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Data Analytic on Energy Consumption in Universiti Tun Hussein Onn Building Campus

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Abstract This research looks into the energy use of several buildings at Tun Hussein Onn University (UTHM). The main objective is to assess the energy consumption of Faculty Civil Engineering and Built Environment (FKAAB), Faculty of Technology Management and Business Faculty of Technology Management and Business (FPTP), Faculty of Electrical and Electronic Engineering (FKEE), Faculty of Computer Science and Information Technology (FSKTM), Faculty of Technical and Vocational Education (FPTV), and Perpustakaan Tunku Tun Aminah. This impacts UTHM buildings. It's also about figuring out why high of energy usage. This done by analyzing the energy utilization of the UTHM buildings. Energy management is measuring and reducing energy consumption in a building. The next step in analysing energy use at UTHM buildings is to collect data over the last three years. It collect data from, 2018-2020. To analyse the data, it must first calculate the building's size and space. Besides that, the building's level must be considered. After obtaining all necessary data, data analytics will be used to analyze the data. Data analytics is the study of analysing factual data to conclude using Power BI (Business Intelligent) software from Microsoft. This programme provide dynamic visualisations, capabilities through an easy-to-use interface.From the analysis UTHM buildings FKAAB, FPTP, FKEE, FSKTM, FPTV, and Library. Consume more energy due to weather, conditions, building construction, and materials utilised. It may be deduce that the appliances and human behavior cause the UTHM building's excessive energy usage. Next, it may use data analytics to categorize the energy usage of each building and equipment on the building in Universiti Tun Hussein Onn (UTHM) Campus and compare the energy usage of each building.
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Keywords: Energy Consumption, Data analytic, Building

1. Introduction

Energy consumption is not always derived from a single source of energy. It is a common misconception that conserving energy requires conserving electricity. It's possible that a completely different energy source has the greatest effect on a specific process. The cumulative energy generated

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and consumed by humans is referred to as global energy consumption. It includes all energy harnessed from all energy sources applied to operation across all industrial and technological sectors in every region, and is typically calculated per year. It excludes food-derived electricity. The socio-economic-political sphere is affected by global energy consumption. The process of measuring and maximising energy consumption in order to save energy in the building is known as energy management. The method of energy management can be broken down into a few steps which is with continuous data collection. Next, to maximise energy efficiency. Then look for way to boost equipment schedules, fixed point and flow rates.

As we know, building in UTHM Campus is a large building that consists different levels and different area of building. For example, FKAAB building have a lot of laboratory room. FKAAB Building consists 7 floors. Every floors have rooms and for laboratory rooms it consist on ground and first floor only. FPTP building also have a lot of laboratory room and office room.FKEE building different to FPTP and FKAAB Building because FKEE Building only have office or staff rooms. It is almost 200 of staff rooms. All building have different area. The different area of each building can cause energy consumption. Other than that, the quantity room on each building also can cause high of energy consumption. On each building may consists many type of room such as computer laboratory, structure laboratory environmental laboratory and many more.

All buildings have their respective Green Building Index (GBI) ratings. The GBI rating tools helps architects and building owners to design and great green, sustainable buildings that can conserve energy, water, provide a healthy indoor climate. To analyze energy consumption, we use data analytic. Data analytics is critical since it aids organizations in improving their results. Companies can assist cut costs by developing more efficient ways of doing business and storing big amounts of data by incorporating it into their business strategy. Data analytics can also be used to help a company make better business decisions and assess customer patterns and satisfaction, which can lead to the development of new and better products and services. To analyze data analytic, Power BI software is the best software to use.

This software is to provide interactive visualisations and business capabilities with an easy to use interface that allows end users to generate visualize data that have added. We will able to analyse clearly of energy consumption in FKAAB building when use Power BI software.

This study is to investigate the energy consumption in UTHM Campus building. The main objective is to analyse the energy consumption of each building in UTHM Campus. This is involved some building in UTHM Campus such as FKEE, FKAAB, FPTP, FSKTM, FPTV and Library. It is also to find the cause of high energy consumption. This will be accomplished by analyse with data analytic with data analytic on energy consumption at UTHM Campus building.

2. Literature Review

2.1 Energy Consumption

It is important to note that "energy consumption" refers to the overall quantity of energy needed to execute an activity or operation. For example, in a plant, total energy consumption can be calculated based on the quantity of energy consumed throughout each stage of production. A factory that makes vehicle parts, for example, will have water, electricity and gas included in its costs. In order to live in a home, one must consume electricity, gas, water, and any other energy source.

As a percentage of total electrical demand, the use of energy is significant. Almost everyone has no idea how to preserve energy in their day-to-day routines. Instead of saving energy, people waste it by purchasing inefficient electrical appliances. Consumption can be reduced or efficiency can be increased in order to save electricity. Reduce the amount of activities that use electricity in order to save energy.

Improved energy efficiency is achieved by selecting the right equipment that uses less energy to do the same tasks (EE). Domestic consumers in Malaysia consume 20.6% of the country's total electricity, according to a 2013 report by the Energy Commission of the country. Tenaga Nasional Berhad (TNB) reigns supreme in the world of electricity. In Malaysia, TNB serves an estimated 7.8 million customers.

To put it another way, TNB's price for the first 200kWh of monthly usage remained at 21.8 cents/kWh, meaning that around 50.4 percent of all domestic customers spend RM43.00 or less per month.

Building energy consumption should have been anticipated and agreed upon from the start by planners, owners, and contractors/implementers so that material selection, design, and electrical equipment such as lighting, air conditioners, and appliances are more energy efficient. For buildings that were constructed traditionally, an effort should be made to analyse energy consumption through energy audits in order to assess the profile of energy usage and energy savings opportunities in order to improve energy efficiency. This paper discusses how energy consumption is one of the most important factors in determining the cost efficiency of a building's operation.

2.2 Data Analytic

When we say "data analytics," we're talking about the process of examining large volumes of data to draw inferences about the content. By looking for patterns in large amounts of unstructured data, data analysts are able to gain valuable insights.

Analyzing data may be useful in a wide range of endeavours. Good data analytics software will show you where you are, where you have been and what has to be done by integrating all of these elements.

There are four main ways to analyse data, says Kumar.

- An explanation of the past is provided through descriptive analytics.
- In diagnostic analytics, the goal is to discover why something happened.
- Predictive analytics looks ahead to the future and predicts what will most likely happen.
- A prescriptive analytics approach identifies the actions that should be taken in order to improve progress or avoid problems in the future.

After the data has been gathered and organised, data analysts must use the four main types of data analytics to analyse and understand the information. There are many ways to interpret data.

"The analysis lens you employ will define the conclusion," says JadeTrack founder and CEO Ryan Prestel. There are two approaches to data analysis: quantitative and qualitative. The first involves analysing numerical data, including aspects that may be quantified. These factors can be compared and measured through the use of statistics. To gain a deeper understanding of non-numerical data such as text, photographs, audio files, and video clips, qualitative researchers use a more interpretive approach.

2.3 Microsoft Power Bi

The Microsoft company claims that "Power BI is a business analytics solution that enables data visualisation and insight sharing throughout your organisation, or embed them in your app or website." The solution's value and adaptability come from utilising the many components and taking advantage of the way they work together. Using a web browser or Power BI apps for Windows, iOS, and Android, users may access dashboards, reports, and connected dashboards and reports.

A desktop application called "Power BI Desktop" is available in addition to the cloud-based BI (business intelligence) capabilities offered by Power BI. Its data warehouse capabilities include data preparation, data discovery, and interactive dashboards. A new service on Microsoft's Azure cloud platform, Power BI Embedded, was unveiled in March 2016. The option to import custom visualisations is a key distinction for this solution.

3. Methods

Data collecting for building information and energy usage is the first step in the process. Data required on this study is the area of each building in Universiti Tun Hussein Onn (UTHM). The building that involve is Faculty Civil Engineering and Built Environment, Faculty of Technology Management and Business, Faculty of Computer Science and Information Technology, Faculty , Faculty of Electrical and Electronic Engineering,Faculty s of Technical and Vocational Education and Perpustakaan Tunku Tun Aminah.

Next process is identifying the level consists each building and number of office rooms also number of laboratory in UTHM Campus building. Data collection on energy consumption also on occupants behaviour. The next stage is using data analytic method to analyse the energy consumption on the building. Last step is, using Microsoft power BI Software to display the data from year to year and also to compare the usage of energy in a year starting from 2018, 2019 and 2020. The method used in this investigation is presented in Figure 1 as an overview.

Figure 3.1

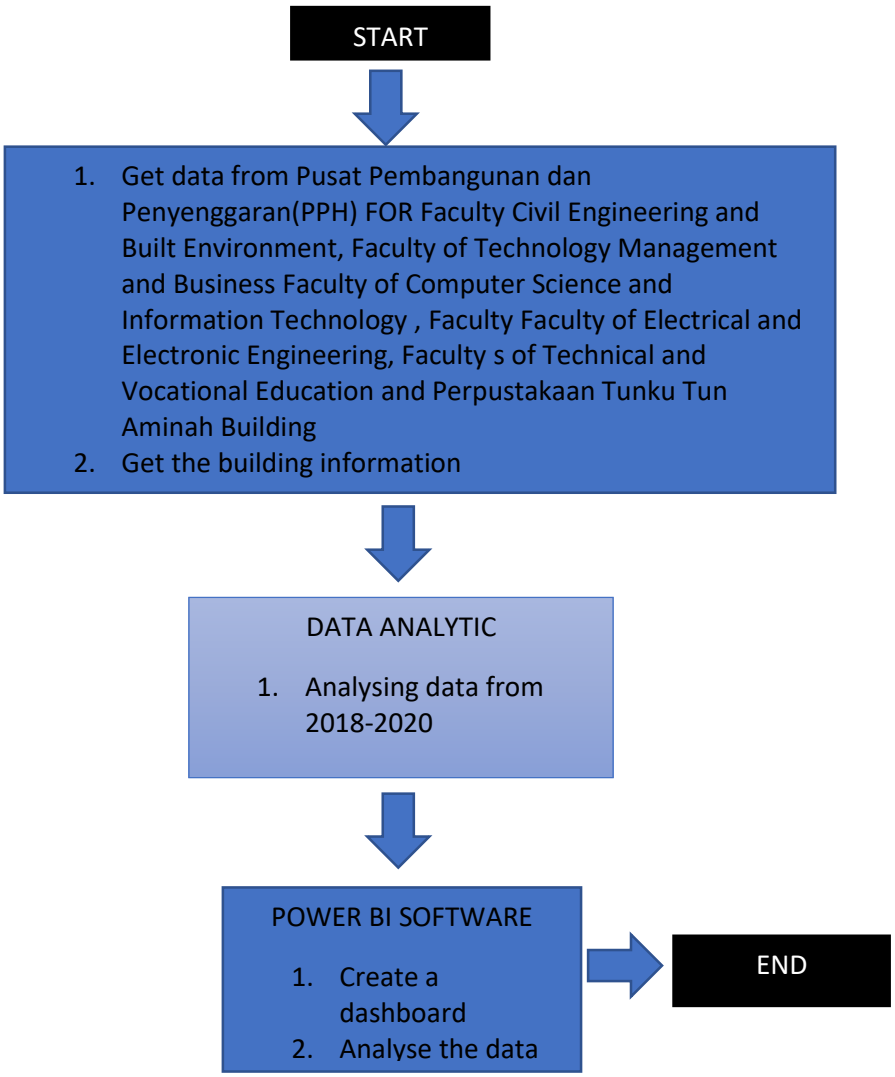

Figure 1: The flow of the study

3.1 Data Collection

In this study, the data for the past three years, 2018, 2019, and 2020, was collected and analysed to determine the energy usage of some building in UTHM. To collect the data of energy consumption, it must also consider area of building, how many floors consists , how many rooms and how many laboratory faculty building in UTHM. The area of the building and the number of rooms and laboratory are the key that contribute a building's overall energy usage. This data we can get from PPH Universiti Tun Hussein Onn. PPH UTHM follow the TNB required for energy consumption. For room or laboratory information we get the plan for each building we get from Mrs. Ima Kharyanti bte Malik from the architect unit (Building).

3.2 Data Analytic

Determine the data which is collect the data about energy consumption in UTHM Campus Building. Every Building and room must consider different result of data because it have different of energy usage. Data analytic can do much more to point out data about energy consumption on UTHM Campus Building. The data that been collected may be separated by months room. This data values will be separated and divided by category.

. This data will insert into the spread sheet by using the software that can take statistical data. The software is called Power Business Intelligent or Power BI. Before insert to Power BI software , this data must cleaned up before analysis. This is because, it must to check to ensure no error or duplication or data not complete.

3.2 Microsoft Power BI software

Import the data to the dashboard. The power BI dashboard were create is to import the data. In power BI desktop dashboard. the Power BI Dashboard will start processing. It is also organizes what was found in the Navigator. Next step is after import data to Power BI dashboard, it can easy to create actual data visualization dashboard elements. The way to do is go to right hand fields panel, and check the desired field. Select all the file and drag into the Power BI Dashboard.

4. Result and Discussion

The results of the study respond to the objective. The objectives of the study will be emphasized. The data analysis divide into several parts which is energy consumption by year on 2018,2019 and 2020. Then, the data separate by month on three year, also by time. The time is on working hour on 0800 to 22:00 and after working hour on 2200-0800 for every month. The obtained data were analyzed using software Microsoft Power Business. This software help to separate the data and can see the difference between the data. All data taken from PPH UTHM was recorded and displayed in visualization. Figure 4.1 , 4.2 and 4.3 shows all the data that have been analyzed. The data were moved to the dashboard Microsoft Power Bi.

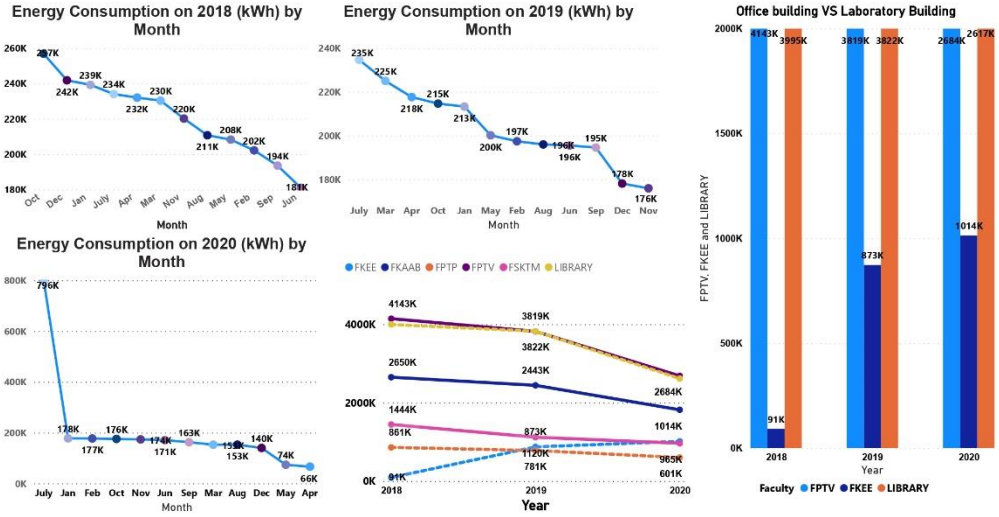

Figure 4.1: Dashboard of Energy Consumption by Month and by year

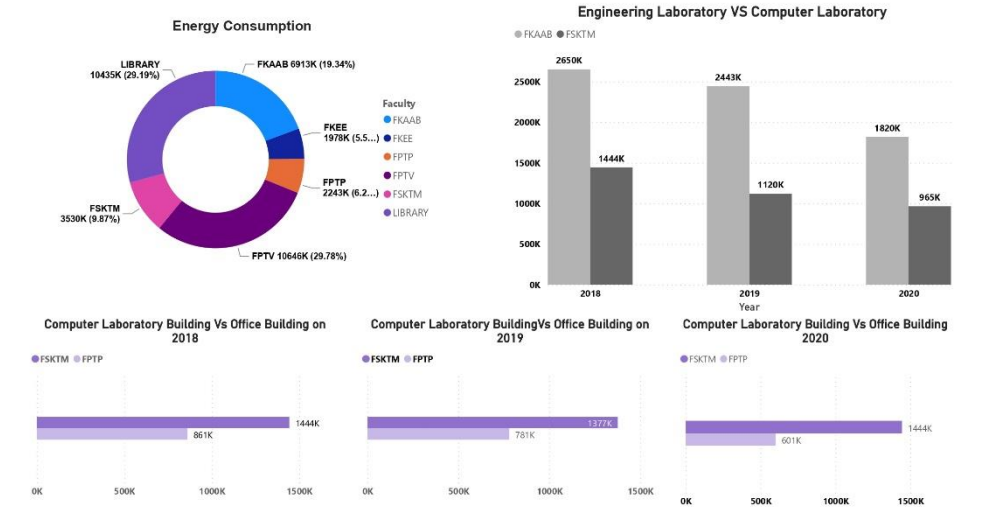

Figure 4.2: Dashboards of Energy consumption Engineering Laboratory VS Computer Laboratory

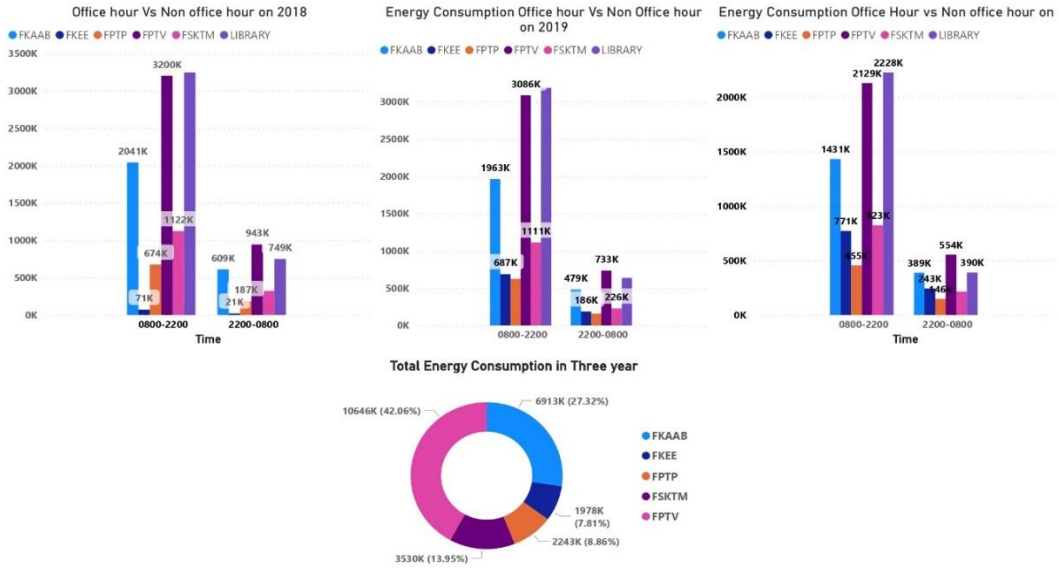

Figure 4.3: Dashboards data analysis of Energy consumption

What we can summaries from the dashboards, the soure of high energy consumption is causes of number of laboratory on each building. For example, Faculty Civil Engineering and Built Environment (FKKAB,) and Faculty s of Technical and Vocational Education (FPTV,) building is the high energy consumption compared to another building. Computer laboratory also consume more energy usage than office building. From figure 4.2, we can see Faculty of Computer Science and Information Technology (FSKTM) compared to Faculty of Technology Management and Business (FPTP), FSKTM use more energy than FPTP.

4.1 The area of the building

The table below summarises the area of each building on the University Tun Hussein Onn Malaysia (UTHM) campus. As can be seen, the library is quite vast compared to other structures, measuring 56189.45 m2. However, the FKAAB building's area is restricted to 42057.50 m2. The building with a small space is FSKTM, FKEE, and FPTP, measuring 11435.68 m2, 13954.26 m2, and 14489.04 m2, respectively.

Table 2: Area of each building in Universiti Tun Hussein Onn

Faculty	Area (m^2)
Faculty Civil Engineering and Built Environment	42057.5
Faculty of Computer Science and Information Technology	14489.04
Faculty of Technology Management and Business	13854.26
Faculty s of Technical and Vocational Education	11435.68
Perpustakaan Tunku Tun Aminah	56189.45

Each building's Universiti Tun Hussein Onn Malaysia energy consumption is shown in the graph in Figure 4.1. We can see that the Perpustakaan Tunku Tun Aminah energy usage is 104350 kWh, higher than any other building. This is because the Library's area is more extensive and has more open space. Because libraries typically have a lot of space, they almost the more usage of air conditioning. As a bonus, the rooms are available 24 hours a day. The second highest energy consumption is in FPTV Building. 10646 kWh is the amount of energy. This building also has a big area, and it is 26426 m2. The cause of high has a significant building area, so in the laboratory, the equipment is frequently used. For FKEE and FPTP Building, these two buildings are less energy consumption, and it is 197 800 kWh and 224 300 kWh, respectively. So the less area of the building, the less energy consumption. Based on the results, high energy consumption is because of the size of the building. The Library is an extensive building area, so on that building more of energy usage.

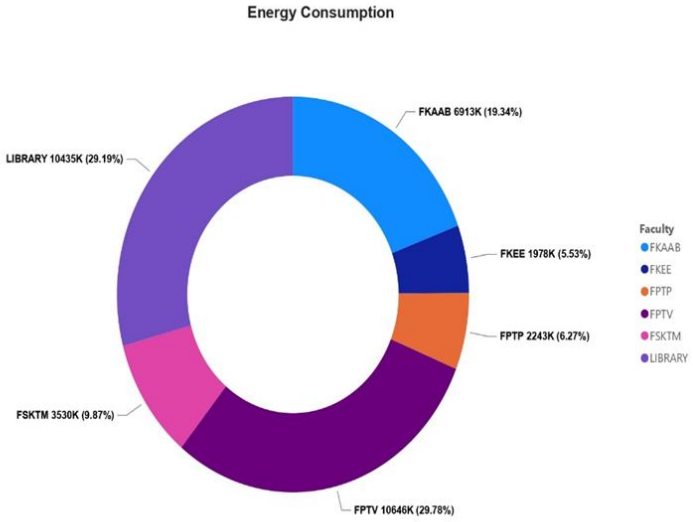

Figure 4.1 Total Energy Consumption in 3 year

4.2 Energy Consumption on Office Building and Laboratory Building

As we know, UTHM Campus has different types of building: Office Building and Office with Laboratory. From figure 4.3, there is energy consumption on FKEE, FPTV, FPTP, FKAAB, FSKTM, And Library. Building. FKEE, FPTP, and Library building only has an office or staff room. In comparison, FPTV and FKAAB room has many engineering laboratories and an office room. For FSKTM, this building have a lot of computer Laboratory. From figure 4.3, total energy consumption from FKEE, FPTP, FKAAB, FSKTM, FPTV and Library building for 2018, 2019, and 2020. We can see energy consumption on FKEE and FPTP lowest than other building. On the other hand, according to data from PPH, UTHM energy usage from FKEE and FPTP building in 2018 is 91249 kWh and 861 000 kWh most down than other building. Same with the other two years 2019 and 2020, FKEE and FPTP building energy usage is the lowest than FPTV, FKAAB and FSKTM building.

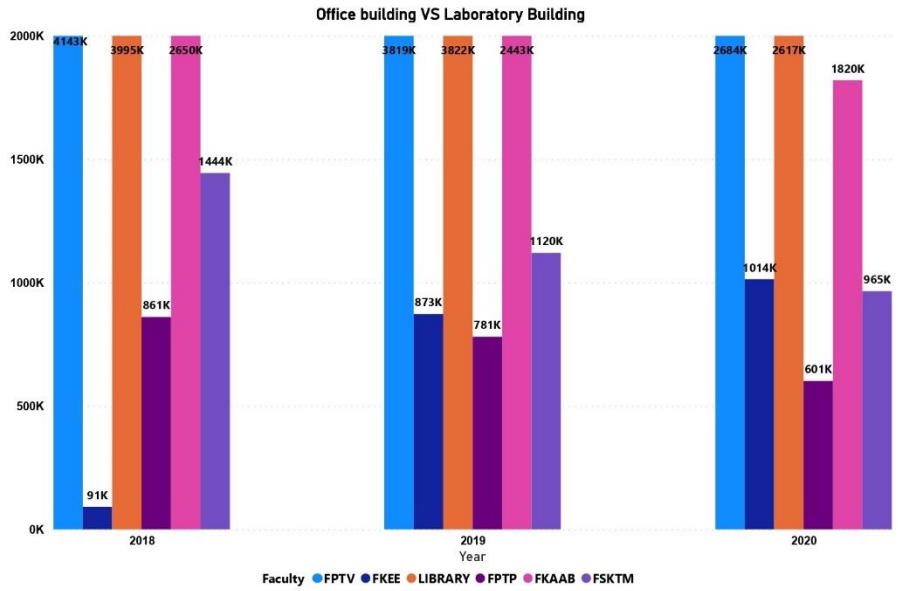

Figure 4.2 Energy Consumption on Office Building (FKEE) and (Library) VS Laboratory Building (FPTV)

As we can see, the difference in electricity consumption of laboratory building with office building is very different. On 2019 FPTV building hit almost 3818841 kWh of elcctricity usage. Thus, buildings that have laboratory consume more electricity usage. Laboratories are energy hogs, requiring up to ten times more energy per square metre than office buildings. The high ventilation rates and related air conditioning loads are the primary cause of excessive energy consumption in laboratory buildings. The ventilation rates are usually required to maintain safety and containment levels, as well as to comply with the applicable authority's and risk management recommendations.

Heating, ventilation, and air conditioning or we call HVAC systems account for the majority of the energy consumption in many lab facilities. Lab building ventilation rates are very high, often up to 12 Air Changes per Hour, since a safe research lab setting requires clean air (ACH).

4.4 Energy Consumption on Computer Laboratory and Engineering Laboratory

Engineering and Computer laboratory is a different type of laboratory. Example engineering laboratory is Geotechnical Laboratory, Structure Laboratory, and Environmental Laboratory is available at Faculty Civil Engineering and Built Environment (FKAAB) Building. As we know, Faculty of Computer Science and Information Technology (FKSTM) is faculty of Science and Technology, and this building is more for computer usage. Figure 4.4 shows the amount of energy used on the FKAAB Building as Engineering Laboratory and FSKTM as Computer Laboratory.

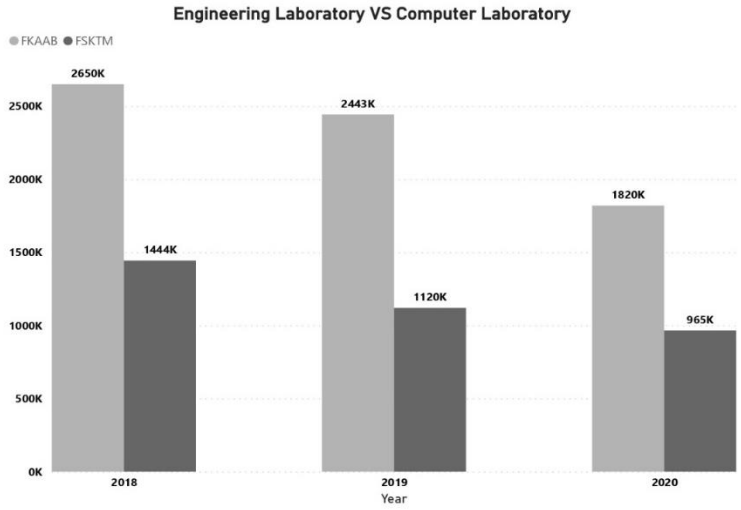

Figure 4.4 Energy Consumption on FKAAB Building and FSKTM Building

As we can see in figure 4.4, FKAAB Building has recorded the highest energy consumption than FSKTM Building in three years. The energy consumption on FKAAB Building is 6931069 kWh more than FSKTM Building 3529522 kWh in three years. Therefore the equipment in the laboratory causes a lot of energy consumption. Other than that, experimental work involving materials testing or electronics is more instrumental than practical. As a result, there are high-connected power demands with a range of electrically powered equipment, resulting in relatively high air conditioning loads and process water cooling requirements. What we conclude, engineering laboratory building is more energy usage than computer laboratory building.

5. Conclusion

We discover that the increased energy consumption in certain buildings on the University Tun Hussein Onn Malaysia (UTHM) Campus is due to a variety of factors, including the weather, the building's condition, the building's construction, and the physical material used. As we can see on FKAAB Building and FSKTM Building, energy on FKAAB Building is high than FSKTM Building. The primary cause of high energy consumption in laboratory buildings is the high ventilation rates and accompanying air conditioning loads. Typically, ventilation rates are required to ensure safety and containment levels while also meeting the relevant authority and risk management criteria. A major obstacle to attaining energy efficiency in buildings is the inconsistency of occupant behaviour. Building occupants can have a significant impact on energy consumption in a variety of ways.

Based on the data analysis, energy consumption on the particular building is by buildings size. As we can see, Perpustakaan Tunku Tun Aminah (Library) is the most higher energy usage. This is because Perpustakaan Tunku Tun Aminah (Library) have 56189.45 m2 area of the building. This building also has spacious are that use more air-conditioning. Because of service and the building sector, demand for air conditioning is increasing. Furthermore, the hot weather creates a large use of the air conditioner, providing the client with a comfortable living. Because the library has 24-hour rooms for students, the air conditioning is on all the time. This can result in excessive energy use in the Library. The source of energy consumption is by area of building, equipment in laboratory and occupants behaviors. In order for individuals to realise the need of saving energy, they must adjust their everyday habits so that they are more likely to do so. This is due to the fact that everyone will be more inclined to save energy now that they are aware of the benefits.

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