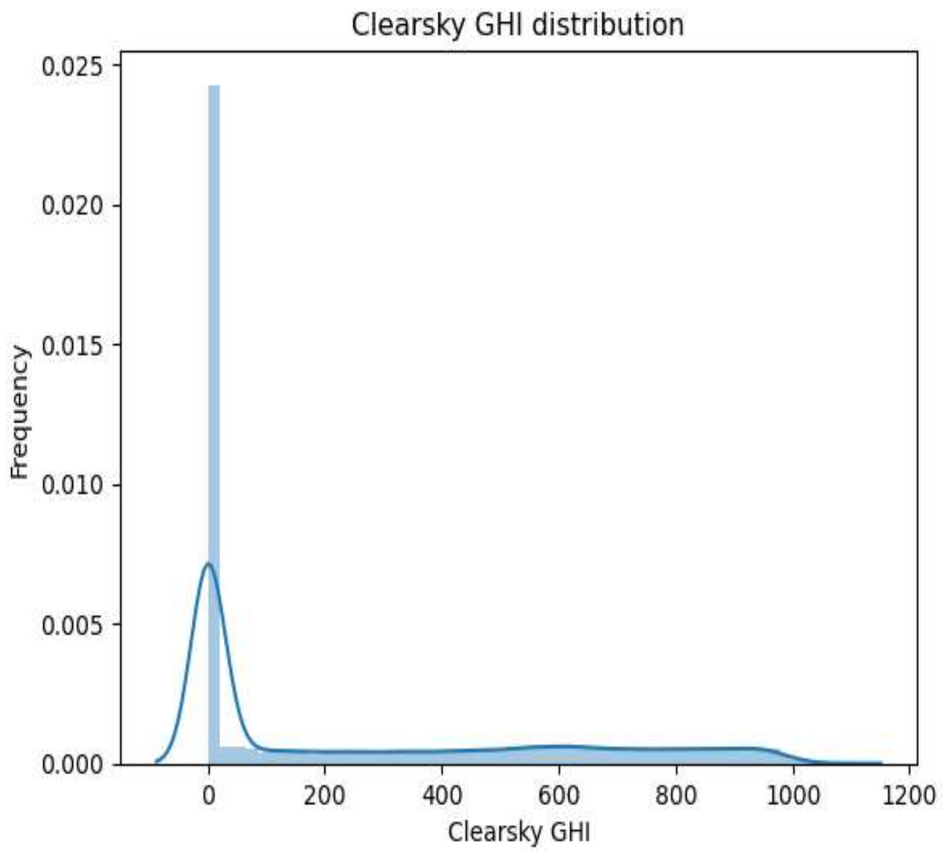
Sustainability AI-ML Case Study

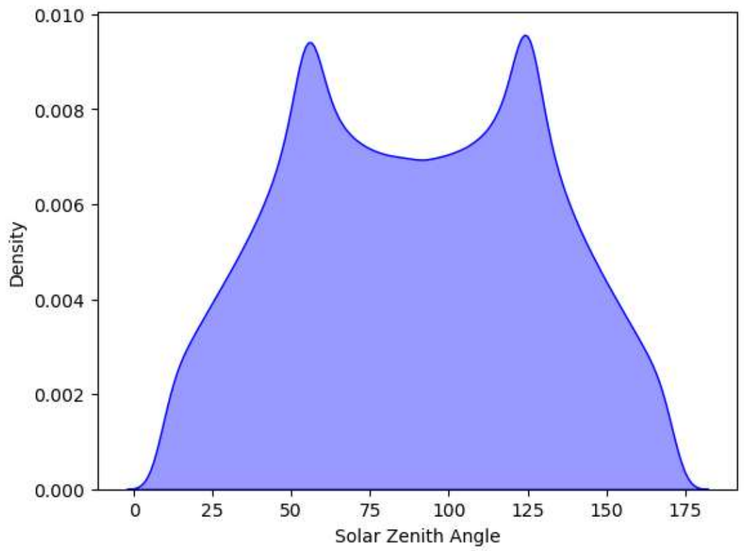
In the sustainability industry, the accurate prediction of clear-sky Global Horizontal Irradiance (GHI) is crucial for efficient and effective utilization of solar energy. Clear-sky GHI represents the solar radiation that reaches the Earth's surface under clear-sky conditions, which is essential for determining the maximum potential solar power generation capacity of a solar panel system. However, predicting clear-sky GHI is challenging due to its high variability and dependence on various meteorological factors such as cloud cover, atmospheric water vapor, and aerosols. Therefore, in this Auto-ML problem, the goal is to develop a model that can accurately predict clear-sky GHI based on a set of meteorological variables. Such a model can help sustainability industries optimize the performance of solar energy systems and improve their overall energy efficiency, leading to a more sustainable future.

The main goal is to predict solar power generation (Clearsky GHI) and help identify the factors that determine solar power generation using Auto-ML.

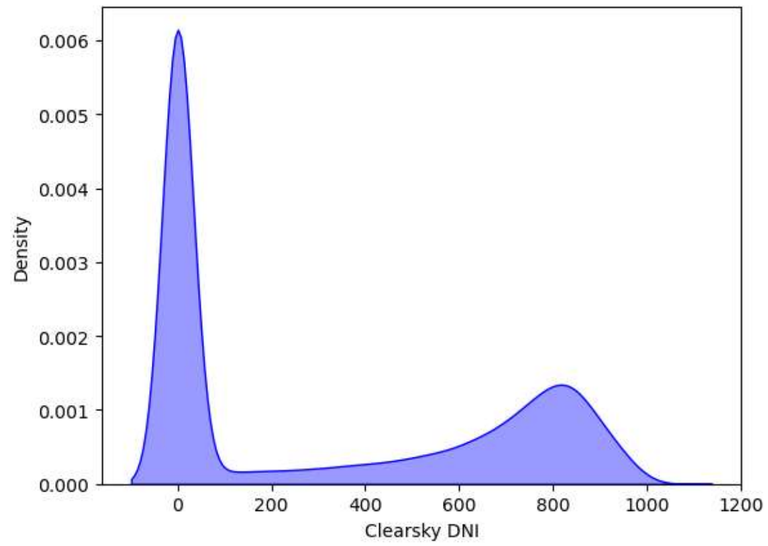


- The bsuiness feature we use here is Clearsky GHI
- Clear sky irradiance, in particular, the Global Horizontal Irradiance (GHI), provides information about the maximum possible solar energy resource available at the location under consideration, which is crucial in estimating or forecasting the performance of solar energy technologies.
- Global Horizontal Irradiance which represents the total amount of shortwave radiation received from above by a surface which is horizontal (parallel) to the ground.
- The plot shows that most of the Clearsky GHI is from 0 - 200.

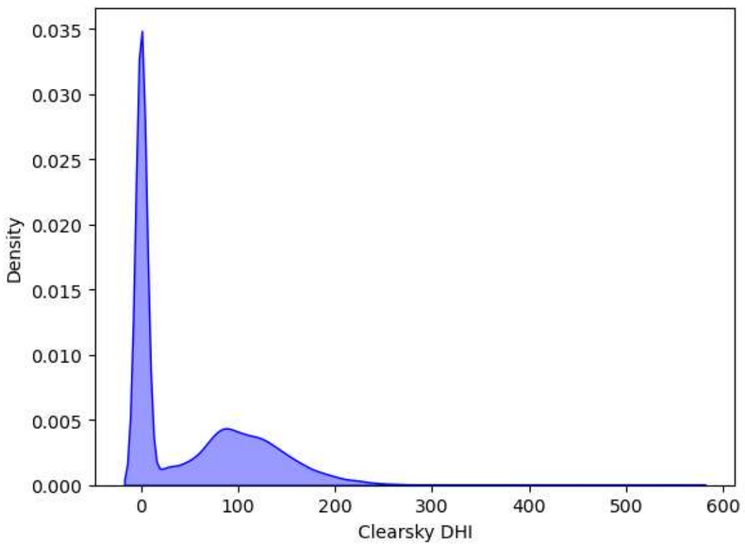
Features Responsible : Auto- ML



- **Solar Zenith Angle =** The solar zenith angle is the zenith angle of the sun, i.e., the angle between the sun's rays and the vertical direction.



- **Clearsky DNI** = Diffused Normal Irradiance which represents the amount of light that is coming perpendicular to surface



- **Clearsky DHI =** Diffused Horizontal Irradiance which represents solar radiation that does not arrive on a direct path from the sun, but has been scattered by clouds and particles in the atmosphere and comes equally from all directions.

Auto-ML Methodology Results

Algorithms	Test Accuracy (25 percentile)	Test Accuracy (50 percentile)	Test Accuracy (75 percentile)	Test Accuracy (90 percentile)
Lasso	92.6	93	93	93
Random Forest	99.9	99.9	99.9	99.9
XGBoost	100	100	100	100
MLP	100	100	100	100
RNN	99.9	99.76	99.81	99.8
ANN	99.9	94.34	99.96	99.79
Total Features	7	13	20	24
Avg. Accuracy	98.71	97.83	98.77	98.74

- **Based on our observation from the standard ML algorithms, 75th percentile has the best average accuracy.**
- **XGBoost and MLP has the best performing algorithm accuracy with 100% accuracy in all percentile.**

Conclusion

Auto-ML can be used to optimize energy usage in buildings, factories, and other facilities. By analyzing data from sensors and other sources, Auto-ML algorithms can identify opportunities to reduce energy consumption, improve efficiency, and lower costs. Auto-ML can be used to calculate and analyze carbon footprints across industries, organizations, and products. This can help identify areas where emissions can be reduced, and enable better decision making around sustainability and climate change mitigation. The dataset has 175,259 records with 2 Categorical and 16 Numerical Features.

For regression, models were created with algorithms using Auto-ML techniques like Lasso, Random forest, XGBoost, Multilayer Perceptron, Recurrent Neural Network and Artificial Neural Network. With these models, performance measurement values were obtained for feature sets of 7, 13, 20 and 24. The Auto-ML algorithms were able to predict the Clearsky GHI with an average accuracy between 97% – 99% and helped to determine the features that influence Clearsky GHI. The major features include Solar Zenith Angle, Clearsky DNI and Clearsky DHI. The Random forest with 98.2% accuracy in 90th percentile where tree showed a threshold of Solar Zenith Angle <= 32.01 degree which leads to highest Clearsky GHI.

Overall, Auto-ML can help solve a range of problems in sustainability, from reducing environmental impacts and improving efficiency to enabling better decision making around resource management and conservation.