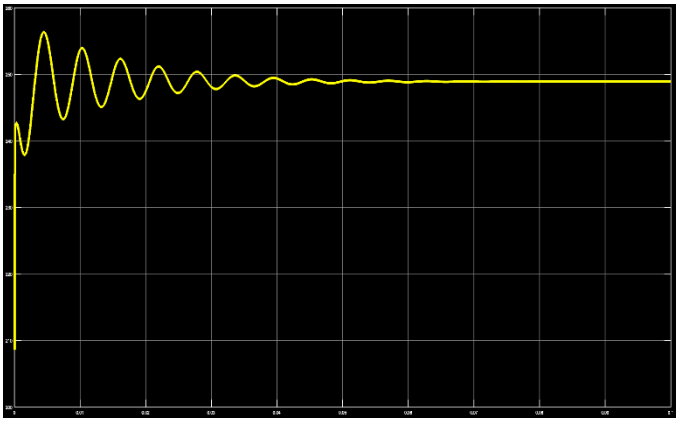

Fig. 9: Voltage scenario when the battery is charging

B. LOAD SUPPLY

With the help of a DC-AC inverter, the rest of the charge is supplied to the household load.Following figure 10 shows the current supply curves of the load.

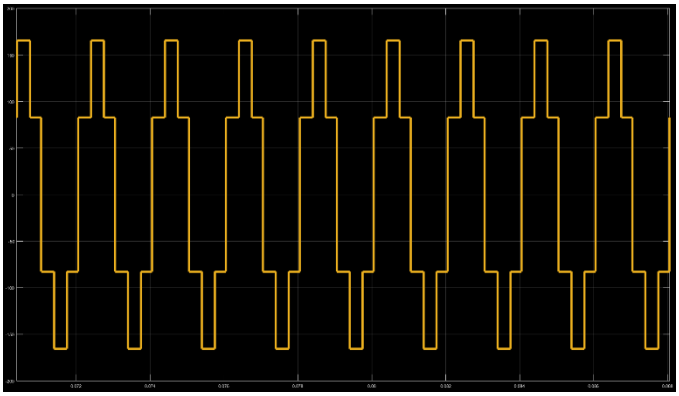

Fig 10:-Vehicle to load current supplying curve

V. CONCLUSION

Electric vehicle (EV) is worthy for V2H operation. Furthermore, the owner of the car will be beneficial by the cost of buying an extra generator. On the other hand, the is an extra cost of fuel and militance of it. In these circumstances, the V2H operation is able to full fill the demand according to the need for electricity. This model is ensuring a smart control and supply of electric power within a very small time. Likewise, there is a prominent future scope of this operation along with grid connection. It could be introduced as a new market policy too. Moreover, environmental pollution seems very alarming globally therefore all other sectors are ready to face it by inventing other policies. Therefore, this theme is very condign to reduces the pollution.

REFERENCES

[1.] Dilip Ahuja and Marika Tatsutani," Sustainable energy for developing countries ", S.A.P.I.EN.S [Online], 2.1 |2009

[2.] Begum, B.A., Hossain, A., Saroar, G., Biswas, S.K., Nasiruddin, M., Nahar, N., Chowdury, Z., and Hopke, P.K. (2011). Sources of carbonaceous materials in the airborne particulate matter of Dhaka. Asia-Pacific J. Atmos. Sci., 5(4); 237-246.

[3.] PDB to become holding company, employees against the move" | www.dhakatribune.com |excerpt date 2018-01-04 |

[4.] Khan, M. F. (2018). LNG Tariff: Implication on Trade and Industries. Dhaka: Keystone Liuhto, et. al. (2015). BSR Policy Briefing 1/2015: Natural gas revolution and the Baltic Sea region.

[5.] Power System Master Plan. http://www.bpdb.gov.bd/download/ PSMP/ PSMP2010.pdf. Accessed on 17th November 2018.

[6.] www.lightcastlebd.com/insights/2019/07/bangladesh-power-sector-filling- the-gap-in-demand

[7.] A. Panday and H. O. Bansal, "Green Transportation: Need, Technology and Challenges", Int. J. Global Energy Issues, Inderscience publishers, Vol. 37, No. 5/6, pp. 304-318.

[8.] Alter Systems, LLC, n.d., Fronius IG: Grid Tied Inverters for Photovoltaic Systems,http://www.altersystems.com/catalog/pdfs/inv

erters/fronius/brochure_ig_2000_3000_2500lv_012008 .pdf (accessed December 2010).
[9.] Seyedmahmoudian, M.; Horan, B.; Soon, T. Kok; Rahmani, R.; Than Oo, Muang; Mekhilef, S.; Stojcevski, A. (2016-10-01). "State of the art artificial intelligence-based MPPT techniques for mitigating partial shading effects on PV systems – A review". Renewable and Sustainable Energy Reviews. 64: 435–455.
[10.] Seyedmahmoudian, Mohammadmehdi; Mekhilef, Saad; Rahmani, Rasoul; Yusof, Rubiyah; Renani, Ehsan Taslimi (2013-01-04). "Analytical Modeling of Partially Shaded Photovoltaic Systems". Energies. 6 (1): 128–144. doi:10.3390/en6010128
[11.] Energy Sources: Solar". Department of Energy. Archived from the original on 14 April 2011. Retrieved 19 April 2011.
[12.] Energy conversion by photosynthetic organisms". Food and Agriculture Organization of the United Nations. Retrieved 25 May 2008.
[13.] Jeff Barrow of Integrated Device Technology, Inc. (21 November 2011). "Understand and reduce DC/DC switching-converter ground noise". Eetimes.com. Retrieved 18 January 2016.
[14.] Electric Cars @ProjectDrawdown #ClimateSolutions". Project Drawdown. 6 February 2020. Archived from the original on 27 November 2020. Retrieved 20 November 2020.
[15.] The Authoritative Dictionary of IEEE Standards Terms, Seventh Edition, IEEE Press, 2000, ISBN 0-7381-2601-2, page 588