

CALIFORNIA SOLAR POWER PREDICTION

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EXECUTIVE SUMMARY

In this Project we focused on the production of **Solar PV** and **Thermal** Energy using 2010-2018 data to **predict the Solar Power energy for 2020.**

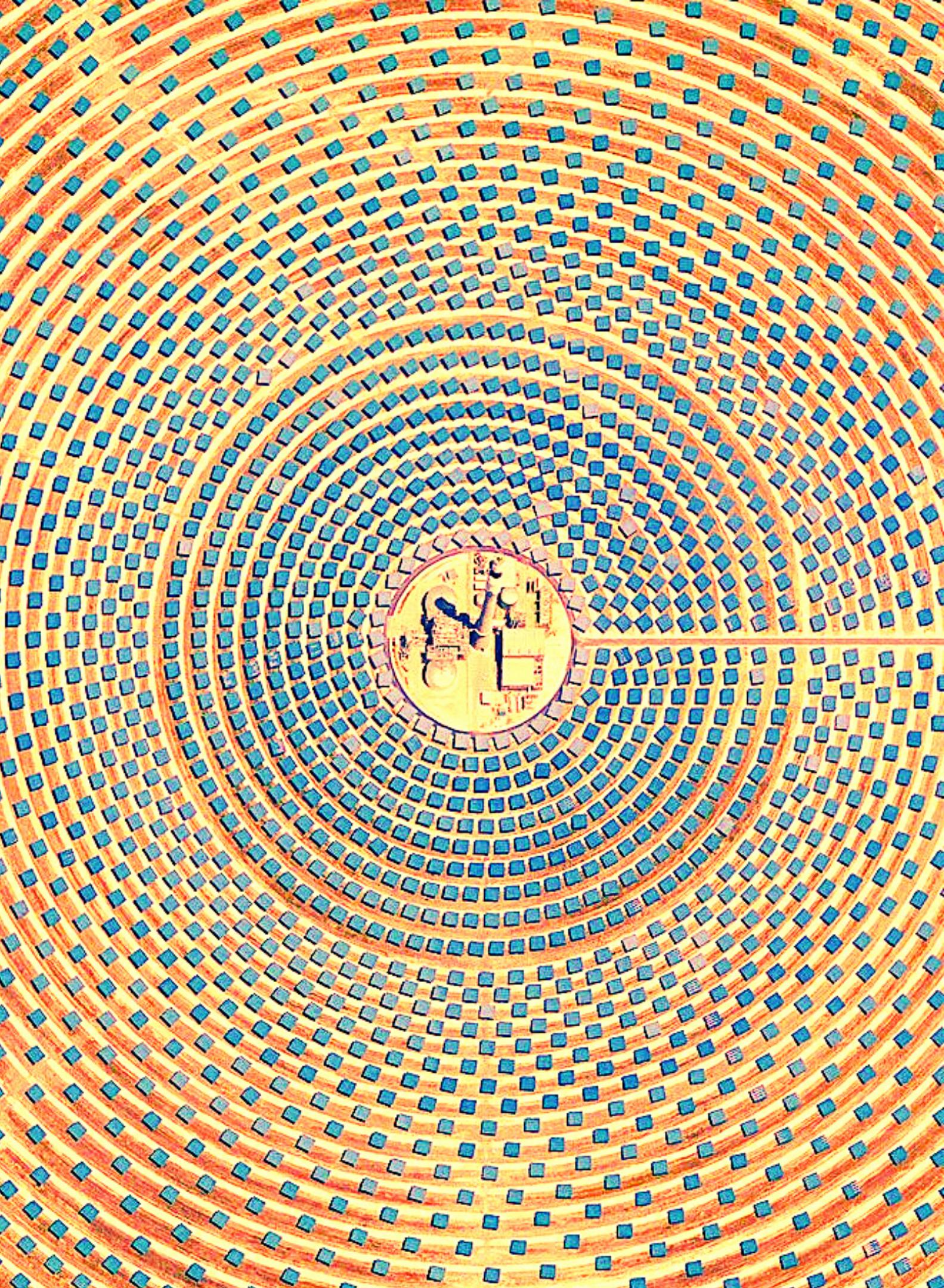
The data was collected through the California ISO Reports. It was performed an exploratory data analysis (EDA) and used the **Facebook Prophet Algorithm** to create the model forecast.



INTRODUCTION

One of the critical challenges in transitioning to an energy economy based on renewable resources is predict the **variability, capacity and reliability** of energy.

While considering solar energy, forecasting can be one by using the knowledge of **Sun's path, the atmospheric conditions, cloudiness**, and other properties of the photovoltaic cells used in the solar farm to capture energy. The **output is highly dependent on the climate**, and summer seasons are likely to attract more solar energy.





California moves towards a **60%** renewable generation portfolio by
2030.

Source: California ISO



**ARRG.. WE HATE
THIS NUMBER!**

solar energy production is responsible for the death of over 8000 birds every year in the EUA.



GOAL:

- Predict the amount of Solar Power that can be generated by 2020 using Facebook Prophet model.

QUESTIONS:

- ⚡ what is the behavior of solar power generation?



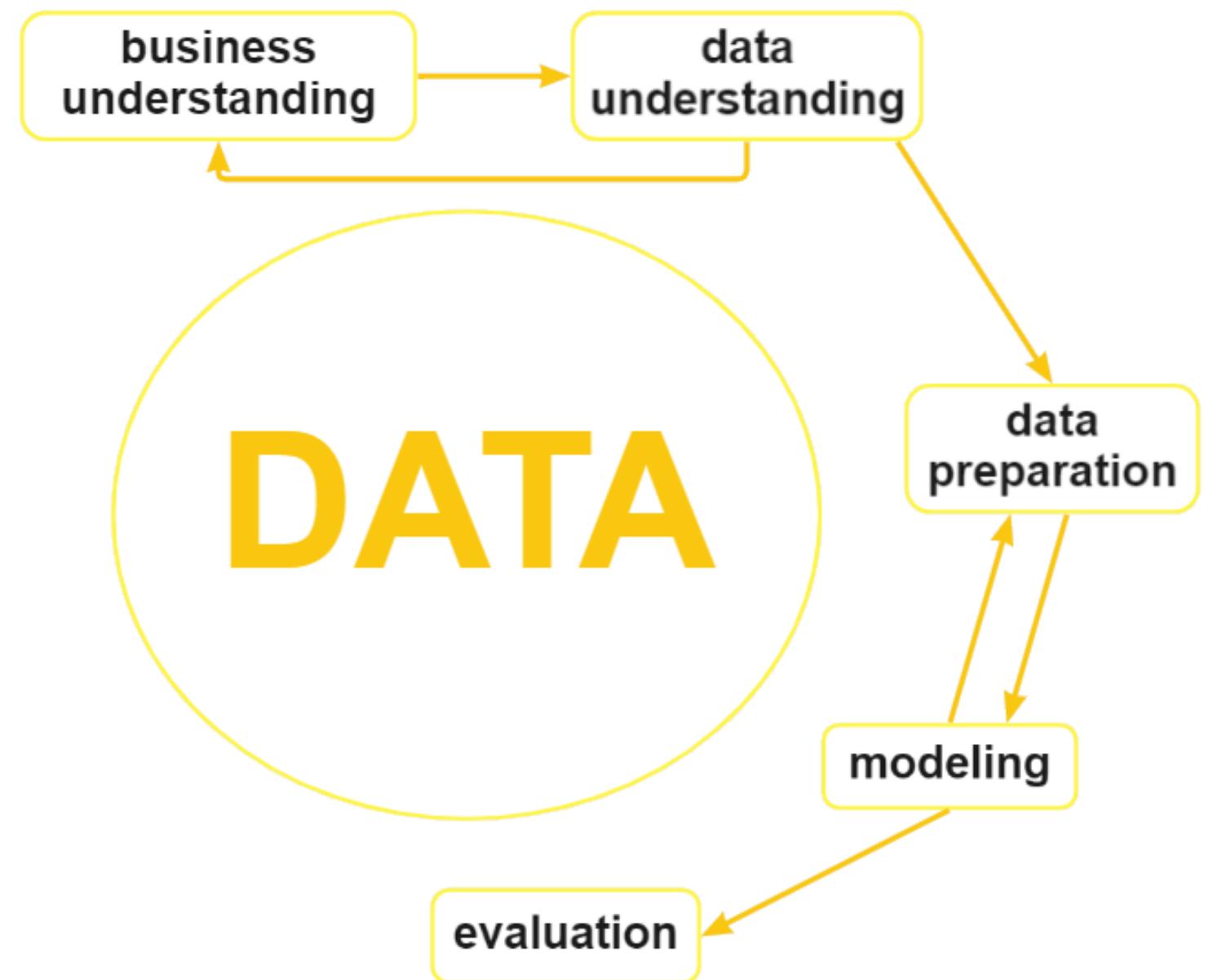
SOLAR PHOTOVOLTAIC ENERGY AND SOLAR THERMAL

Photovoltaic systems use photovoltaic cells to collect solar energy from the sunlight, and **converts it into direct current (DC) electricity**. The reflection of the sunlight will create an electric field across photovoltaic systems, causing electricity to flow.

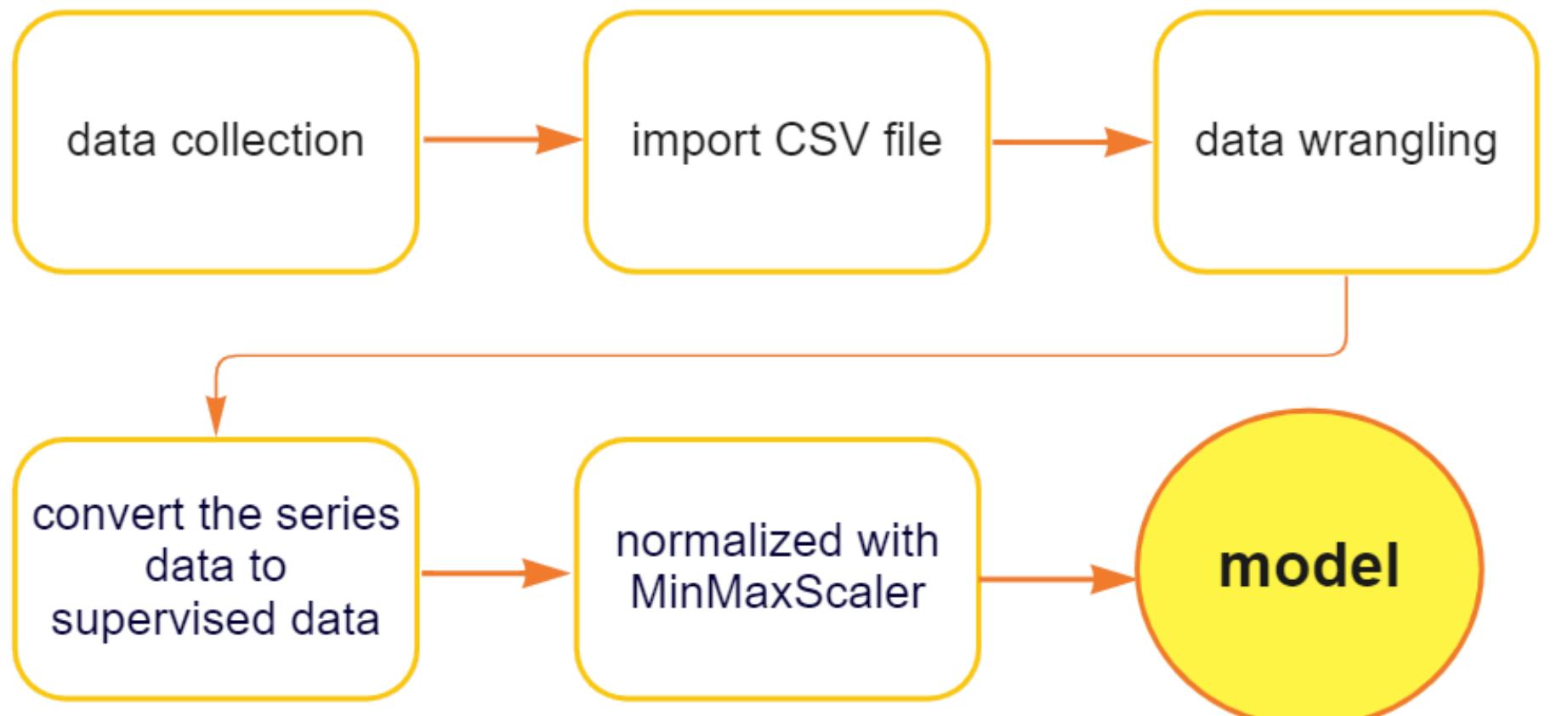
The DC electricity will be **transported to an inverter**, which will **convert** this **DC power into alternating current AC**, which is used for home, business and industrial segment.

Thermal solar energy uses the heat of the **sun to transform it into thermal energy**. Unlike photovoltaics, solar thermal energy systems do **not generate electricity**. Is used for heating, like showers, taps, use in swimming pools or industrial processes.

METHODOLOGY



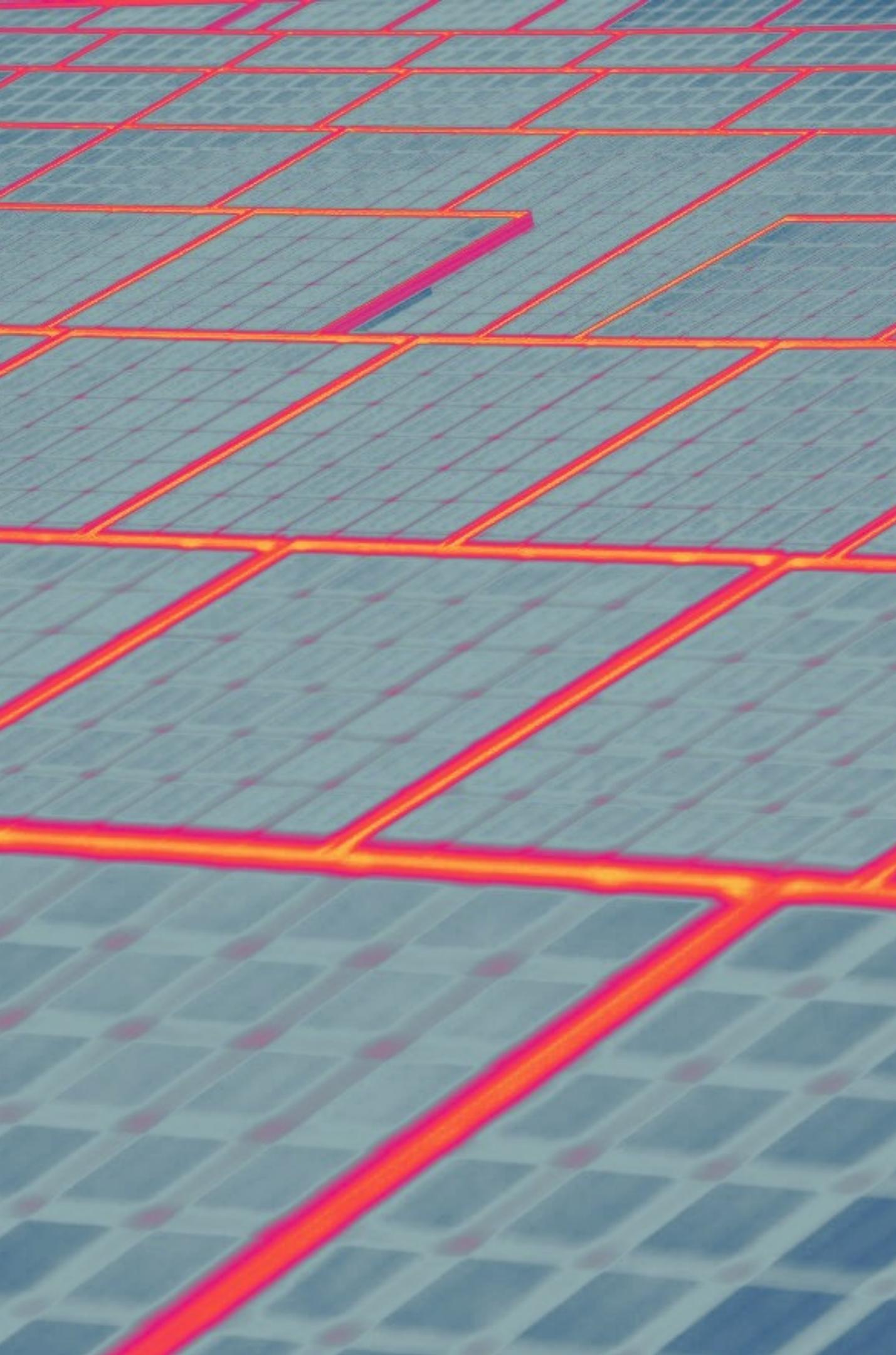
SOLUTION ARCHITETURE



DATA COLLECTION

The data was obtained through the from the **California ISO Reports**. The California Independent System Operator (ISO) maintains reliability on one of the largest and **most modern power grids in the world**.

The dataset "**California Renewable Production 2010-2018**" consists of **hourly metering of the power reports** from various power sources on a megawatt-scale. Familiar sources include Geothermal, Small Hydro, Biomass, Biogas, wind, Solar PV (photovoltaics), and Solar Thermal.



DATA UNDERSTANDING

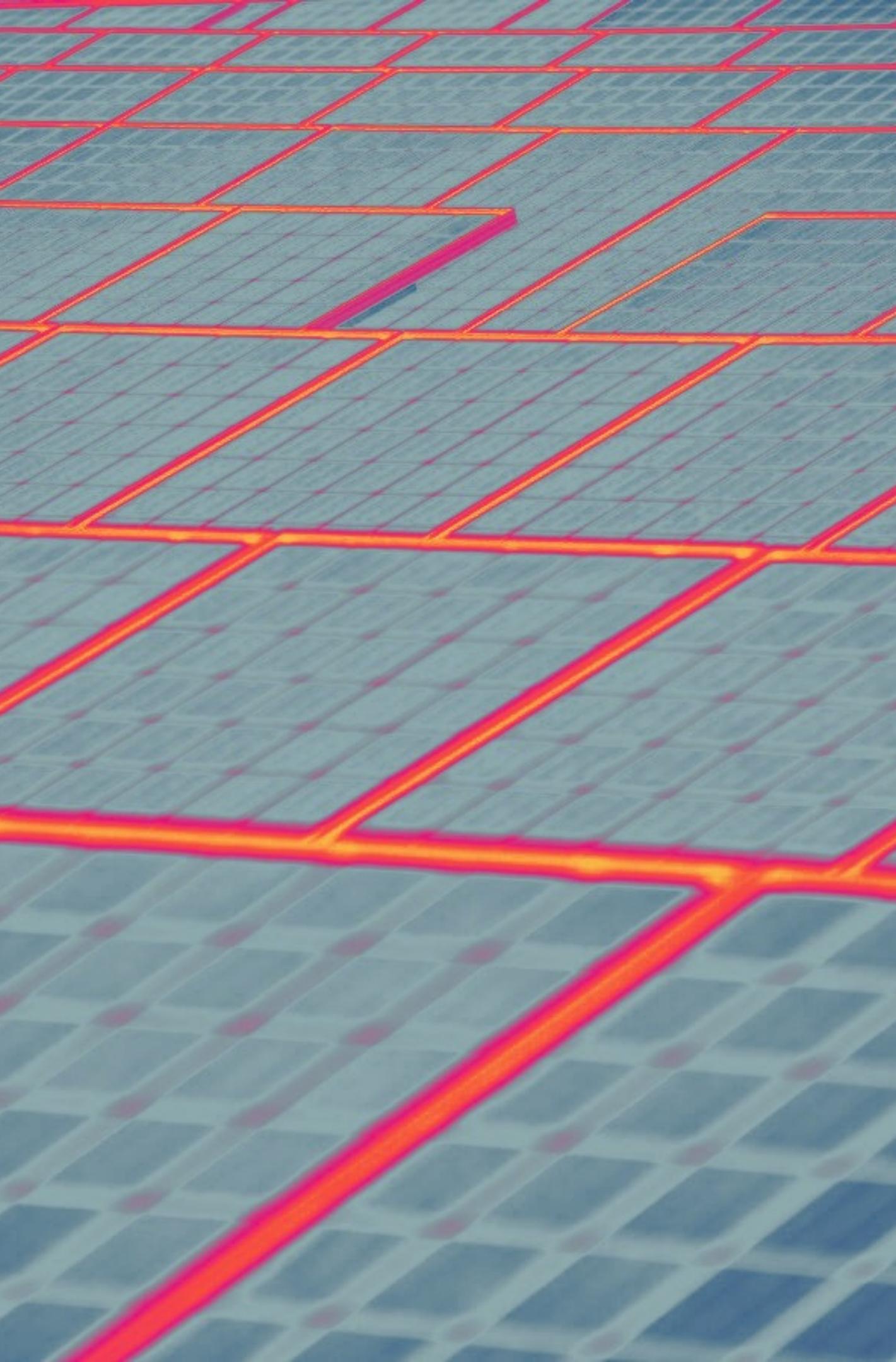
Based on our understanding the Solar column turning into Solar PV and Solar Thermal in 2013, let's begin to decompose some of the trends we may expect to see in the time series data. Since we know that **solar production is strongly correlated to solar irradiation**, there seems to be good reason to expect some daily trends to emerge.



DATA WRANGLING

We used the "usecols" parameter takes an array of only the required columns to be taken into the dataframe.

The data is sorted according to **time-stamp** and filtered by "notna()" function, to drop the rows containing NaN or Null values. The NaN values mean that there **were no measurements in the period**.



DATA MODELLING

Preprocessing

Before training the model, preprocessing is done to the data to convert the series data to supervised data.

This process is done by taking a particular group of samples and tabulating all of them in the same row so that the last column is the sample that needs to be predicted.

The data was **normalized** with **MinMaxScaler** from **sklearn** then passed on this function to return a data frame in the form which enables supervised learning.

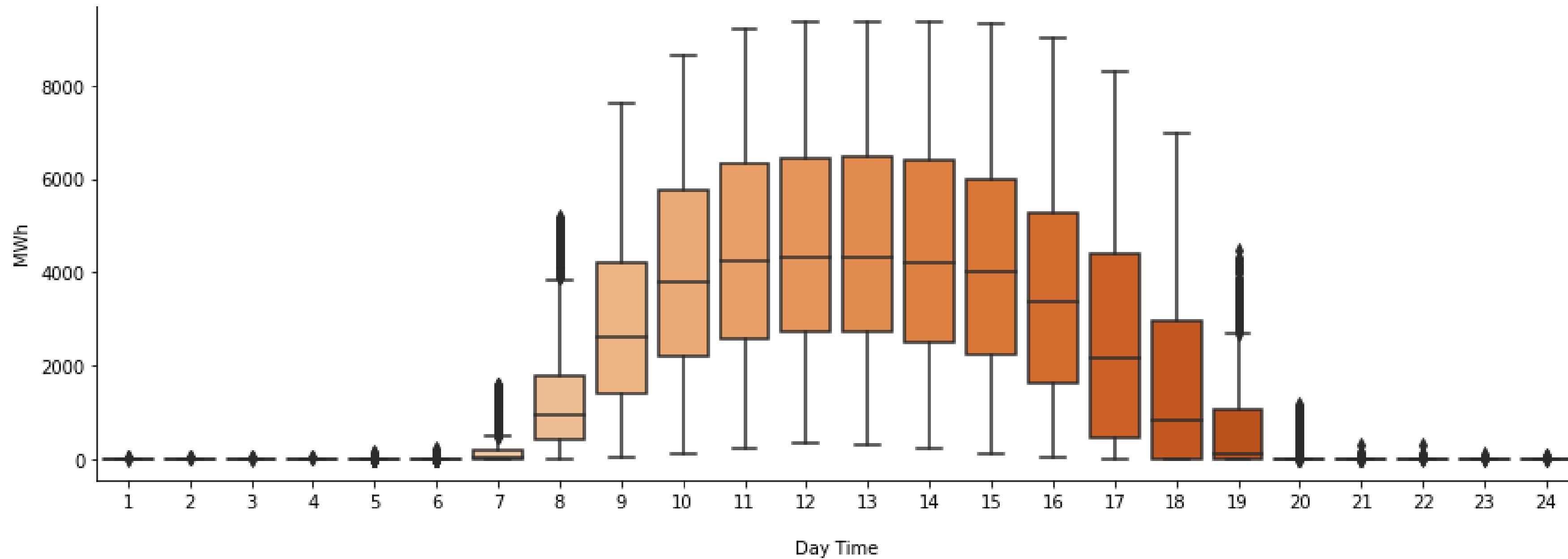


VISUALIZATIONS



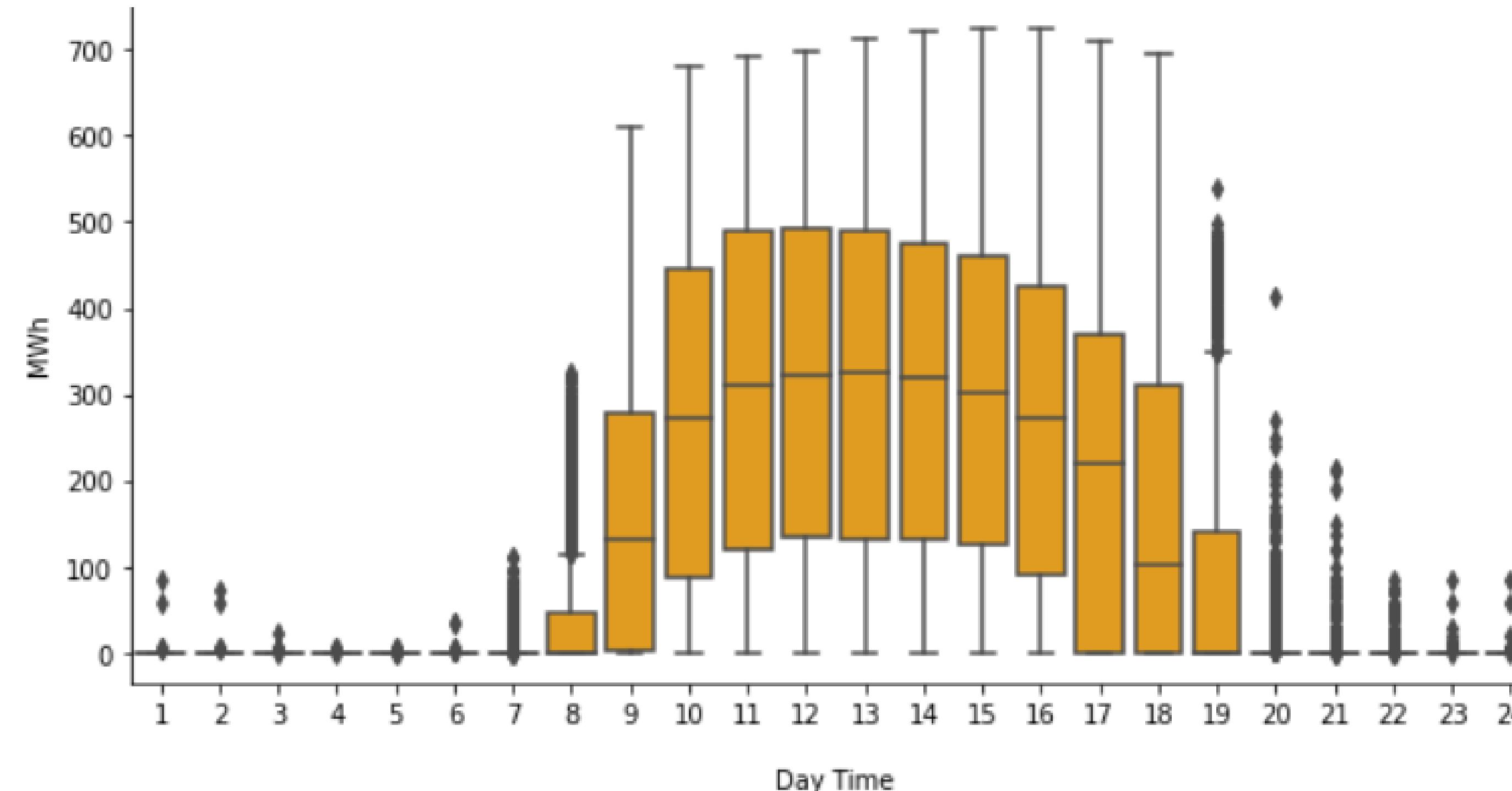


SOLAR PV Average Production by Day



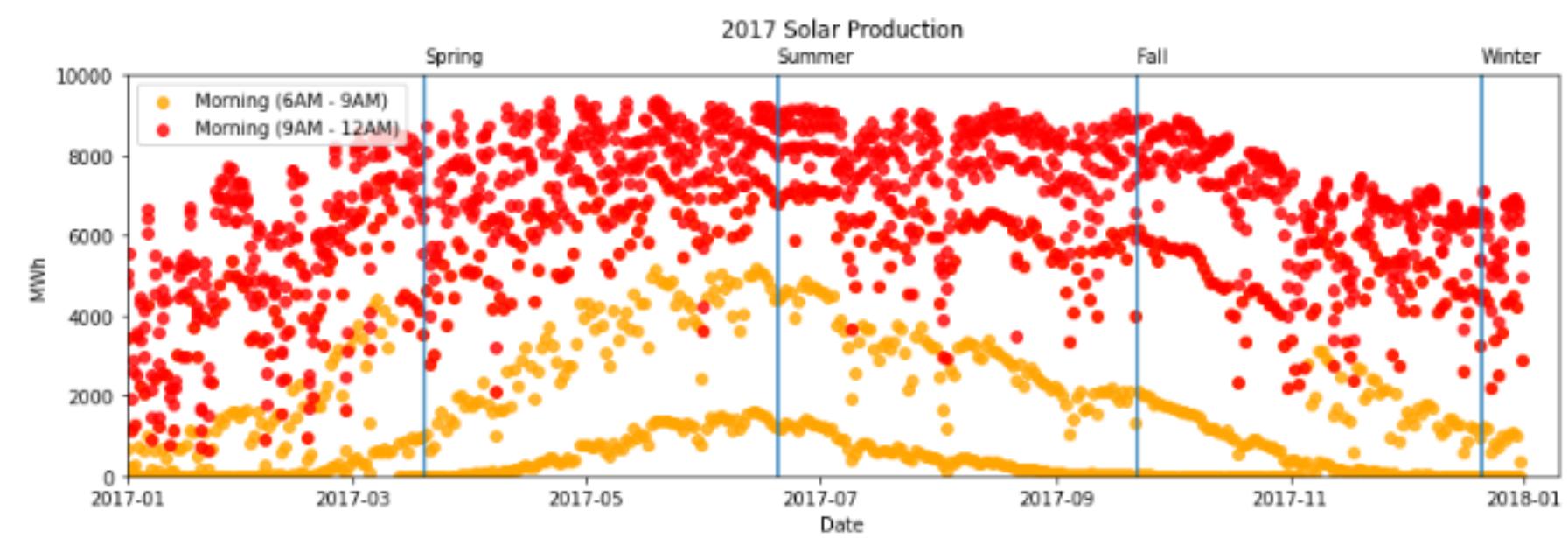
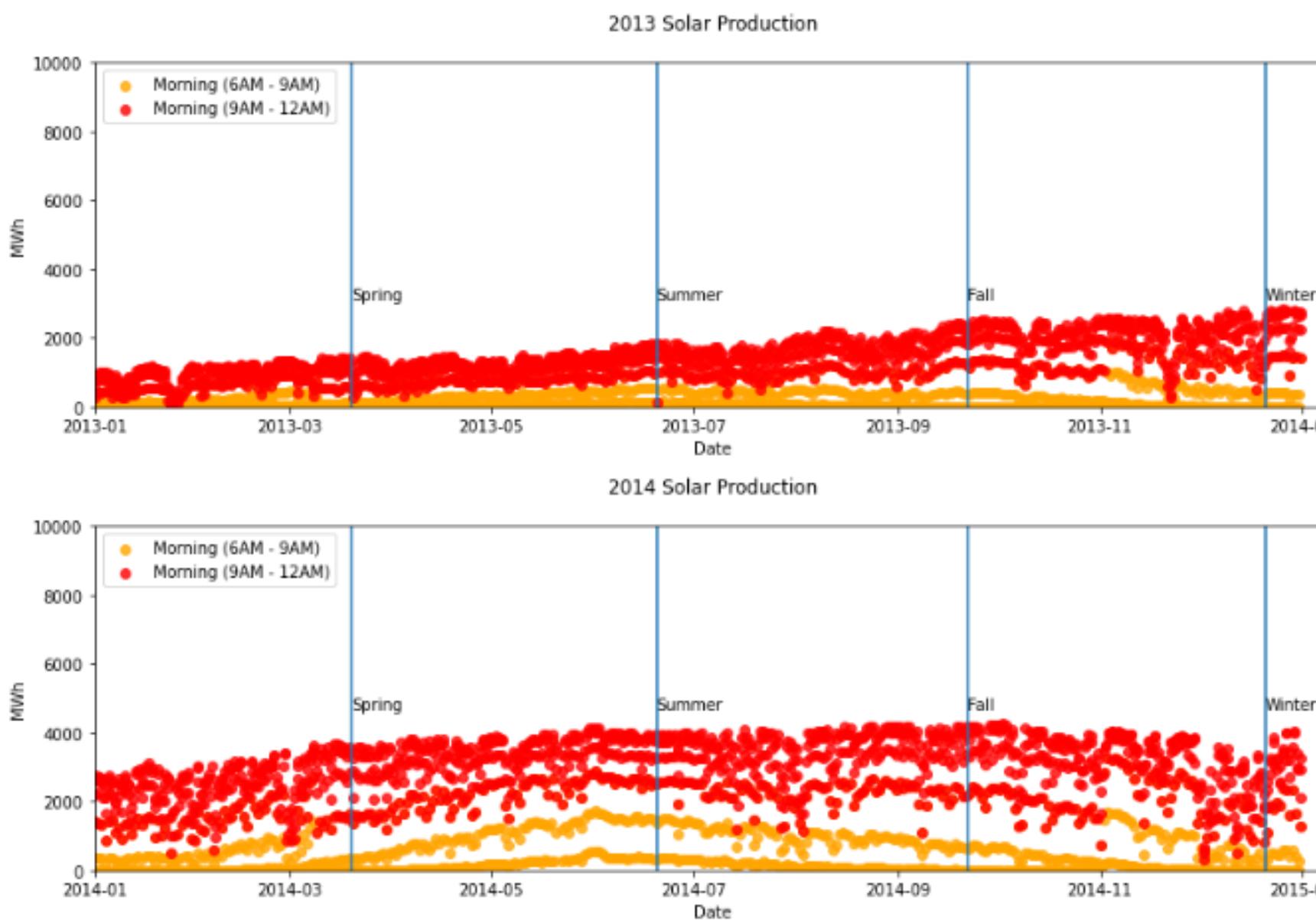


SOLAR THERMAL Average Production by Day



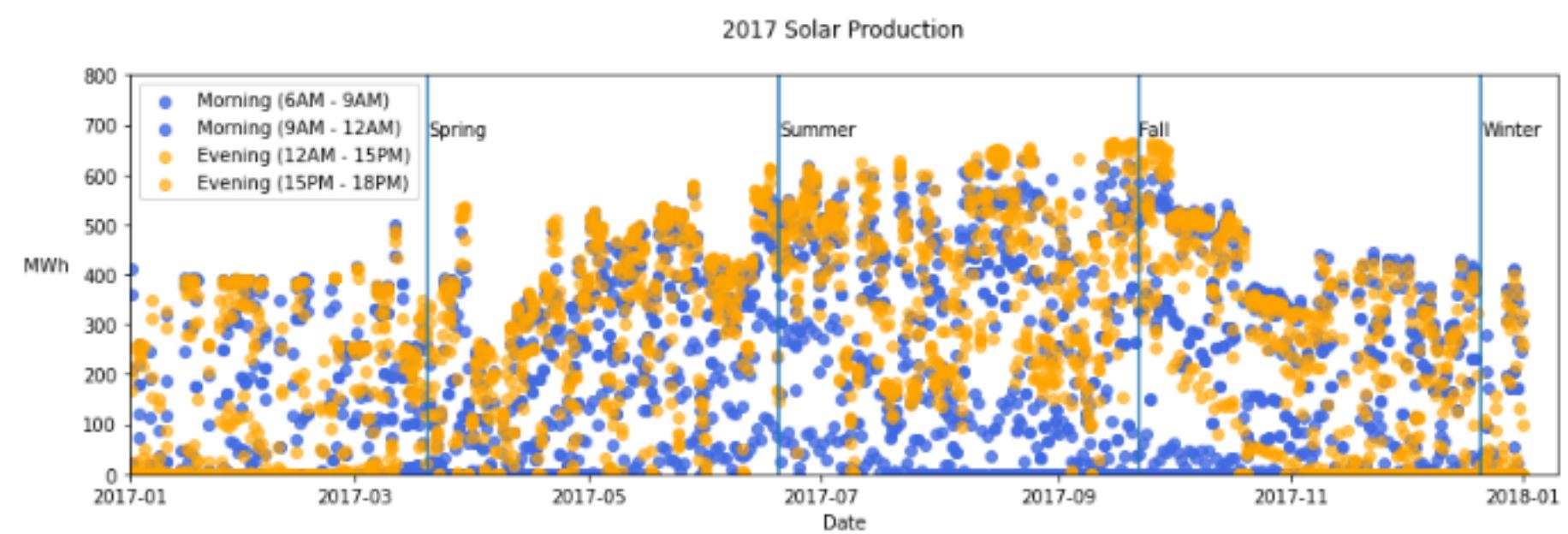
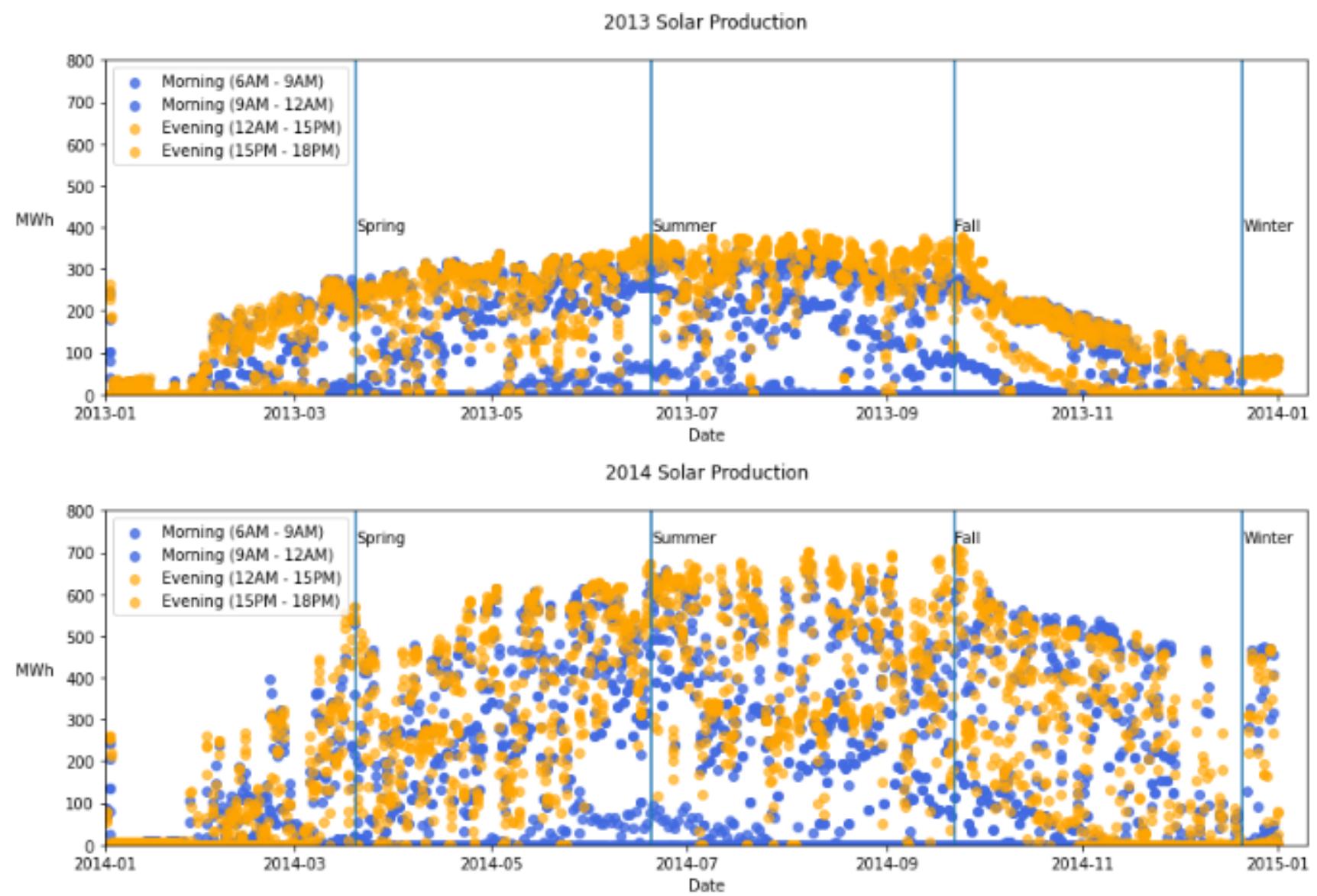


Solar Power PV Production





Solar Thermal Power Production



MODEL



FACEBOOK PROPHET

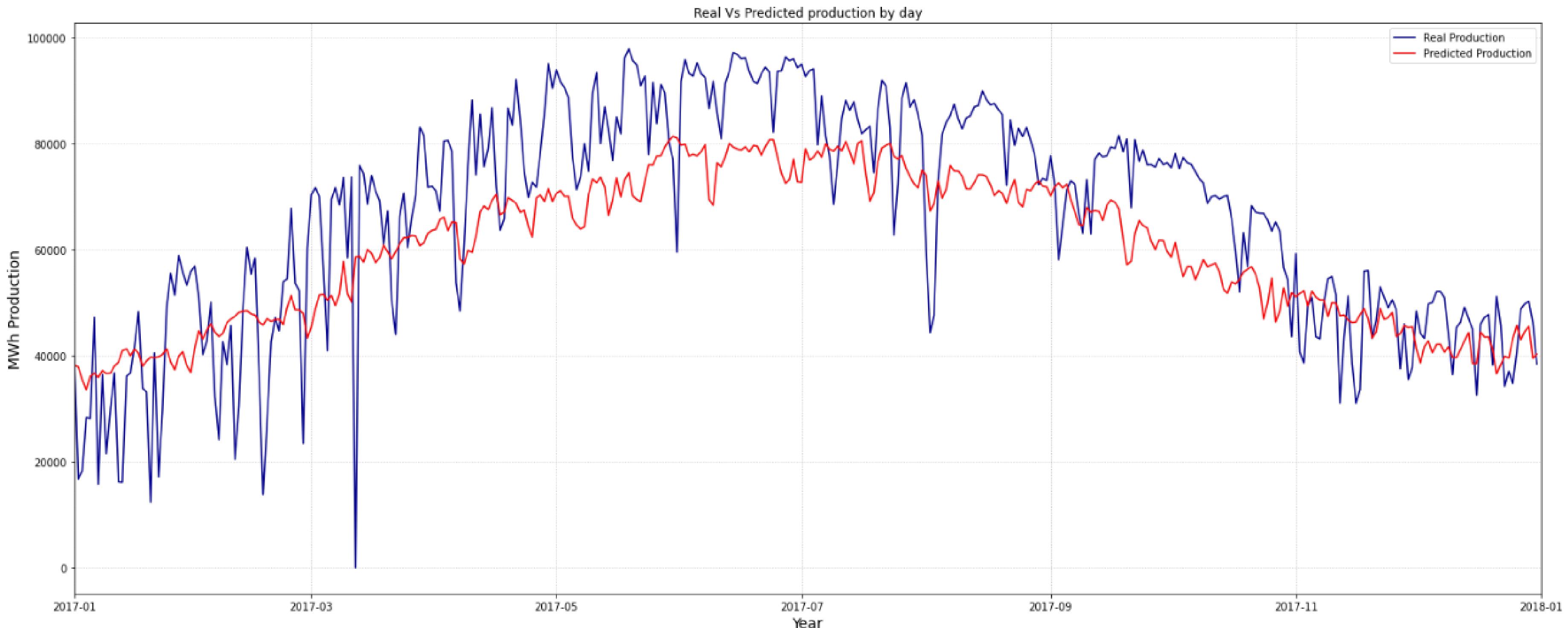
Facebook Prophet is a preferred modeling package among many data specialists due to its ease of use, robustness to outliers and missing data points, and it's relatively fast model training and inference speed and typically handles outliers well.



RESULTS



SOLAR PV POWER - 90%

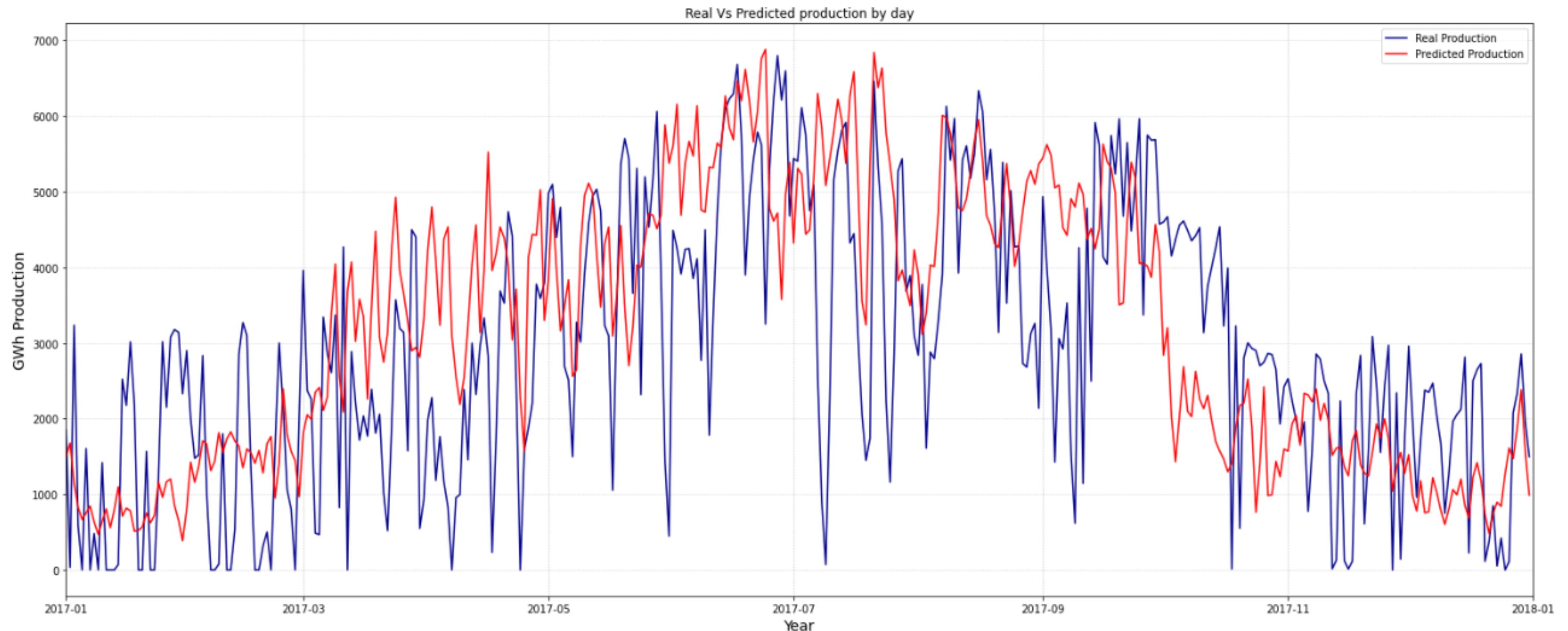


Predicted 2017 Solar PV : 21794.2 GWh

Real 2017 Solar PV : 24206.68 GWh

Total Year Error (%) : 9.97 %

THERMAL POWER - 90%



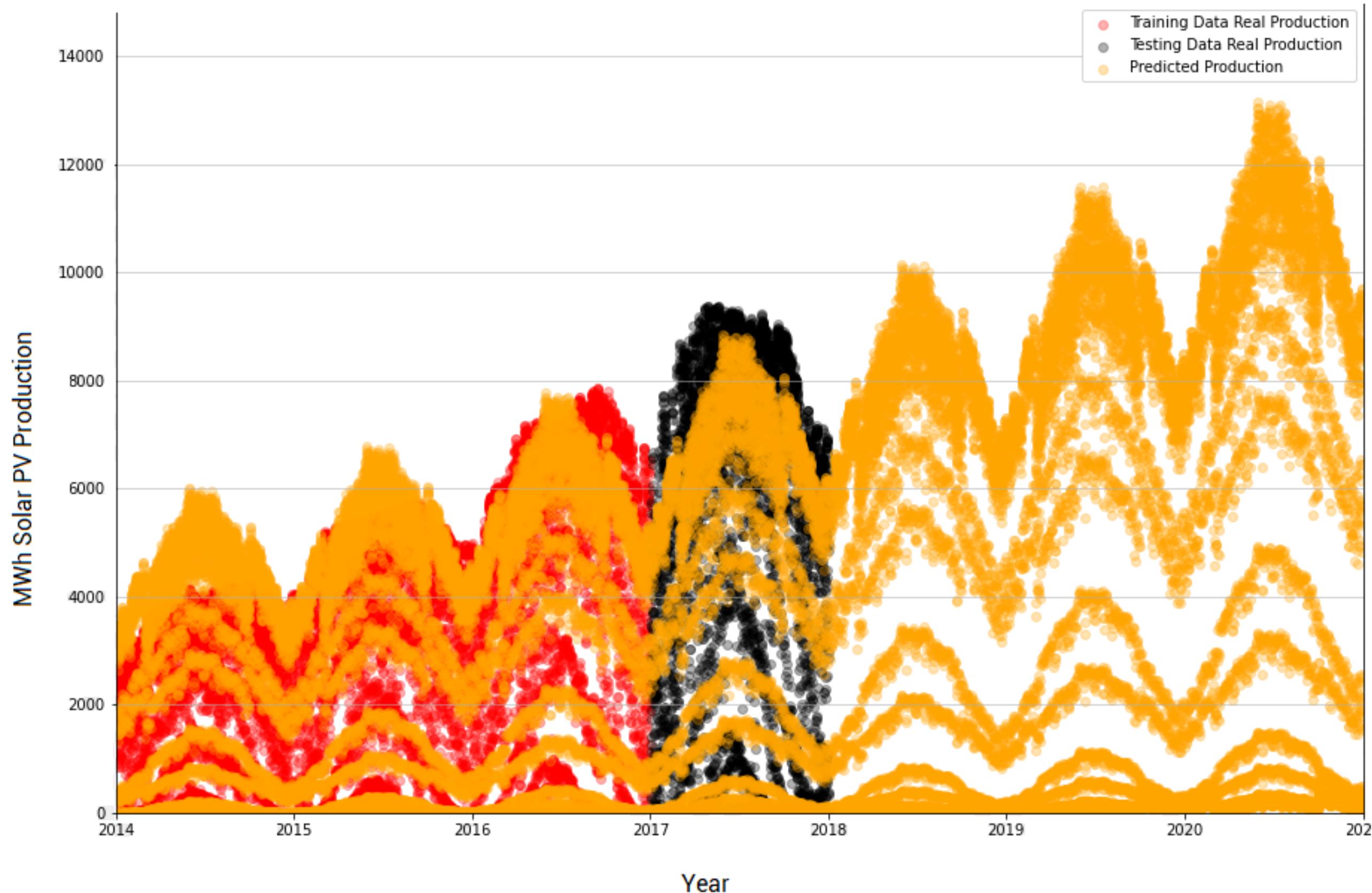
Predicted total 2017 Solar : 1167.22 GWh

True total 2017 Solar : 1063.57 GWh

Total Year % Error : 9.75 %

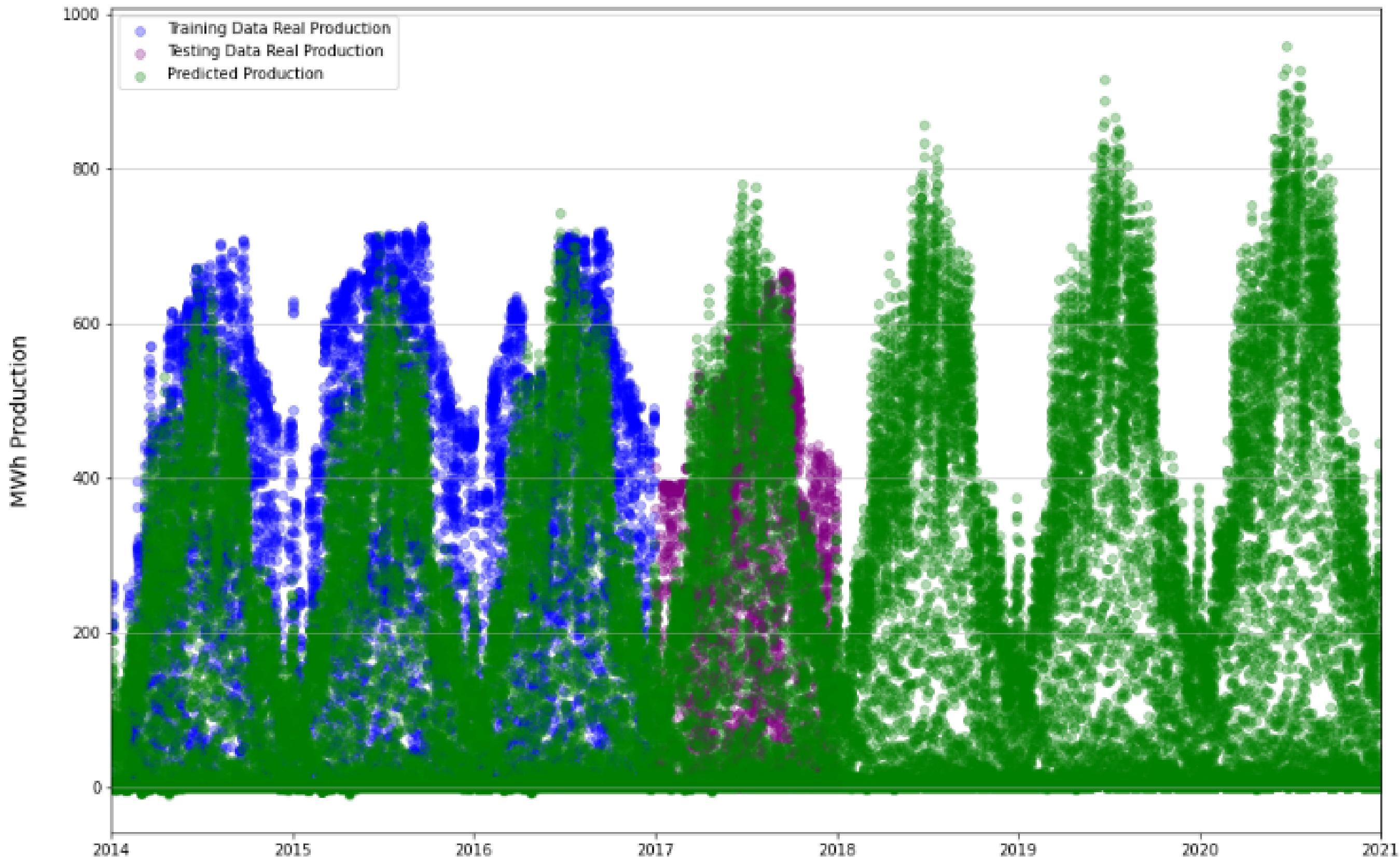
Solar Power PV Forecast

We've achieved an pic of 13,000 MWh forecast by 2020



Solar Thermal Forecast

We've achieved an pic of 1000 MWh forecast 2020





CONCLUSIONS

- The increased “Morning” and “Evening” production may indicate an increase in solar panel efficiency over the years. Both by improving technology and by increasing the number of solar farms.
- The model applied to the Solar PV and Solar Thermal prediction showed good accuracy.
- Prophet proved to be a robust algorithm for time series prediction. Simple to prepare, fully automatic and requires fewer computational resources.
- With the analysis in question, it became evident that the forecast of solar energy has been growing significantly over the years and will occupy more and more space in the energy matrix of the Planet.

THANK YOU!

