WRITE WHITE PAPER SEAMLESS

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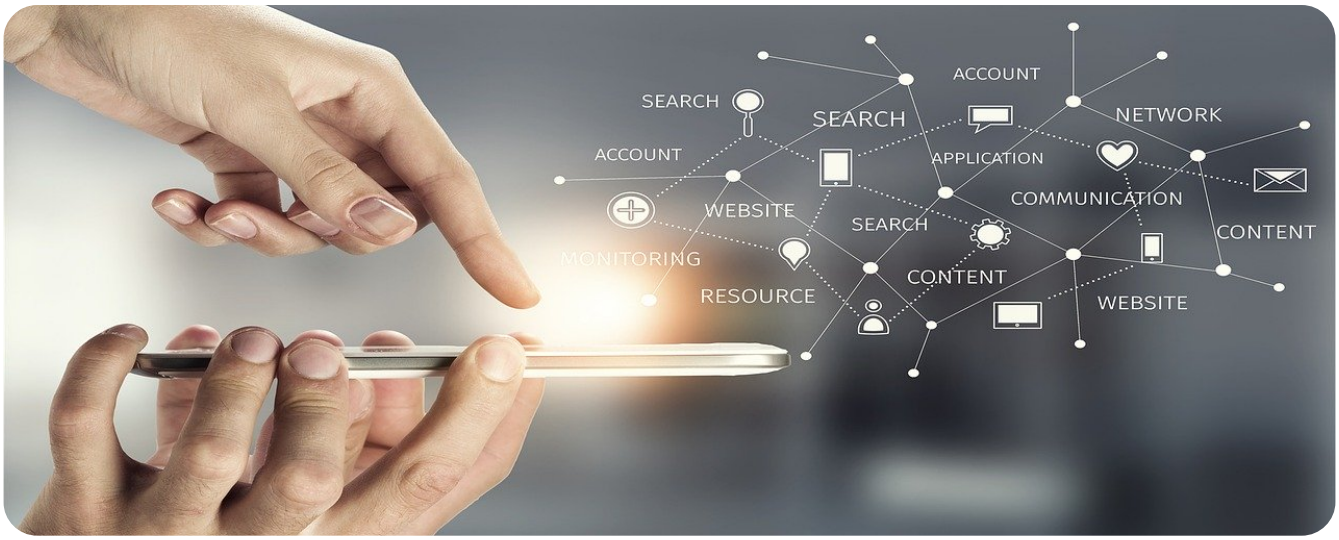

INTRODUCTION

Solar energy is one of the best investments around – make the most of your rooftop real estate. Thousands of households in Melbourne and throughout Victoria have installed a home solar power system that could generate sunlight to provide power energy for the whole system of the house. Solar energy is renewable energy that could help reduce carbon emissions bring down our collective dependence on fossil fuels. Having Solar panels rooftop could help you to reduce payment for electricity. Seamless is a solar panel simulator for solar panel power advice getting information about weather and area on Google map and OpenWeather API to generate and print out summary generation for each household type.

How it works?

Seamless is a simulator application based on the current weather of areas on the map in Victoria to analyze and calculate power consumption as well as power generated by solar panels. From there, users are able to understand and aware of how many panels need to be installed before making a final decision. The power that the Seamless generates will provide approximating natural sunlight, time, temperature, cloud cover percentage throughout online data. It was developed by using Nodejs and Html to design the interface and back-end products, all data collection will be store in the IBM cloud for further purpose. As simulating the weather and power generation, Seamless will bring out to users many benefits where the deployment of a solar system to be renovated for house types of family or couple. The level of complexity of solar simulators varies significantly from simple static maps describing the suitability of a rooftop PV system to pre-calculate technical potential under the fixed assumption and financial simulators.

- Target setting: Seamless can support evaluated for the renewable energy potential by providing and evidence and database analysis of solar PV rooftop. The analysis establishes the suitable of rooftop areas, corresponding installable capacity, number of solar panels.

- Energy comparison: Users could also apply house types in a different area on the map to understanding area conditions and compare to other cities on the Map. The data will be display on the tables including power generation, weather, temperature, cloud cover, number of panels that need to be installed.

Typical Energy Consumption

The primary purpose of Seamless is to estimate the power needed for a real house type before installing panel systems relevant to the house. From there, we could analyse, design solar systems to pursue renewable energy alternatives.

-Household 1: the first household has 4 occupants having a house in a suburb 40 km away from the city. The Household includes Electric hot water, heating, cooling, electric cooking, one swimming pool, 2 TV, 3 computers, and a clothes dryer. The average power consummated is 41 kWh per day and costs 10$ per day. Most of the power is used to operate the heating and cooling system daily.

-Household 2: The second household has 1 couple. The household includes Electric hot water, heating system, electric cooking, plasma TV, 1 computer, and a clothes dryer. The average daily use is 22.7 kWh per day and costs 5$ daily for the electricity bill. They do not have a pool or associated pumps.

-Household 3: The third household has 3 people: 2 parents and 1 child. The household includes Air conditioning, LCD TV, 3 computers, Dishwasher, Clothes dryers. The average daily use is 13.7 kWh and it costs 3$ per day. Mostly, the bill shows hot water and air condition are used more than others.

-Household 4: This house has 1 occupant, most of the energy consumption is used for air-conditioning and plasma TV. The daily energy consumption is 7.03 kWh and it costs 1.50$ per day.

The effect of temperature on solar panel efficiency

Solar panels are often tested at 25C (77F) and thus solar panel temperature will generally range between 15C and 35 degrees Celsius. During which solar cells will product at maximum efficiency. However, the solar panels can get as hot as 65 degrees Celsius (149F) at this point, the solar cell will be hindered. The standard practice to test solar panels for power output at 25C. The output power will decrease by half of a percentage for every degree the temperature rises about 25C.

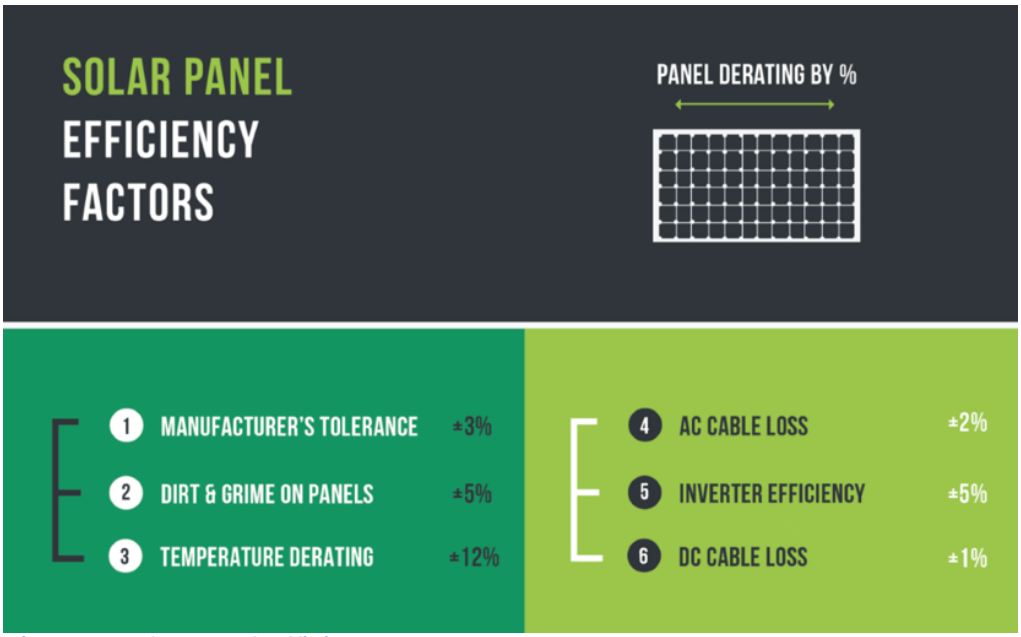

Figure 1: Solar Panel Efficiency Factors

To summarise the post above: If it is 40 degrees outside then your panels are probably sitting at 65°C so you have to multiply your temp ecoefficiency (which is usually about -0.5%/°C) by the temperature of the panels above 25°C: 0.5 x (65°C-25°C) = 20% losses, assuming it was a 40°C day.

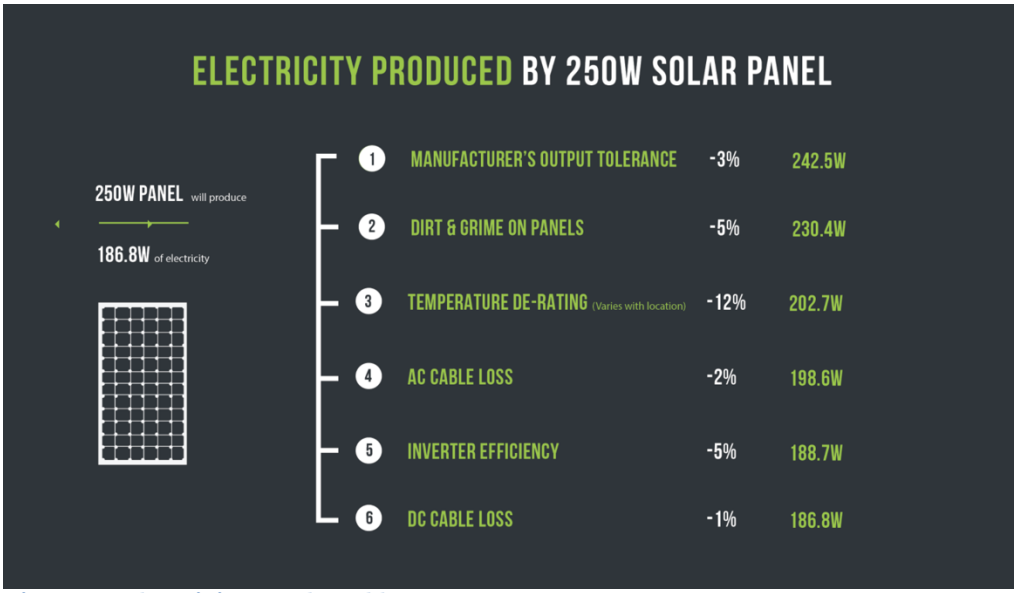

Figure 2: Electricity Produced by 250W

On the cloudy days or snowy days: Solar panels can still produce **10–25%** of their typical output. Solar panels are tested at 25 degrees Celsius, and for every temperature above that, the panel's output efficiency is reduced. In this regard, the colder winter weather can carry some advantages over summer. Even on cloudy days, solar panels can still receive the optimum energy they need. Since panels rely mostly on UV light, cloudy days can still provide an optimum environment for energy production and conversion. This is because UV light can still penetrate clouds. The average solar panel can still produce 10% to 25% of its rated capacity, depending on cloud density. Homeowners can help to further offset the impact of shorter days and the effects of clouds and wintry elements on solar panels by keeping on top of their solar usage in winter and tending to their panels for optimum performance.

Dust accumulation: The reductions in power and efficiency were caused by decreasing the short circuit current of the PV module with dust accumulation; it seems dust accumulation disperse the sun rays falling on the PV module surface, it will reduce the power generated of solar panels.

Water Drops: Temperature of panel system is a significant determinant impacting the speed of electrical flows through any given electrical. The water droplets could decrease the temperature of the PV module that could improve potential difference, enhance power output from the system. The temperature coefficient is decreasing. Therefore, the overall efficiency of module is enhanced, especially during summer and clear sky days. Therefore, it can be concluded that water sprinkling cooling system provide and optimum solution for ensuring energy efficiency.

How much power can receive from sunlight and Fomular

Each panel could produce 250W or 200W energy, then your system might have 20*250W = 5kW or 25*200W system. A typical user could use 8 – 9 kWh per day on average, while a household with 5 people could use 33kWh per day. Therefore, the solar PV system should produce 33 kWh per day which is equal to 80 * 250W.

- co-Efficiency percent = Manufacturer's output Tolerance (1% or -1%) + dirt on panel (5%) + AC cable loss (2%) + Inverter Efficiency (5%) + DC cable loss (1%) = 12 %.

- Temperature derating above 25C = {20 or 30 (temperature of the panel) + Ambient Temperature – 25(STC)} * 0.5% co-efficiency (for 1 degree above 25C).

Sunny:

- Cloud cover 0: power generated = Pmax -Pmax*(Temperature derating percent)

Cloudy:

- 25%: power generated = (Pmax – Pmax*(Temperature derating %)) * 66.3 %
- 50%: power generated = (Pmax – Pmax*(Temperature derating %)) * 54.9%

- 75% and above: power generated = (Pmax-Pmax*(Temperature derating %)) * 7.4%

Winter:

- Power generated = Pmax * 25%

Feature of the product

- Listing of houses and selected appliances: This feature provides 4 different households with 4 relevant power consumptions. The power consumption could be changed by clicking on the button then a user could select the devices that they have in the house and change the hours and quantity of the devices

- Google map API: the set of API and SDKs allows us to embed Maps into Nodejs development. Users could retrieve the location as well as the address of the markers on the map.

- Open weather API: a free online service provides global weather data including current weather data, time for sunrise and sunset, historical data, or weather forecast in 48 hours.

- Chart bar display and table analysis: display data from Google map API, Open weather API, power consumption, the power generated, and a number of solar panels.

API/Class structure

- Map.js:
    - Appliances array: List of devices used in household. You could change quantity, usage hours and power of devices.
    - Household array: List of 4 houses having unique ID, name, power consumption and devices list for the house.
    - Create map: call back function to create a map, generate the 4 markers.

- Remove markers: Set onclick the marker on the map, then household will be removed immediately from the map and devices list of the markers. Then, the total power generation on graph and pie chart will be reduced.
- getSensorData2(): based on location of the marker on the map, this function will collect the data from Node Red and OpenWeatherMap service to display weather condition, temperature, cloud cover and pass the power generated and power consumption to local storage to display on pie chart and graph

- Weather.js:
  getWeather(): collect data from 4 cities displaying on web application. It will show the weather current, lowest temperature, hottest temperature of the days.

- Charbar.js:
  ChartButton(): Summarise weather data and power consumption of houses on the map. The total power generated is also displayed as a graph for comparison between 4 types of houses.

Working of the application

Features of the Dashboard

Dashboard of web application is show in figure 1 with four house icons which can be drag and dropped onto the map. A simple navigational bar with website name below it has four cities Melbourne, Sydney, Geelong, Brisbane current weather data forecast. A google map has been displayed into the dashboard below which we have added four table having column Address, Weather, Temperature, Power generated and Number of panels. These tables will get updated dynamically when we drag and drop the house icon onto the map.

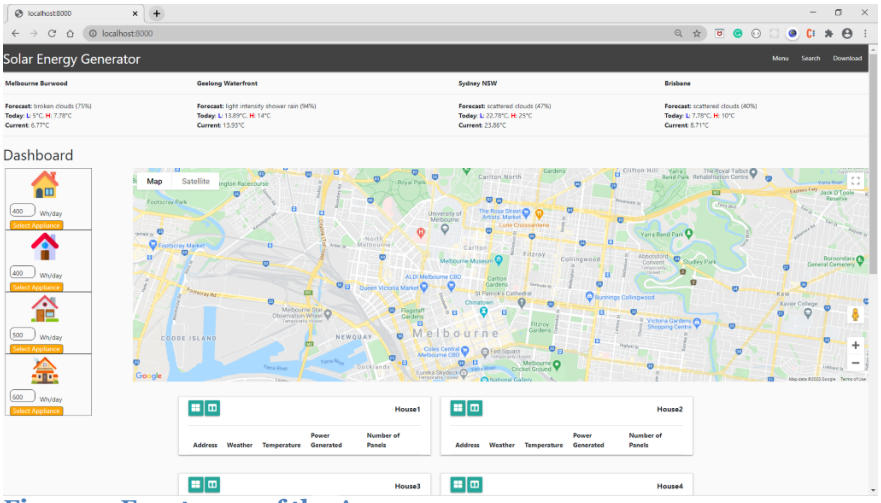

Figure 3: Front page of the App

Figure 2 shows the list of appliances that can be changed to get the power consumption per house. We have added few basic appliances that is used in daily household with its energy consumed, quantity and number of items (can be changed by the user). Click Close and save this will update the power consumption of the house which can be seen below the house icon.

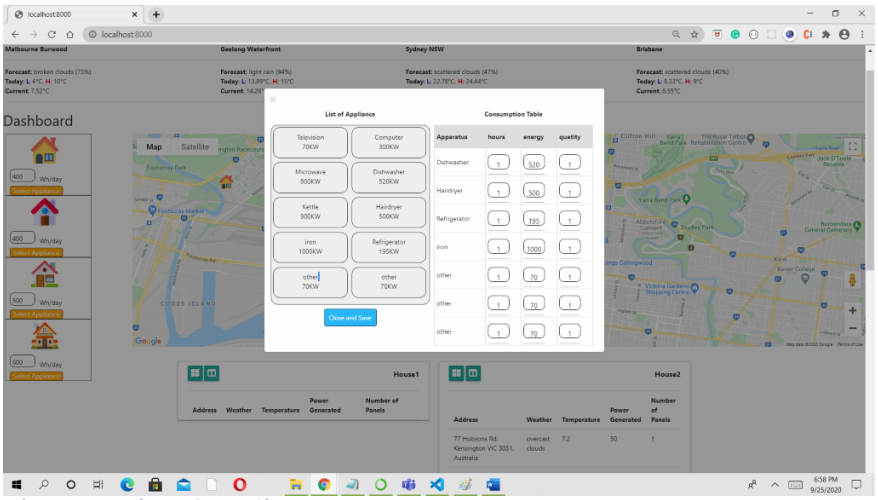

Figure 4: List of Appliances

Figure 3 shows two card which has general information about the solar energy this will get replaced with the charts once we click Display chart button.

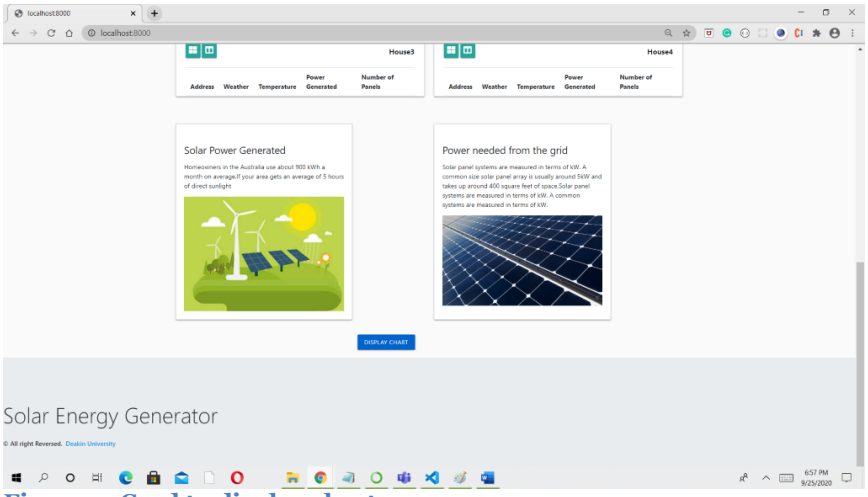

Figure 5: Card to display charts

Functioning of the Dashboard

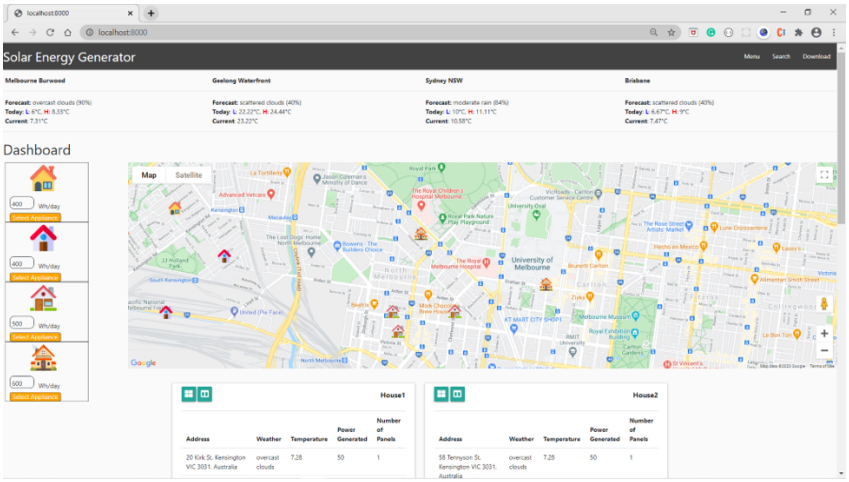

Figure 6: Drag and drop the house on the map

Figure 4 showing the houses Dragged and Dropped onto the map. These houses when put onto the map will generate data which will be displayed in the Tables below the google maps. If you want to delete a house you could simply click on the house on the map, the house will be deleted, and the data will automatically be deleted from the tables of that particular house.

Figure 5 shows four tables displaying the data of all the houses dropped onto the map. The columns Address, Weather and Temperature is being fetched from the Weather API. The column Power generated, and Number of panels is generated from the algorithm which tells the energy generated of that area and to generate that power how many panels user will be needing respectively. If you click on the house onto the map and delete the house, then data will automatically be deleted from the tables dynamically for every house. This Power generated is further added of every house type and then displayed in the charts shown in Figure 6.

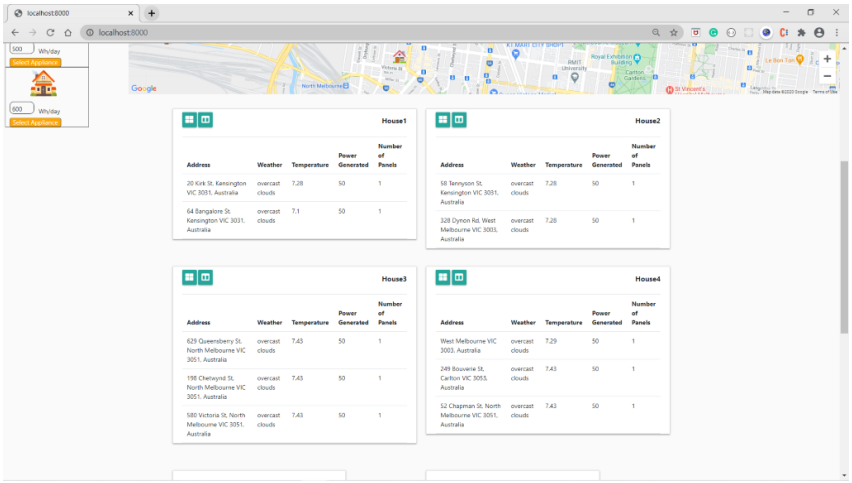

Figure 7: Data displayed in table

Figure 6 shows the two charts being displayed when we click the Display Chart button below it. The two charts are bar chart and a polar area chart. The bar chart shows the total power generated by the solar panels of each house type respectively whereas in the polar area chart shows the total power consumed by each house type.

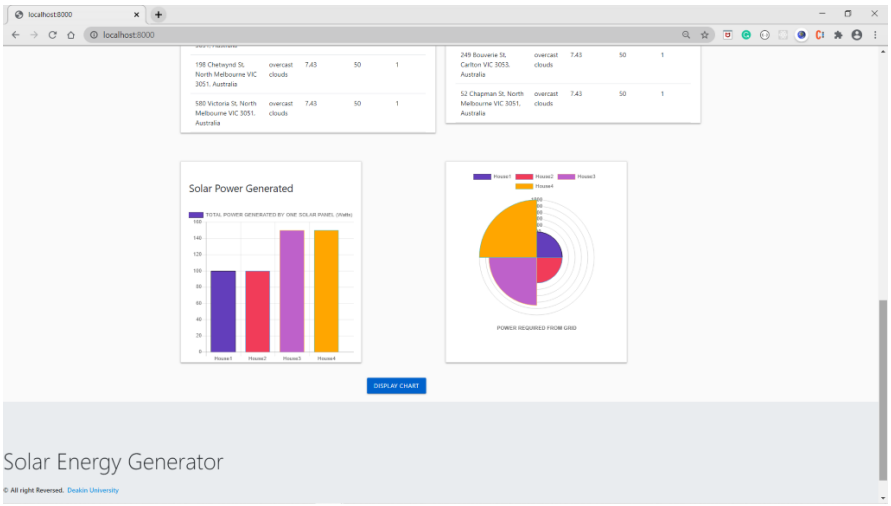

Figure 8: Display data on Chart

Conclusion

In order to address real world problem, we have created a Solar energy Calculator to let people know about the solar energy that can be generated from there locality in real time. The concepts and the calculator design have the potential to change people mind set to use solar panel as an energy option. This calculator can show how electricity usage increases in the future have the potential to affect your out of pocket electricity expenses. It also allows you to work out the potential electricity usage in the future. The graph and tables in the dashboard compare the energy generated and consumed by a particular house individually. Overall the research work and the code are up to industry standard and have a lot of potential in future.

Resources:

Node-red: https://solarpanel.mybluemix.net/red/#flow/687b45b2.979e0c
Username: vietit58@gmail.com
Password: viet1234!

IBM: https://cloud.ibm.com/cloudfoundry/overview
Username: vietit58@gmail.com
Password: Viet1234

Openweather: https://home.openweathermap.org/users/sign_in
Username: vietit58@gmail.com
Password: Viet1234

Example of Openweather: https://solarpanel.mybluemix.net/test?latitude=-38.289026&longitude=144.245741

GoogleMap API: https://maps.googleapis.com/maps/api/geocode/json?latlng=-37.81,144.55&sensor=true&key=APIkey

Openweather: https://api.openweathermap.org/data/2.5/onecall?lat=-37.81&lon=144.55&%20exclude=hourly,daily&appid=9a06430e50edbedd9e1b7e33089dca45

GitHub: https://github.com/gangoc1151/SolarPannel/tree/master