

# Forecast of Renewable Energy Consumption

## *Insight into Solar*



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# Summary of Goals

## WHAT:

The world of solar has advanced dramatically, solar clean energy is becoming more accessible every day. High residential electricity costs prompt homeowners to turn to solar for financial savings and environmental benefits.

## WHY:

These trends motivated us to take a closer look at residential solar energy consumption in the United States.

## HOW:

Exploration into Monthly Solar Energy using four distinct techniques:

*Autoregression*

*Linear Regression,*

*Multi-layer Perceptron Regressor*

*Random Forest Regressor*

## Solar Energy Trends:

Residential Solar Energy is exponentially increasing since 2012. The residential electricity price is highly correlated to the residential solar energy consumption.

## More info about data

Solar Energy Consumption by the residential sector from [U.S. Energy Information Administration](#)

Residential Energy Demand Temperature Index (REDTI) from [NOAA National Oceanic and Atmospheric Administration](#)

Average Retail Price of Residential Electricity from [U.S. Energy Information Administration](#)

“Time series forecasting is an important area of machine learning that is often neglected. It is important because there are so many prediction problems that involve a time component. These problems are neglected because it is this time component that makes time series problems more difficult to handle.”

“

[Jason Brownlee: What is Time Serie Forecasting?](#)

“In descriptive modeling, or time series analysis, a time series is modeled to determine its components in terms of **seasonal** patterns, **trends** and relation to **external factors**. In contrast, time series forecasting uses the information in a time series (perhaps with additional information) to forecast future values of that series.”

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[Jason Brownlee: What is Time Serie Forecasting?](#)



# Data Exploration

## Defining Features

### Features on a time series

- Seasonality:
  - months
- Serial dependency:
  - Lag
  - Peek

### Other features:

- Price
- Total Energy consumption
- Temperature Index

“The main features of many time series are **trends** and **seasonal variations** ... another important feature of most time series is that observations close together in time tend to be correlated (***serially dependent***)”

“

[Jason Brownlee: What is Time Serie Forecasting?](#)



## Data Cleanup

- Time series analysis
  - Decompose
  - Auto correlation
  - Lag plot
- Features
  - Add Price and Temperature
  - Seasonality – 2 approaches
- Most correlated features
  - Overall Heatmap w/wo Normalization
  - Normalization Using Log1
  - Scaling



A photograph of a solar panel array installed on a grassy hillside. The panels are blue with white grid lines. The background shows a vibrant sunset or sunrise with orange, yellow, and red hues in the sky.

**UNDERSTANDING THE  
TREND**





## Monthly Trend

Dataset analysis: understand trend

### Model to describe our times series

- To identify the predictive model that best fits our time series, we leveraged a range of approaches, from the most simplistic to robust machine learning models.
  
- Time series analysis (These models help describe the time series dataset)
  - Persistence model
  - Autoregression
  - Autoregression with history

# Machine Learning: forecasting



- *Linear Regression,*
- *Multi-layer Perceptron Regressor*
- *Random Forest Regressor*



## Applications & Tools

**For exploration, dataset and model creation:**

- Jupyter Notebooks
- python, pandas, numpy, matplotlib, seaborn, sklearn, statsmodels, plotly

**For production, Interactive web page:**

- Flask app
  - Html/css/bootstrap/bootswatch
  - Javascript
  - Jsonify (Get)



## References

- Solar Energy Consumption by the residential sector from [U.S. Energy Information Administration](#)
- Residential Energy Demand Temperature Index (REDTI) from [NOAA National Oceanic and Atmospheric Administration](#)
- Average Retail Price of Residential Electricity from [U.S. Energy Information Administration](#)
- Time Series concept: <https://machinelearningmastery.com/time-series-forecasting/>
- Data analysis study: [https://github.com/Arronno/House-Prices--Advanced-Regression-Techniques-/blob/master/AI-0009-Report.ipynb](https://github.com/Arronno/House-Prices--Advanced-Regression-Techniques/blob/master/AI-0009-Report.ipynb)
- Use of Autoregression: <https://machinelearningmastery.com/autoregression-models-time-series-forecasting-python/>
- Reference study: <https://github.com/Azure/cortana-intelligence-energy-demand-forecasting>
- Use of Multi Layer Perceptron Regressor:  
[https://www.programcreek.com/python/example/93778/sklearn.neural\\_network.MLPRegressor](https://www.programcreek.com/python/example/93778/sklearn.neural_network.MLPRegressor)
- Lag and Peek data manipulation credit Matthew Young from Cryptocurrency forecasting



# Thanks!

Any *questions* ?

You can find our full analysis at

- ◉ <https://github.com/gvo34/energy-solar>