CHAPTER FOUR

Results and discussion

4.1 Introduction:

In this chapter the results from the complete model shown in chapter three is discussed. The wind turbine and PV manufacturing data sheet information are shown in appendices (I) and (III). All these data is taken and implemented in the design for each system using MATLAB/SIMULINK.

The major input for PV cell is the solar irradiation and cell temperature as shown in Figure 4.1 and Figure 4.2. Also for wind system the major input is wind speed profile curve as shown in Figure 4.3.

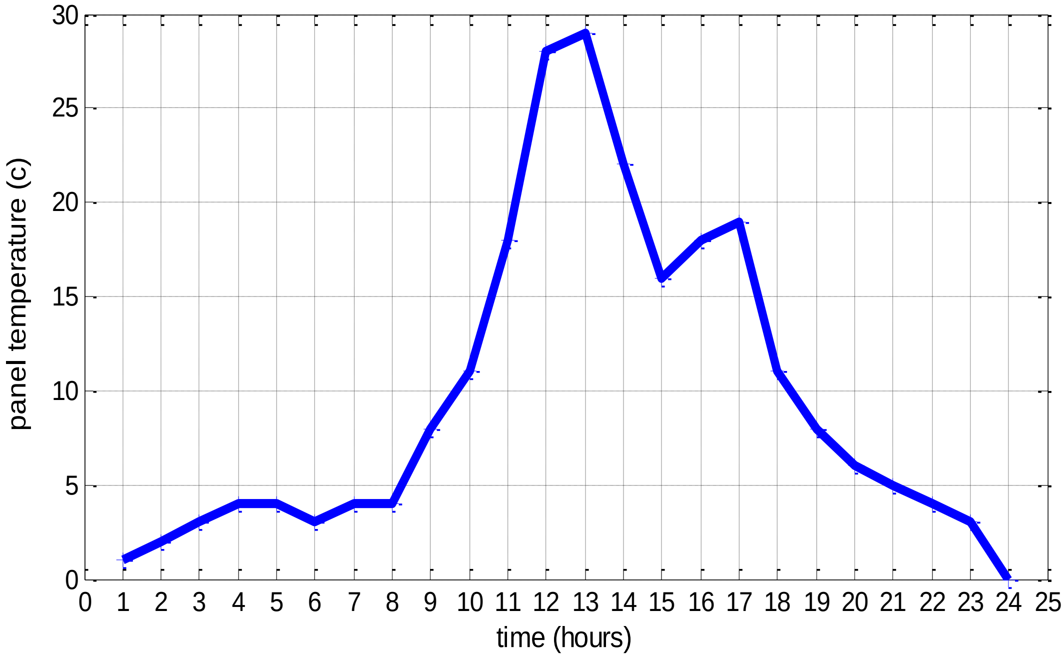

Figure 4.1: The daily curve for temperature profile

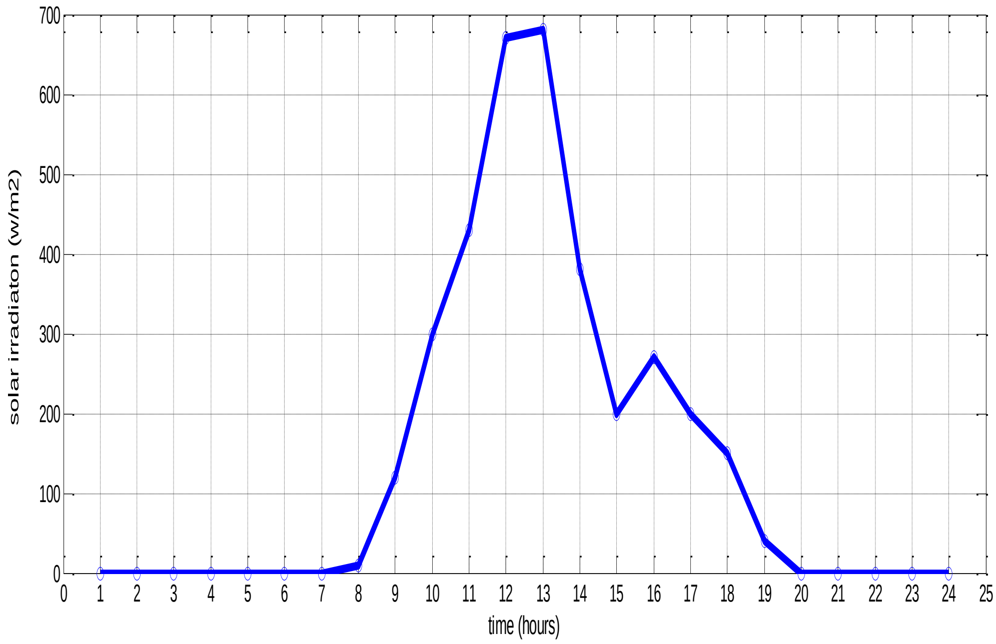

Figure 4.2: The daily curve for solar irradiation

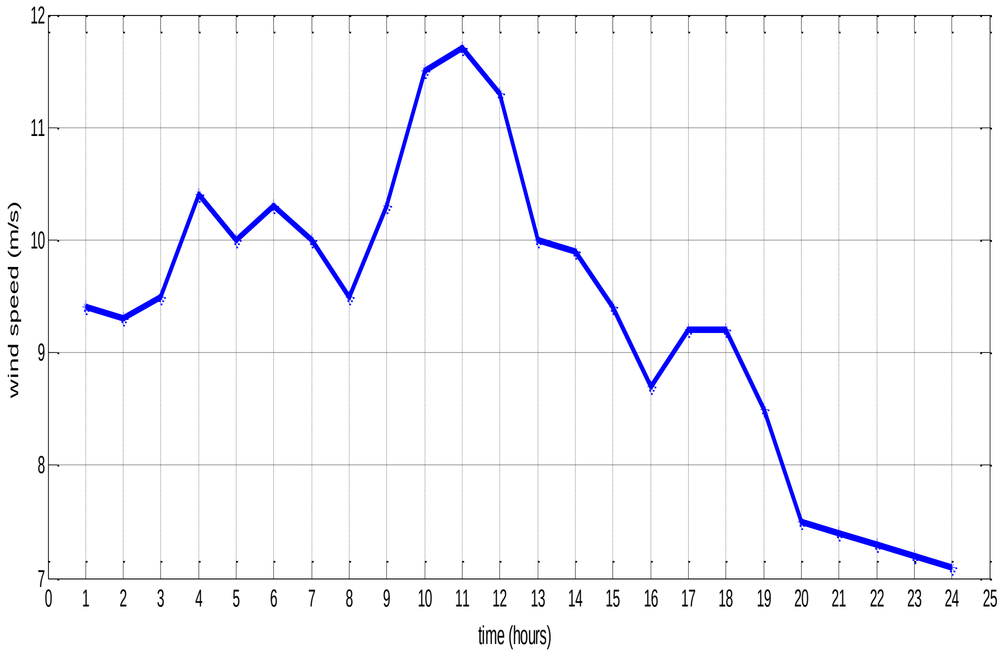

Figure 4.3: daily profile for wind speed

4.2 Results:

According to the data shown in Figures 4.1 , 4.2 and 4.3 (temperature, solar irradiation and wind speed profile), the simulation is performed using MATLAB/ SIMULINK and the results are presented for the PV, wind bus bar and the total hybrid system bus bar as shown in figures.

Although the photovoltaic voltage fluctuates due to solar radiation variations, the proposed control system of the solar power plant successfully keeps the load voltage stable at 400V. The output voltage of the dc/dc converter is depicted in Figure 4.4.

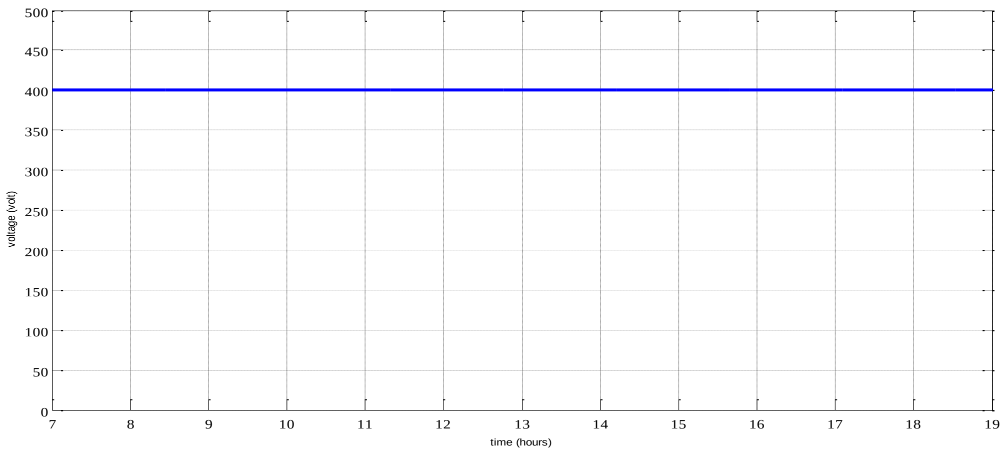

Figure 4.4: The output voltage of the dc bus bar for the solar cell

From figure 4.5, it could be noticed that the output current of the PV panel has the same curve of the solar radiation which is mean the current is proportion with the solar irradiation.

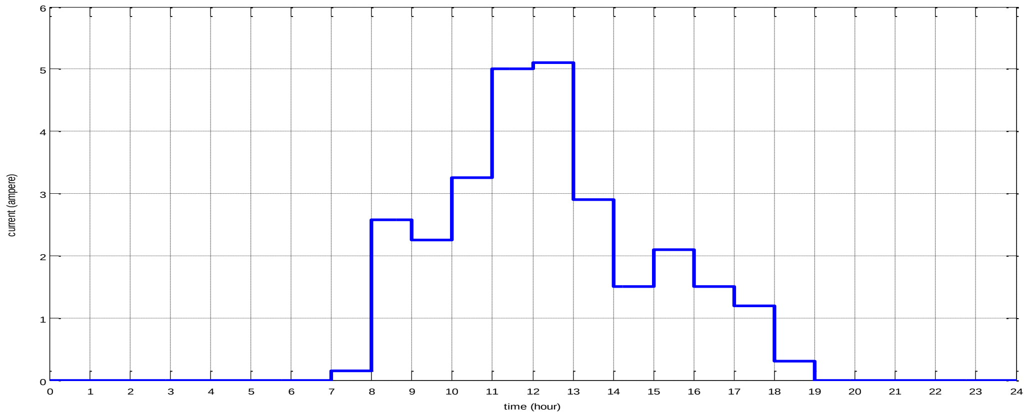

Figure 4.5: The output current of P&O algorithm during the day

From figure (4.6), it can be observed that the solar system doesn't work in the early morning and evening due to the unavailability of the solar irradiation, and according to that the wind system works, which covers the hours that the solar system missed.

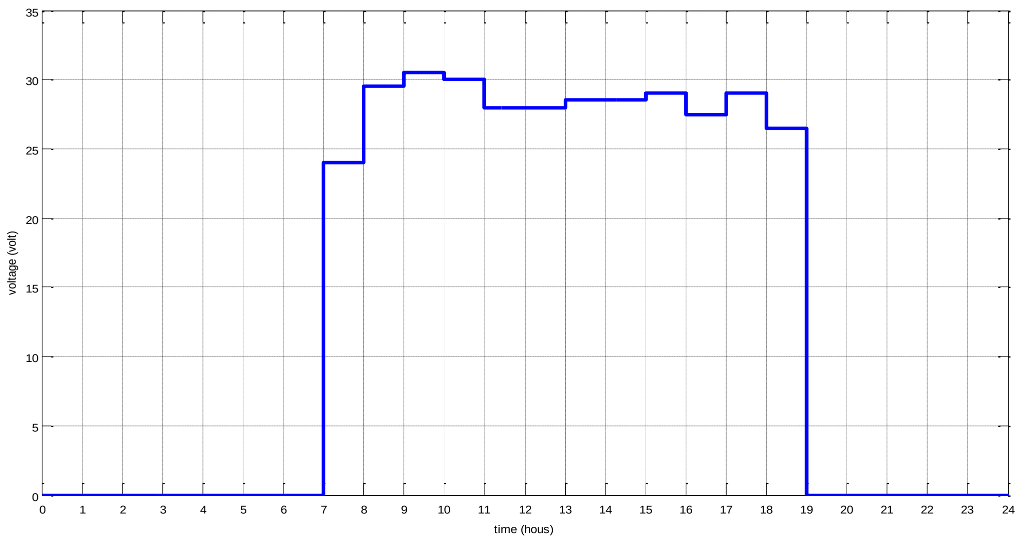

Figure 4.6: The output voltage of the P&O algorithm during the day

Due to the fluctuation of the output of the three phase bridge rectifier, there is need to put filter to smooth, the output voltage of the wind turbine bus bar as shown in Figure 4.7.

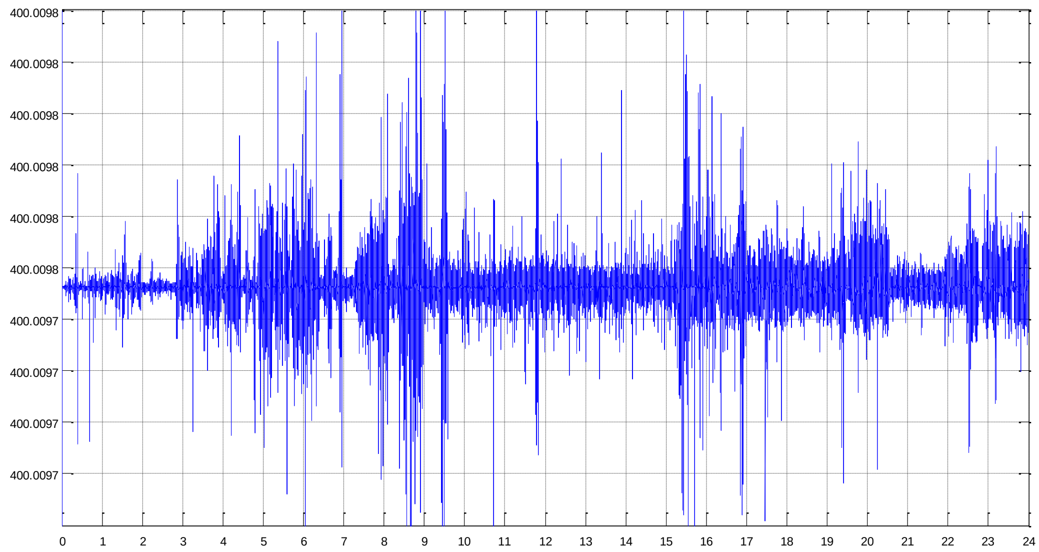

Figure 4.7: The output voltage of the transformer (voltage without filtering)

From Figure 4.8, it can be observed that although the available voltage from the wind generator fluctuates due to wind speed variations, the PI controlled firing angle (α) of the double bridge ac/dc converter successfully maintains the output voltage of the wind turbine at 400V and the filters make the output voltage smooth without fluctuation .

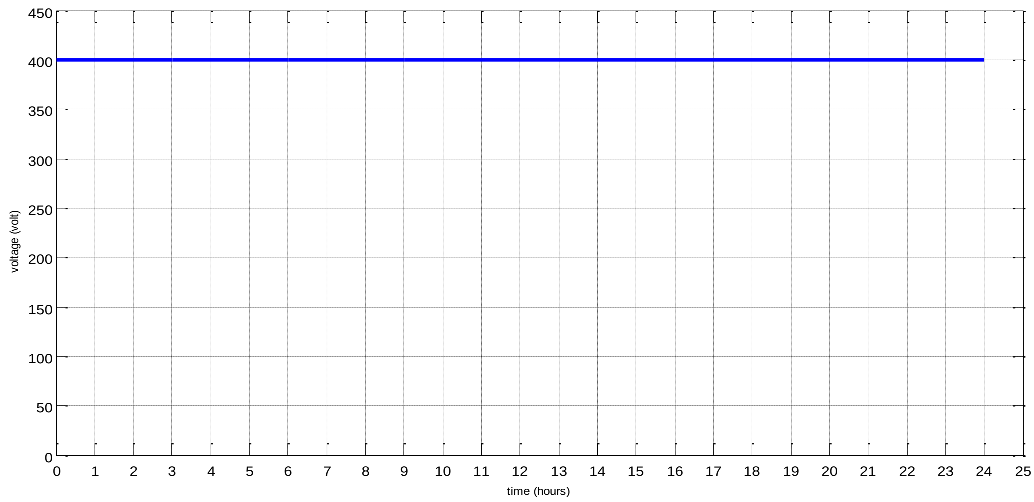

Figure 4.8: The output voltage of the wind turbine (after filtering)

When there is unreliable of the renewable energy solar and wind system diesel generator is added as stand by to cover the load when there is leakage in hybrid system with the same rate of voltage (400) as shown in Figure 4.9.

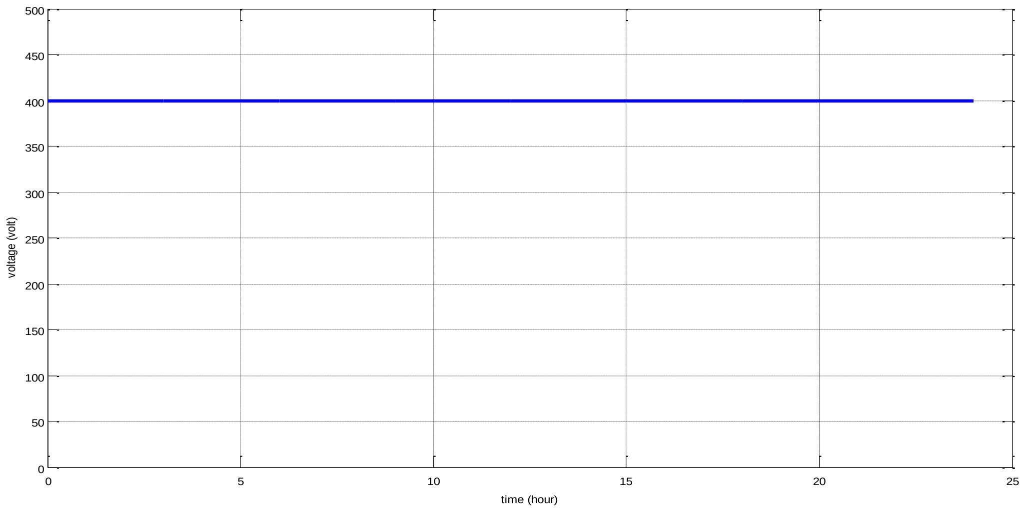

Figure 4.9: The voltage of the backup generator

The total hybrid system dc voltage is shown in Figure 4.10, it can be observed that each system generate the same value of voltage (400V) Therefore, any loss or unavailability in voltage for one system, there will be produced the desired value of voltage.

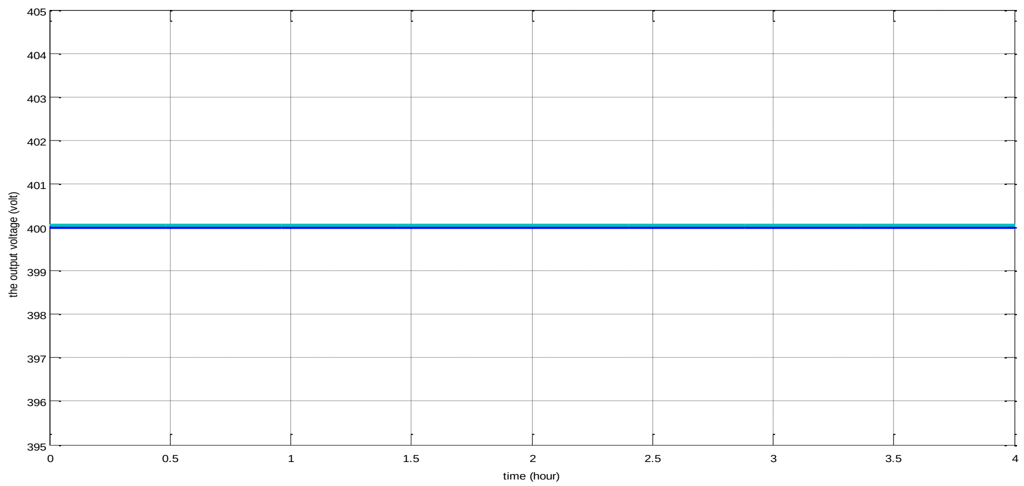

Figure 4.10: The total voltage of the hybrid system

Since the voltage of the dc buses is kept at 400V, dc/ac full bridge inverter is used to deliver the required voltage to the load side at 60Hz frequency and 240V line-to-neutral voltage. The current and voltage delivered to the load side by the PV/WT hybrid topology is illustrated in Figures 4.11 and 4.12.

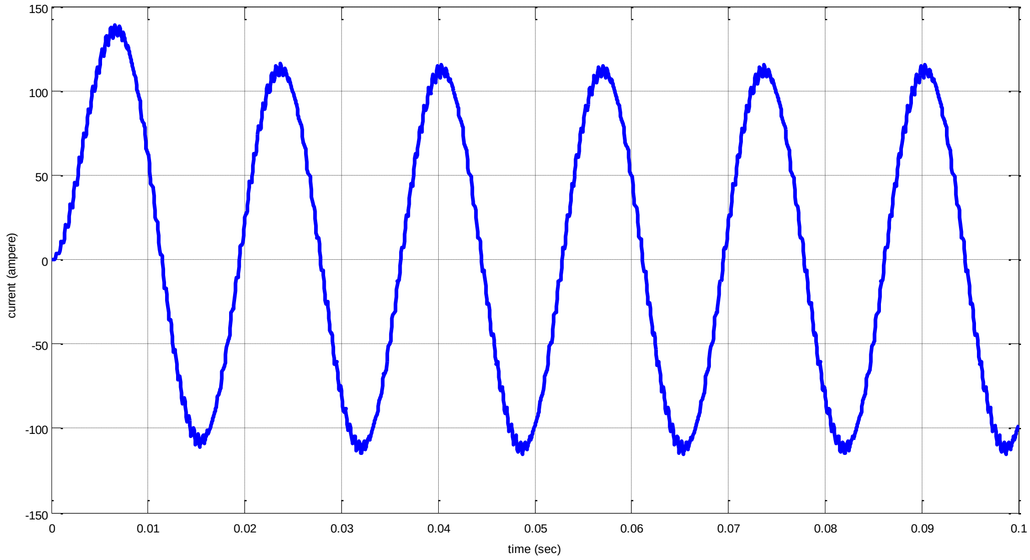

Figure 4.11: The total output ac current of hybrid system after using inverter

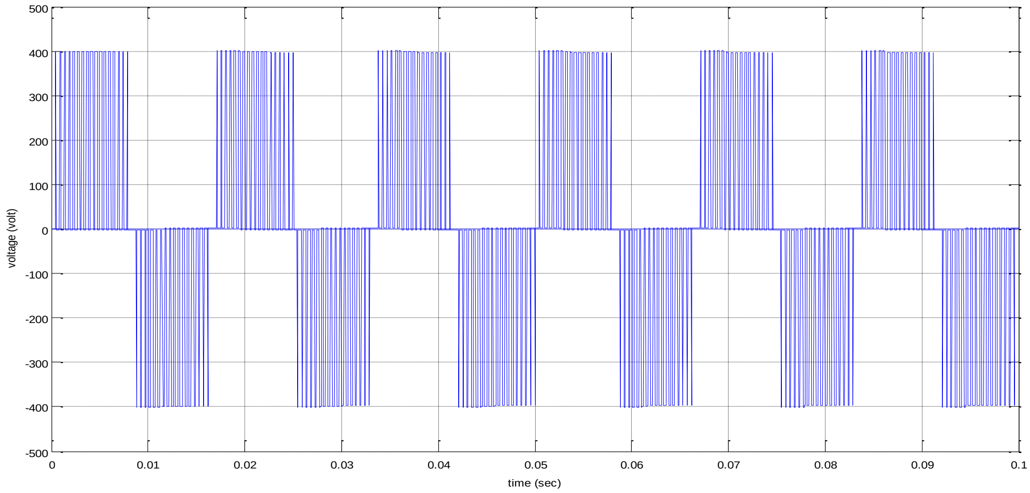

Figure 4.12: The total output ac voltage of hybrid system after using inverter