**Executive Summary**

Analysis by Robby Hooker

**Introduction**

This summary is based on analysis done for Trane Technologies, who was hired by the school to in effort to cut energy costs. The data provided is taken from Itron smart meters that measure energy use around campus. There are 95 data points per meter, per day, from October 21, 2020 to March 9, 2022.

**Aim**

The goal of my analysis is to find interesting trends in the data that I can use to make suggestions as to how the university can lower their energy cost.

**Energy use considering age of building**

For the data to be useful when comparing different buildings, I took the provided information, which was in kWh, and converted it to Wh/sqft, this way we can get some sort of grasp on how much energy a building uses without data skewed based on the size of the building. A caveat of this method is that the data did doesn’t include the square footage of the buildings, so I didn’t have this metric for every building. Thanks to my classmate Harley, who reached out to the University Architect, and the Universities website, I was able to obtain the square footage of seven buildings.

Using the entire range of dates, as this should give an accurate assessment of how the building perform, I calculated their total Wh/sqft usage over that time. The below graph shows these values in a bar chart, along with the year the building last received a major renovation.

Chart, bar chart

Description automatically generatedGraphical user interface, text, application

Description automatically generated

At first glance this chart seems inconclusive pertaining to a relationship between the year a building was built and its energy efficiency, however I would argue otherwise. When considering the type of building we can see that newer building are slightly more efficient from old, in the case of these seven. In the case of residential buildings (Weir and Minor) the newer building spent 2804.05 less Wh/sqft than the older. As for academic buildings (CME and Library) the newer spent 1926.61 Wh/sqft less than the older. Although the dining buildings (JC West and Union) have a difference of 12928.02 Wh/sqft, they were renovated only a year apart, so barring an energy conservation technology breakthrough in the year 2015 that I am unaware of, this difference is unrelated to building date. Based off of the dining and academic differences, however, it seems evident that newer buildings are more energy efficient, and although the numbers make look negligible, over many years they will add up and become significant.

The graph also reveals an unexpected anomaly, the Union. Three buildings that would seemingly have similar usage due to their level of dependency on students, and similar hours of business are the Library, Union, and JC West, but the data shows that the Union uses 15621.45 Wh/sqft less than the Library, and the previously mentioned 12928.02 Wh/sqft less than JC West. Clearly the Union is doing something right that the other two are not, and if the school could figure this out, they may save a substantial amount of money.

**Energy use considering time of year**

Much of the energy use at the university depends on the students, so naturally we would expect different energy use when more students are on campus vs off. Looking at our data based on the time of year will help to quantify this assumption. On top of student traffic, the time of year also comes with temperature changes, so this analysis will also help to identify energy use based on weather.

To obtain useful data, we will look at singular building’s energy usage over the course of the year. Keeping the building constant should result in fair data, using kWh per day as data points. To get a grasp on how different building’s usage changes over the year, I examined different types of buildings, the first being a residence hall, Stewart. Below is a line graph of Stewart’s energy usage over the course of a year.

Chart, line chart

Description automatically generated

Notable dates when students are out of classes are May 1st through August 23rd, November 20th to the 28th, and after December 10th. Clearly these dates show an expected drop off in energy uses, as there are far less students on campus using energy. For me the most interesting information from this graph is the difference in energy usage during the two seasons that students were present, spring and fall. The spring had consistently lower energy usage than the fall, which made me think this could have related to air conditioning. The graph below from climate-data.org shows that the weather patterns in fall and spring are very similar in Oxford, so in my comprehension the two shouldn’t have such a large difference in energy usage, as the students are there during both, and the weather is more or less the same. Chart, line chart

Description automatically generated

If the University could figure out why this gap exist, and how to bring fall usage to a similar level as spring, they would save a significant amount of money over time.

Next, I used the same premise while analyzing the energy usage of an administrative building, Martindale. The below line graph shows the energy usage of Martindale Student Services Center over the course of a year.

Chart

Description automatically generated

This graph shows that Martindale, being less dependent on student traffic than Stewart, has a more constant energy usage during the year. Even so the graph is far from a straight line, as it jumps up and down between 600 and 1000 kwh per day most of the year. Upon taking a further look at the data set, it seems these dips into the 700 kwh are somewhat sporadic. My original thought was that weekends would cause them, but weekdays also spent time fluctuating between 1000 and 600. This is actually good for the University, as they should be able to bring everyday usage down if they can understand why certain days have less, considering the building should have the same amount of traffic during all weekdays.

**Conclusion and Final Suggestions**

In conclusion, my data analysis was useful in realizing trends based on time of year, type of building, and building construction dates. It helped me come up with ways the University could save money on their energy bill, especially over a long period of time. My first suggestion to them would be to update the technology in their buildings as much as possible, as the data shows new buildings save more energy than old. My next suggestion would be to try to make the Library, JC West, and other similar building function closer to how the Union does, as the ladder saves far more energy per square foot than the former. I would also suggest the university tries to get residence halls using less energy in the fall, as they should theoretically have similar numbers in the fall and spring, however spring is much more energy efficient. Finally, I would suggest they find out why administrative buildings have significant fluctuation between seemingly random days. If they can find out how to behave as the lower usage days do more consistently, they’ll save large sums of money.