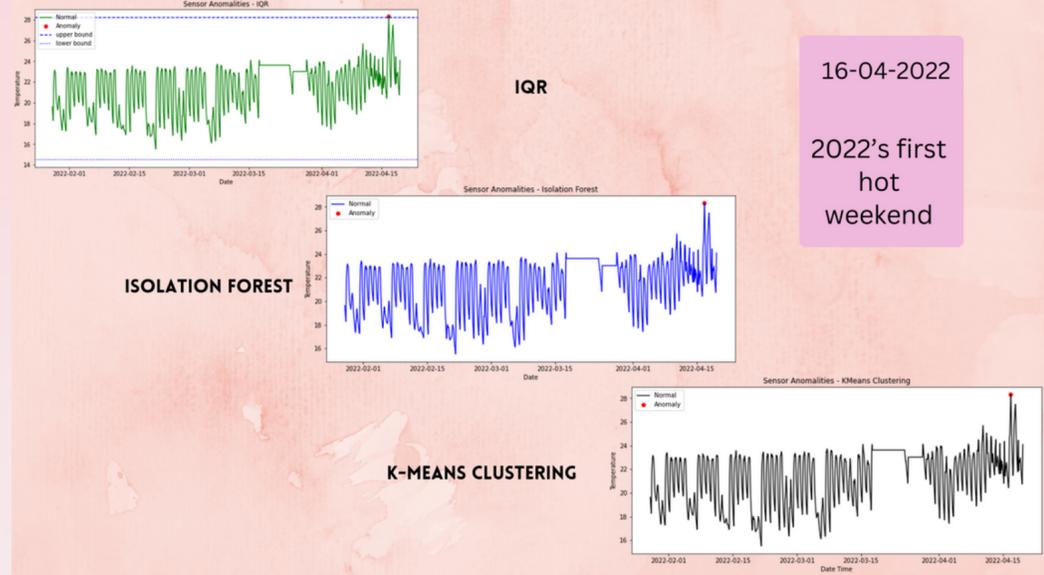


# Driving Net-Zero Energy Targets Using Smart Sensors

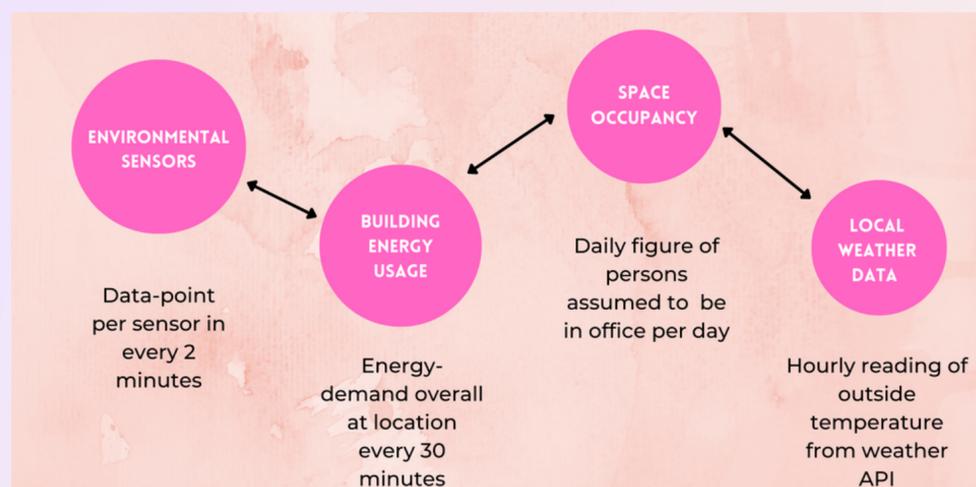
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## Introduction

Achieving net zero energy targets is the need of the hour.  
 (i) Soaring energy prices in the UK and Europe. With the current factors affecting the world, it is expected that the household energy price cap in the UK will rise to 80% in the coming October.  
 (ii) Climate action goals of COP21 aimed to keep global warming to a 1.5-degree Celsius to a 2-degree Celsius increase. The need to reduce carbon outputs and control emissions was the primary goal of COP21.  
 (iii) Buildings alone contribute to around 30% of the total greenhouse gas emissions. Hence, energy savings is advisable to minimise cost and meet the climate action goals.



## Data



These Datasets are provided for two individual buildings of (i) GHD London Office (ii) GHD London Retail

## Methods

### Visualization of Data

- Visualizing time series using Line plots

### Exploratory Data Analysis

- Check for Seasonality
- Check for Stationarity

### FORECASTING AND PREDICTION

Time Series Forecasting and Prediction of both sensor readings and local temperature is made using the following ML algorithms,

- ARIMA
- LSTM
- Prophet

The predicted temperatures are related to energy consumption and occupancy using,

- OLS regression

This method quantifies the energy consumption profile using the predicted indoor and outdoor temperatures.

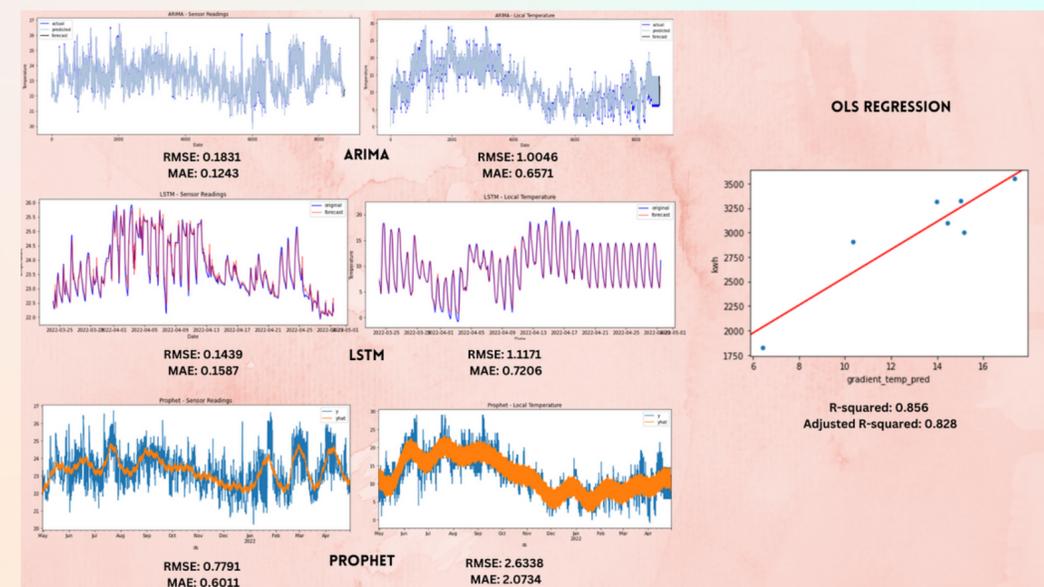
### ANOMALY DETECTION

Time Series Anomaly Detection methods to single out instances of extensive heating/cooling in the building

- IQR
- Isolation Forest
- K-Means Clustering

## Time Series Forecasting and Prediction

This technique helps in predicting and forecasting temperature values. The environmental sensor readings and the local temperature correspond to the indoor and outdoor temperatures of the building. A new feature is created by calculating the difference in the indoor and outdoor temperature predicted values called the 'Temperature\_Difference'. These temperature difference values are then related to other variables such as occupancy and energy usage using the OLS Regression technique to find the energy consumption of the building due to heating and cooling.



The amount of energy that can be saved by employing few energy saving techniques is identified and the amount of money that can be saved is calculated by 1 KWH = £ 0.1436

## Time Series Anomaly Detection

This technique identifies instances or dates where there is the extensive usage of cooling or heating required. 16-04-2022 was identified as an anomaly. The reason is, it is the first hot weekend of 2022. GHD office does not air condition during the weekends. Thus, identifying occurrences of extreme events from the data, helps in better preparation and handling of the extensive heating/cooling needed. Thereby, conserving energy.

1	2	3
<b>SWITCHING OFF HEATING DURING NON-WORKING HOURS</b>	<b>REDUCING THE INDOOR MAINTAINED TEMPERATURE BY 4 DEGREES CELSIUS</b>	<b>DELAYING HEATING BY A MONTH</b>
KWH savings: 12268.85	KWH savings: 3982.9	KWH savings: 771.78
Cost savings: £ 1761.80	Cost savings: £ 571.95	Cost savings: £ 110.83