

HVAC System Insights

Examining the system to improve tenants comfort

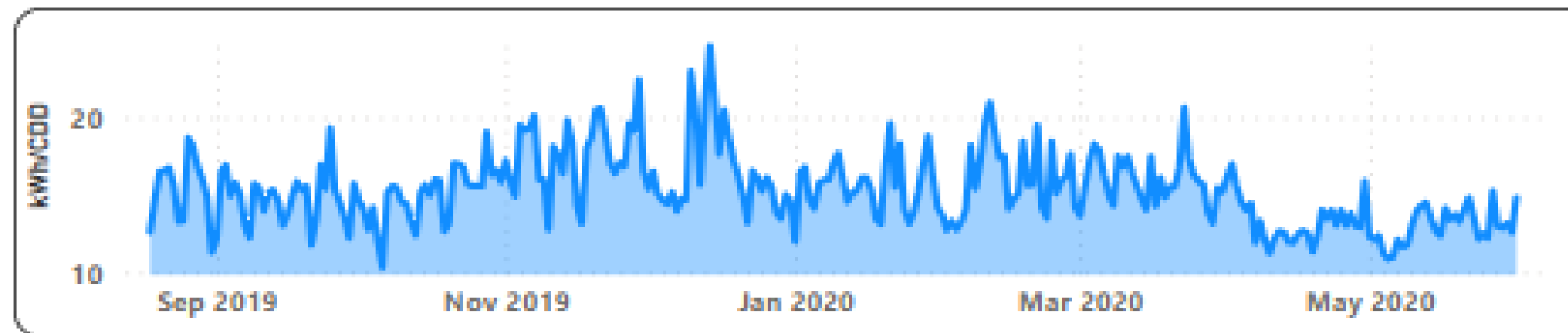
Problem Statement:

Your company has been contracted to optimize the energy consumption of a large commercial building's HVAC (heating, ventilation, and air conditioning) system. The building has been experiencing high energy bills and complaints from tenants about the temperature of rooms not being comfortable. You have been tasked with analyzing the system's data to identify inefficiencies and recommend solutions to optimize energy consumption and improve tenant comfort.

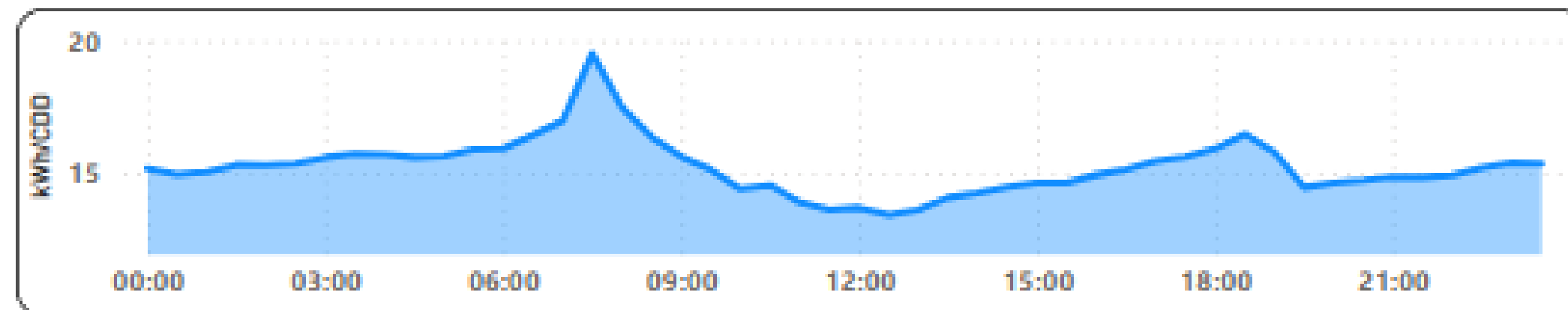
Energy Consumption /CDD (kWh/CDD) metric:

- While calculating the energy consumption per cooling degree day metric the base temperature is assumed to be 20C.
- The overall value of the metric for given data is 15.11.

Variation with time:



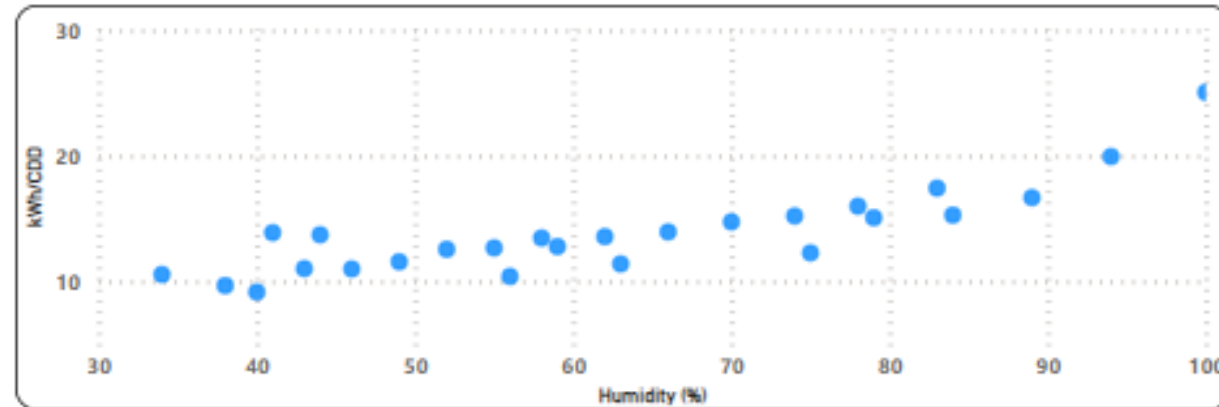
- The metric is higher in November and December which are the months of lower temperature.
- It is least during the April and May which are the months of higher temperatures.



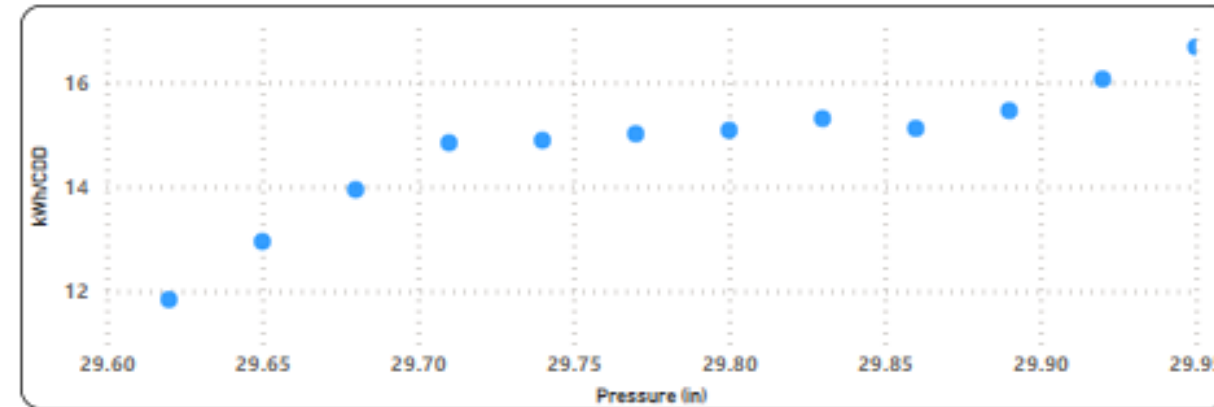
- Typically on any day, the metric reaches its maximum value at 7:30 am and starts decreasing.
- It reaches its minimum value at 1:30 pm.

Variation with external factors:

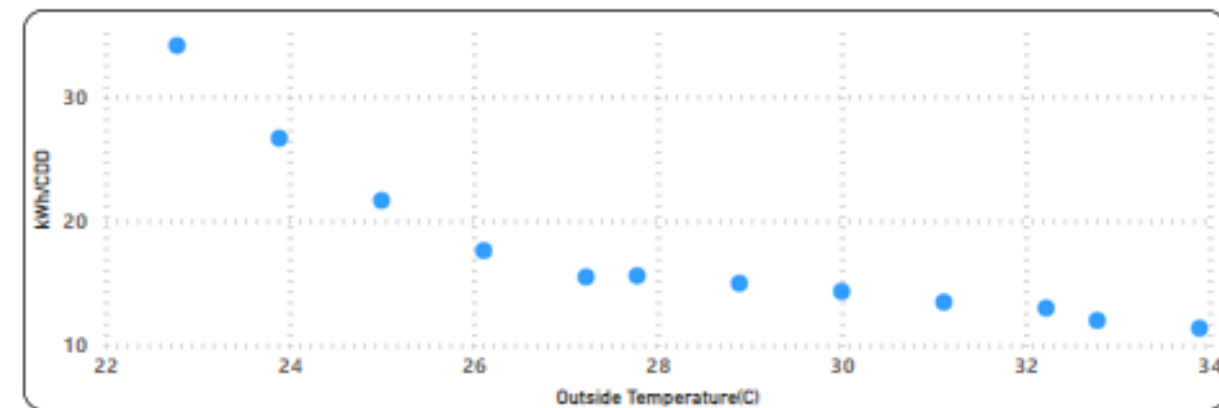
Humidity:



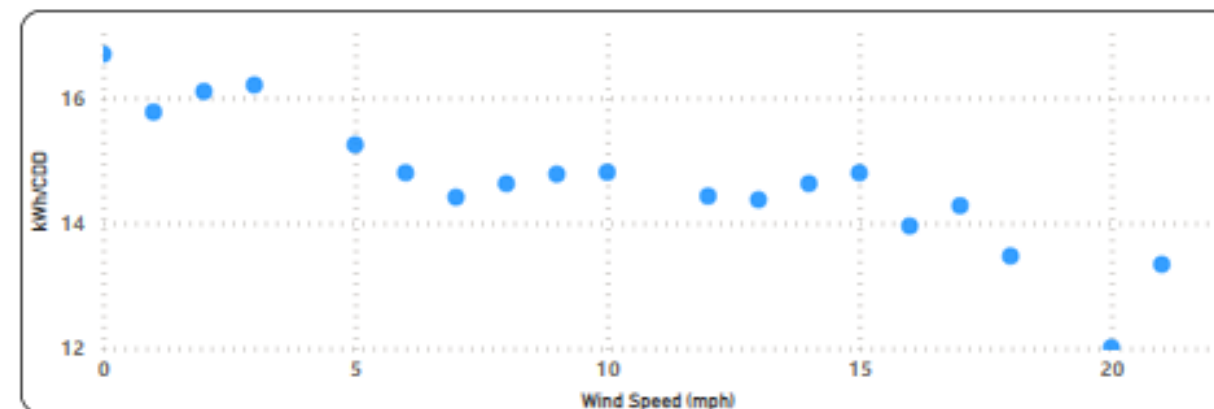
Pressure:



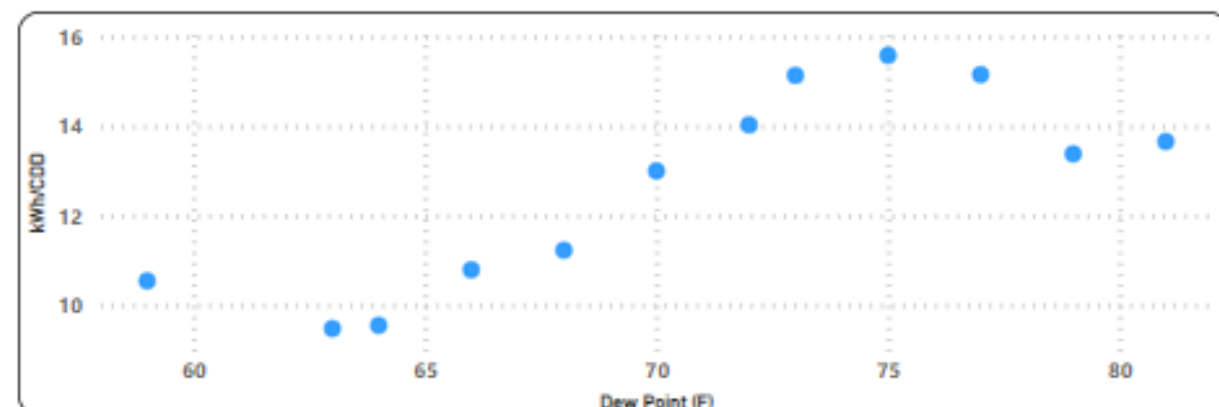
Outside Temperature:



Windspeed:



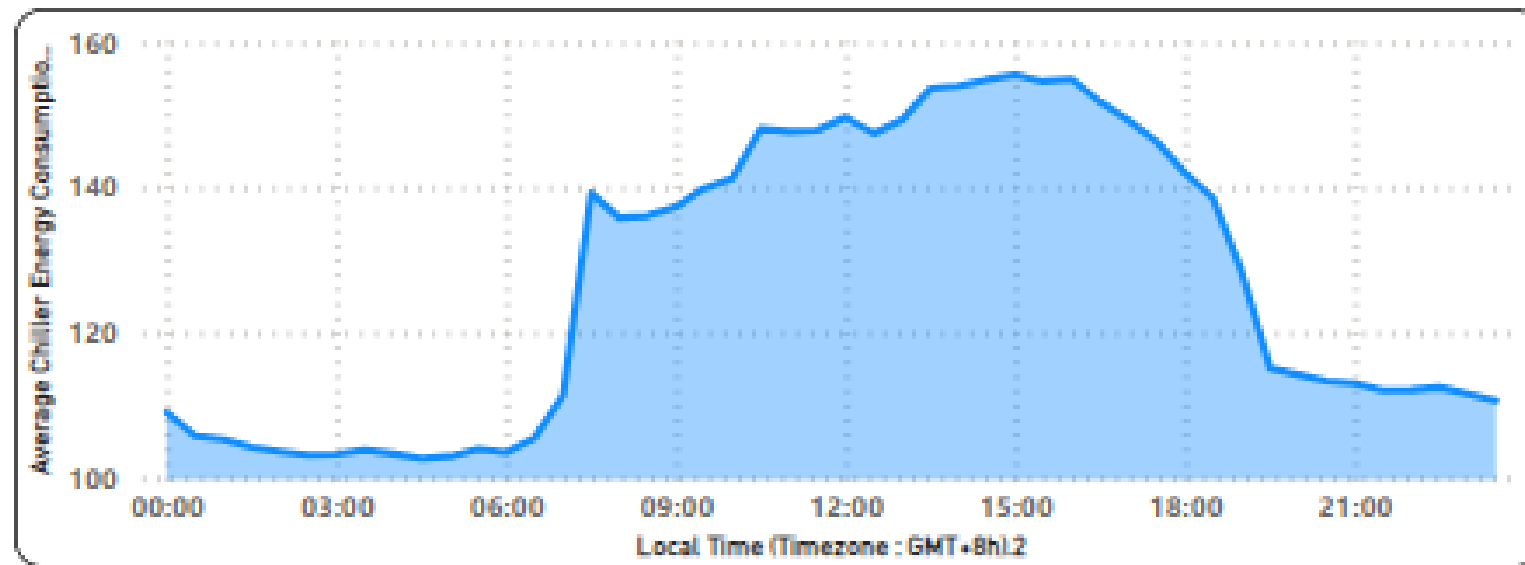
Dew point (F):



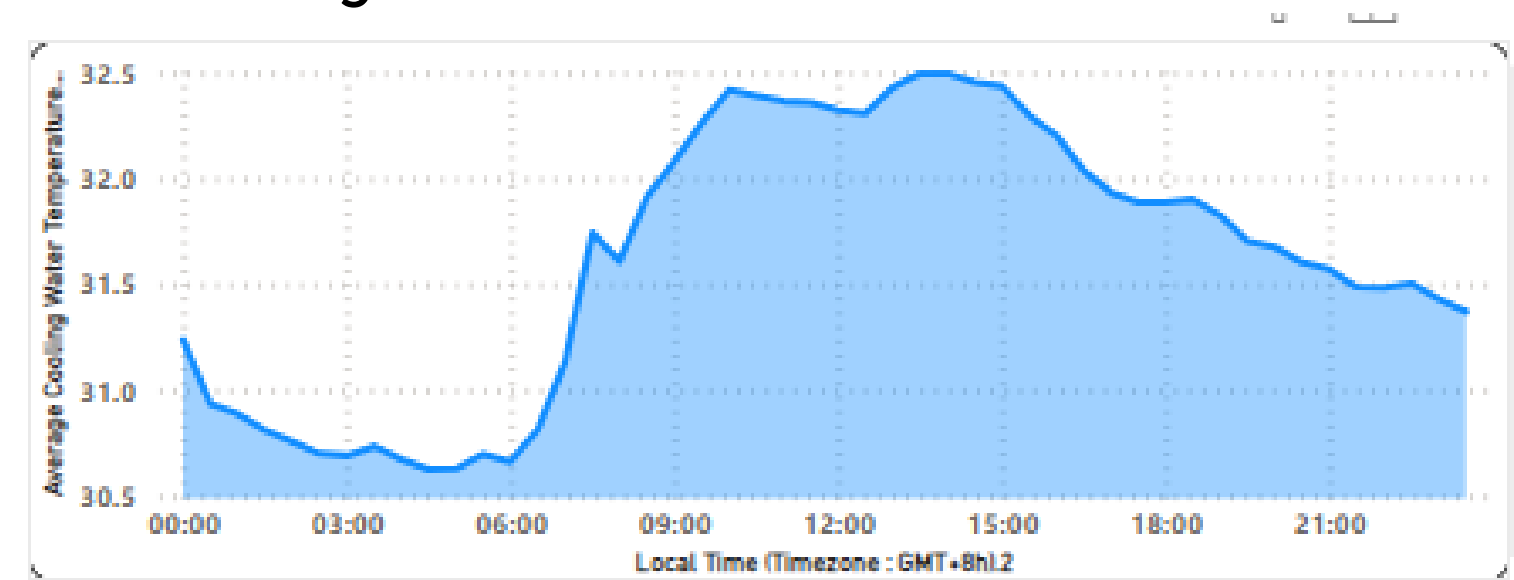
- The energy efficiency is low when outside temperature is low. This implies that system and components should be reviewed frequently for maintenance.
- It can be seen that the metric increases with the increase in Humidity of the room, Dew Point and Pressure, and varies inversely with Wind Speed. Therefore it is suggested to improve the ventilation of the occupants space to reduce load on the system.

Timely variation of Chiller Energy Consumption, Building Load, Chilled Water Rate, Cooling Water Temperature

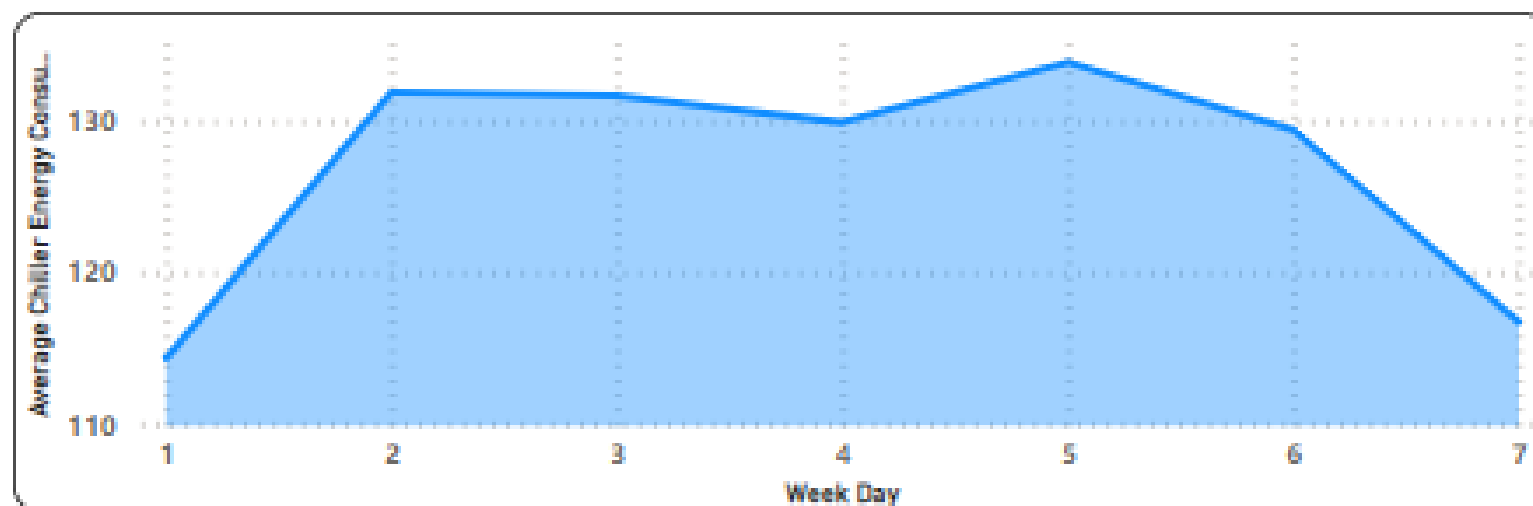
Chiller Energy Consumption:
In a day:



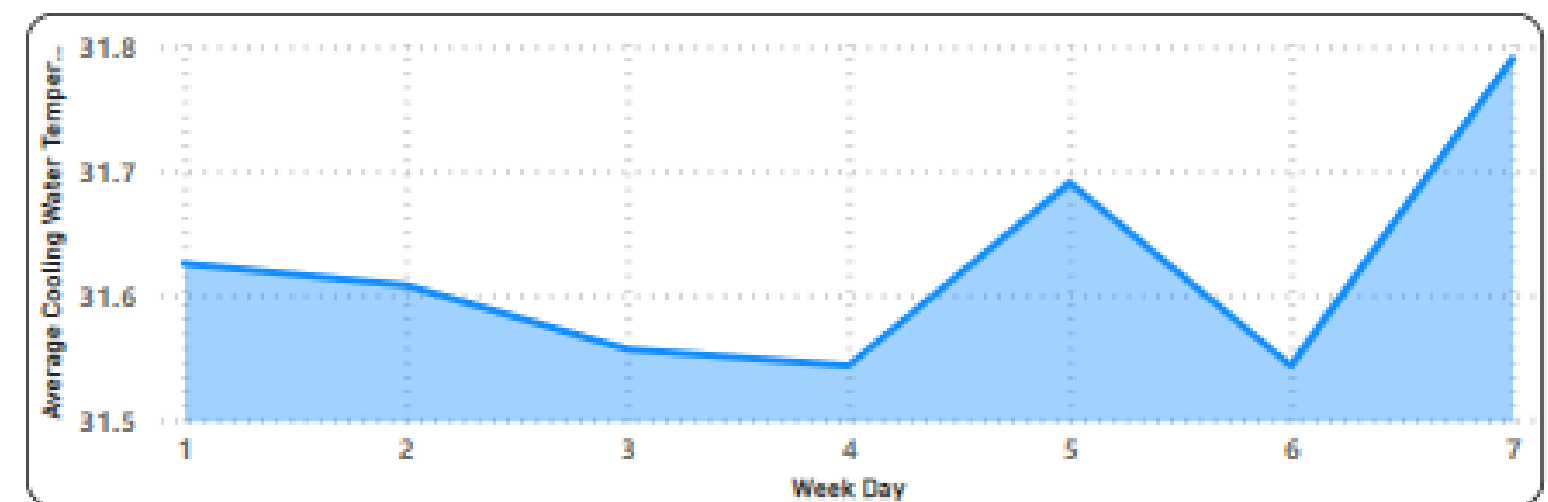
Cooling Water Temperature
In a day:



In a week:

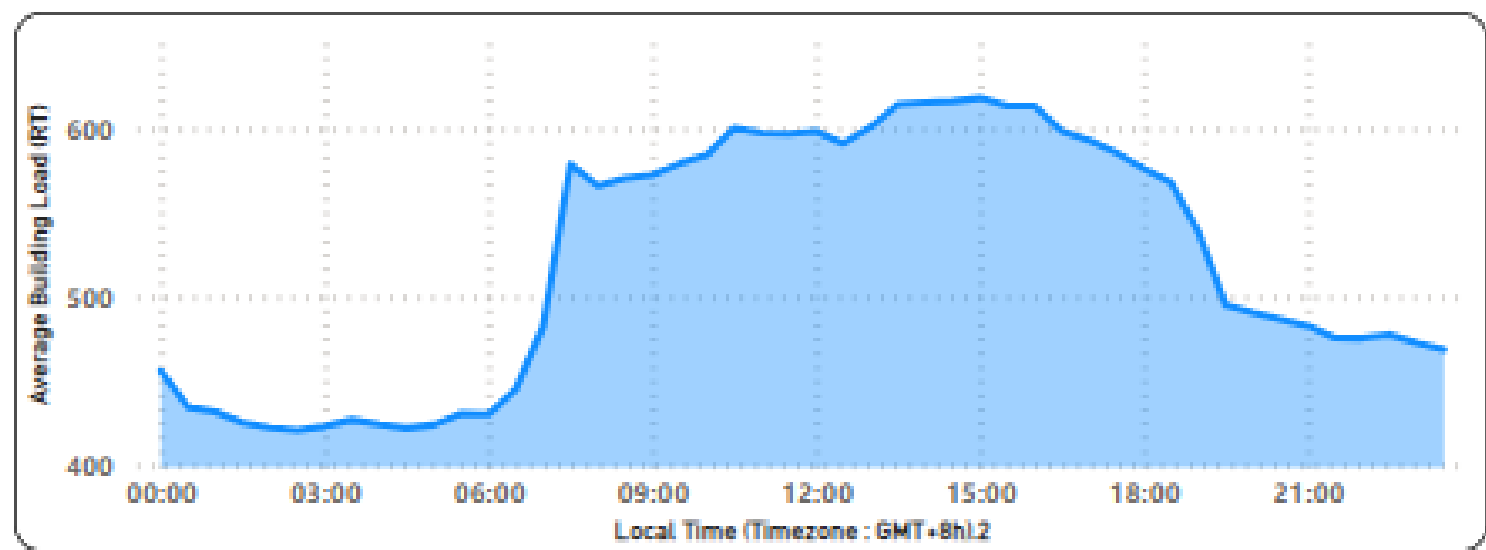


In a week:

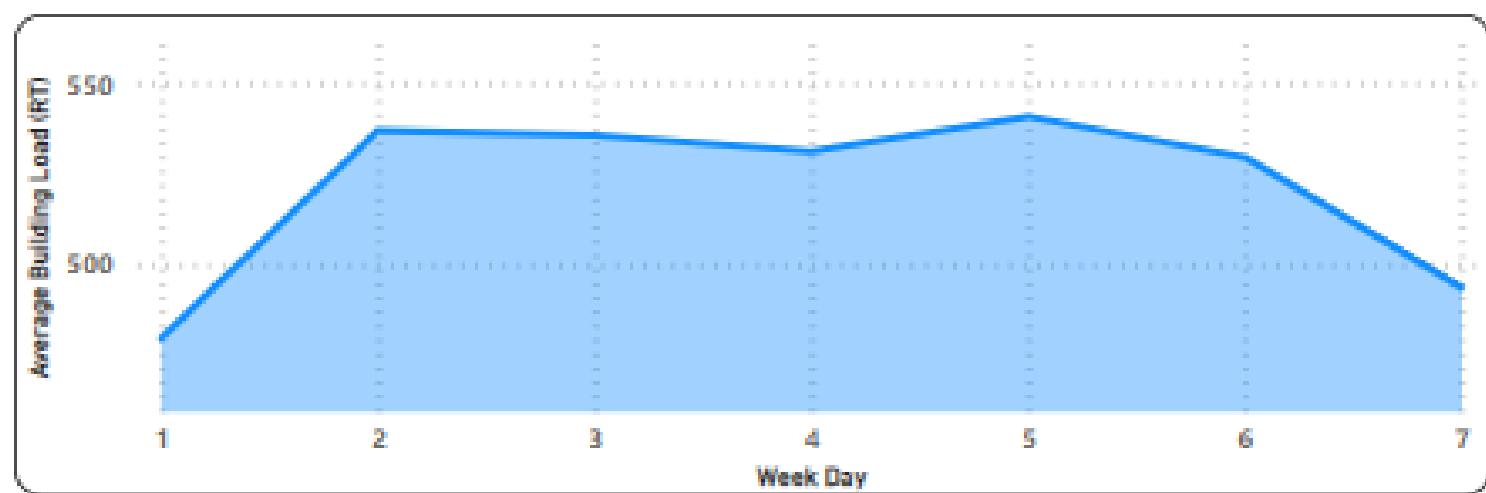


Building Load

In a day:

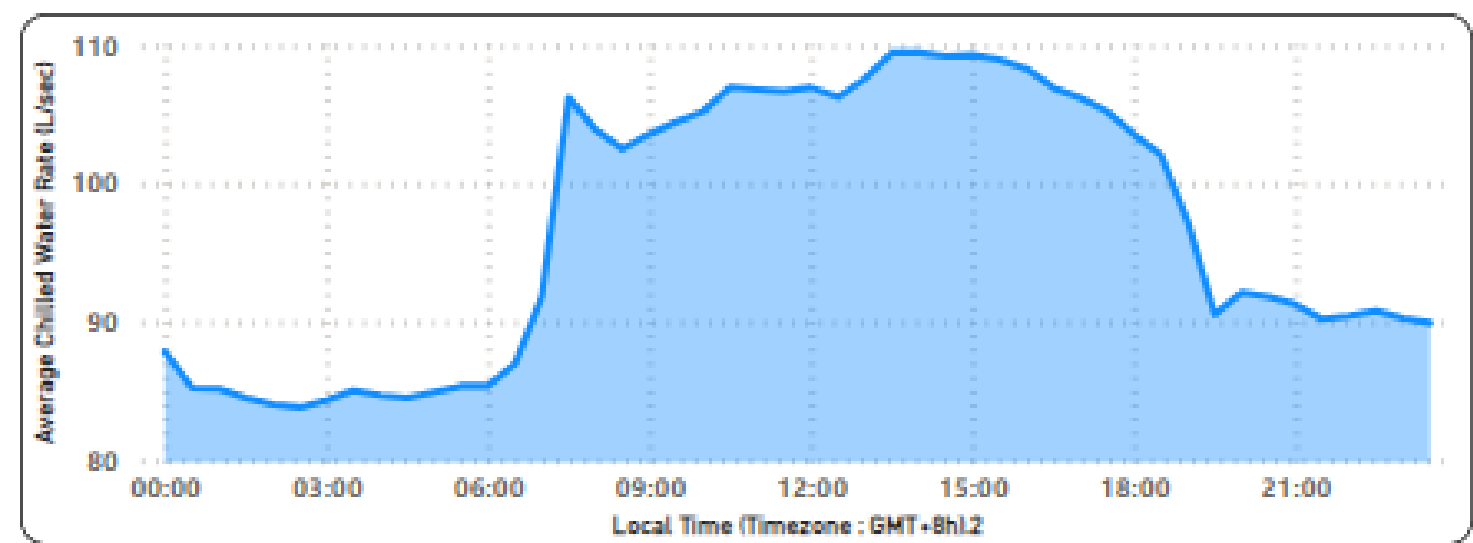


In a week:

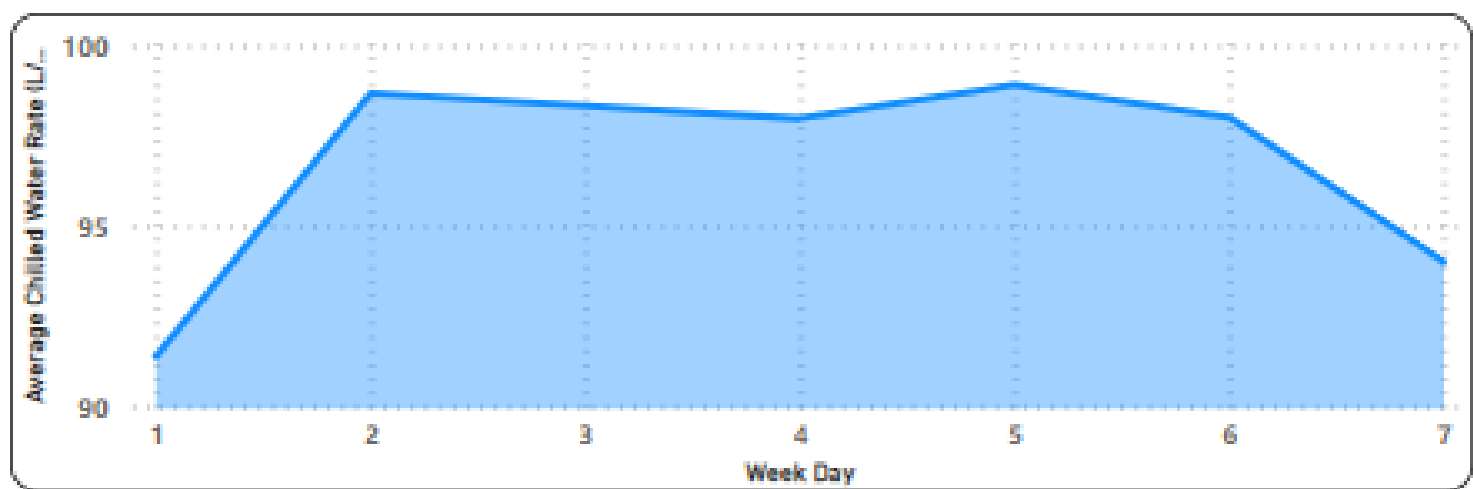


Chilled Water Rate:

In a day:

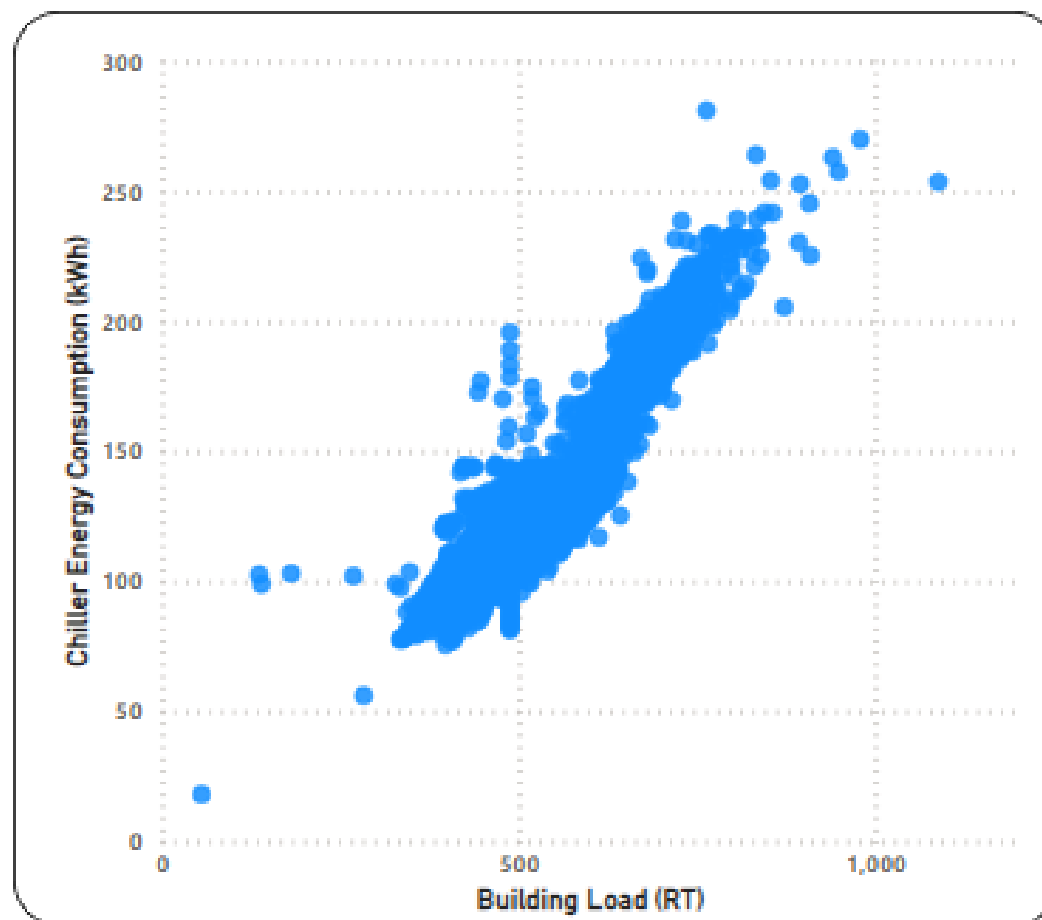


In a week:

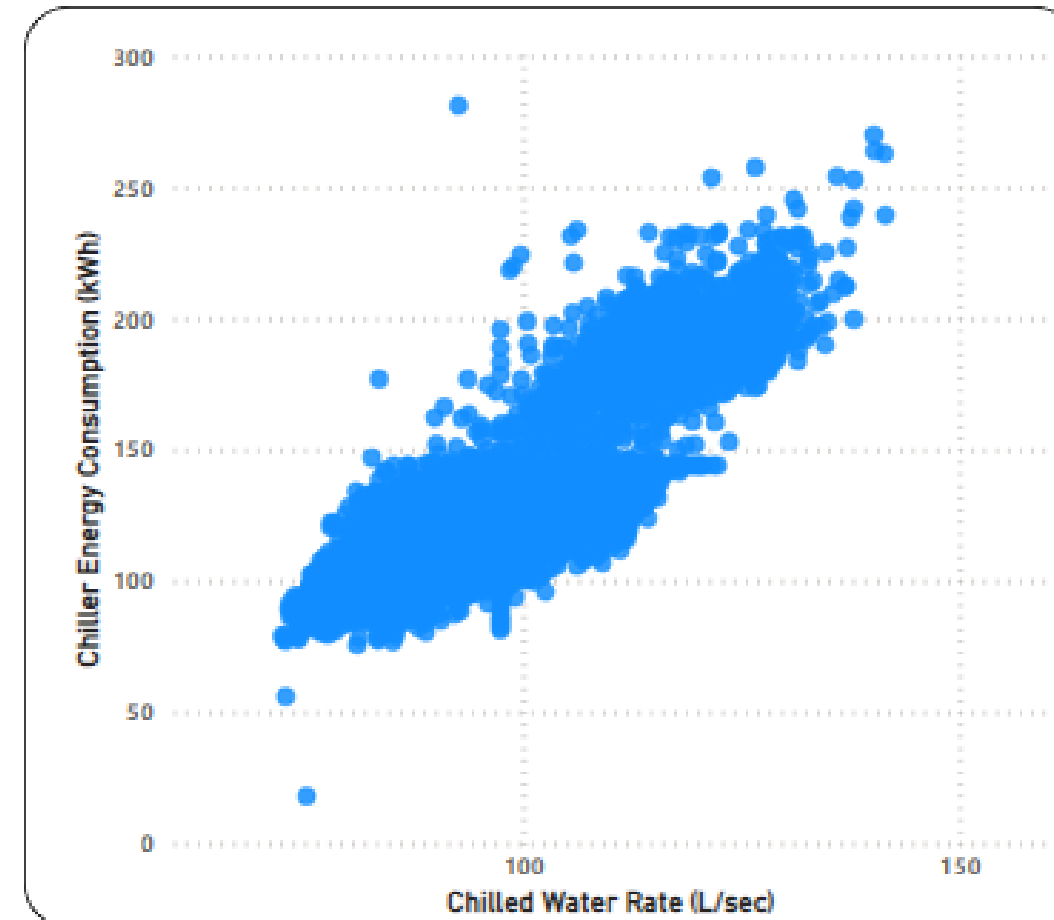


Effect of Building Load, Chilled Water Rate, Cooling Water Temperature on Chiller Energy Consumption.

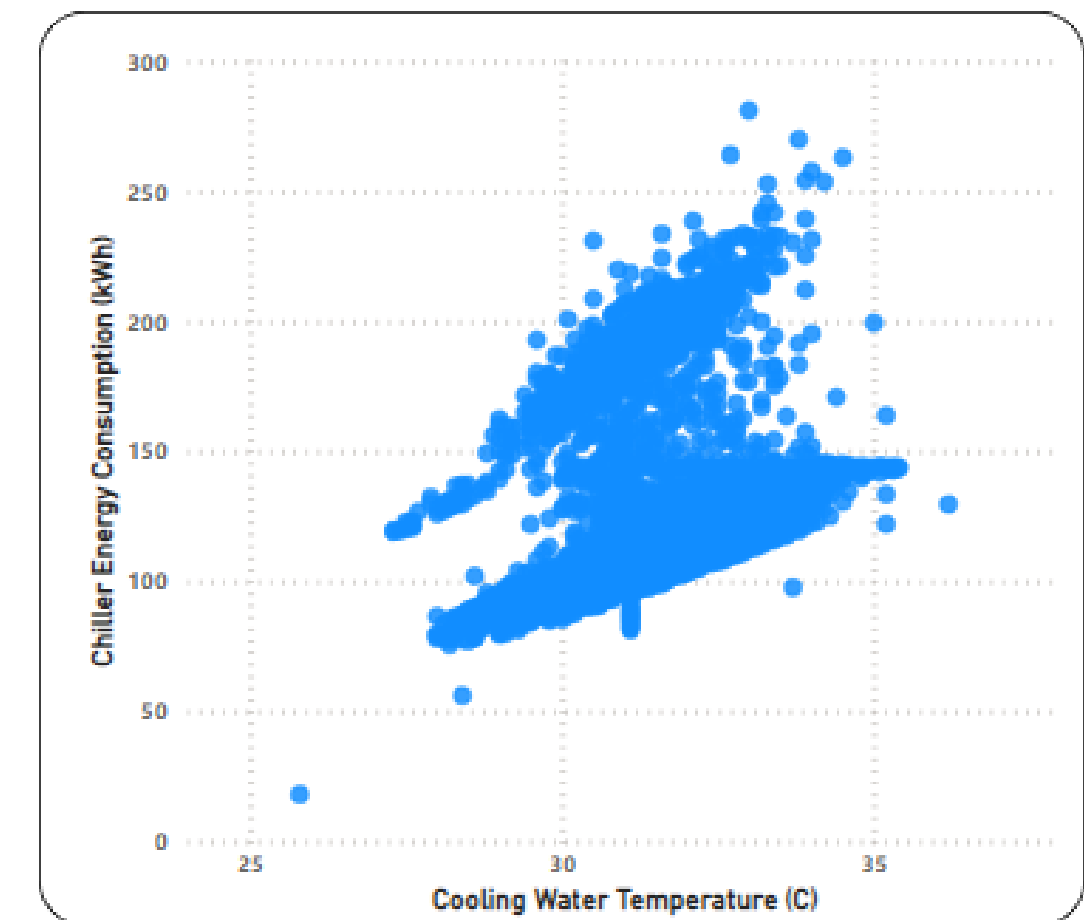
Building Load:



Chilled Water Rate:



Cooling Water Temperature:



Insights:

- In any given day, the average energy consumption, average rate of chilled water, average cooling water temperature, average load on the building starts to increase from 5:00 am and reaches the maximum value at 2:30 pm. From then there is a decline.
- The rise in these factors can be because to maintain indoor comfort of occupants who arrive daily.
- Whereas the energy efficiency metric is decreasing during those peak hours. Thus the system is performing well when the outdoor temperature are high.

Linearity between variables:

Chilled water rate and energy consumption:

- The linear relationship between the two suggest that we need to optimize the chiller water rate. This can be done by installing variable speed drives on pumps

Cooling Water temperature and energy consumption:

- To optimize cooling water temperature we can implement automatic temperature controls, setting the temperature to minimum possible.

Building Load and energy consumption:

- To optimize the building load during peak demand times we can temporarily reduce usage of unnecessary equipment, improving the insulation of the building.