E3S Web of Conferences **433**, 03004 (2023) https://doi.org/10.1051/e3sconf/202343303004
REEE 2023

Evaluation of Factors that Influence Electrical Energy Consumption in Higher Educational Institutions – Preparatory for Energy Management System

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Abstract. The Philippines' need for electricity has dramatically expanded over the last decade due to the country's growing economy, population, and significantly subsidized energy rates. Eventually, especially in schools, integrating green technology may be a way to solve the rising need for electrical energy. But the acceptance rate of such technology is low due to the expensive set-up costs, climate irregularities, and insufficient awareness of the customers and trained professionals. But before utilizing green technology, an energy audit should be conducted as it is the first step in reducing energy consumption at the facility level and assuring a level of efficiency that is acceptable. University campus is a representation of diverse buildings with diverse and substantial energy consumption thus providing an excellent testbed to identify the characteristics of the energy consumption of mixed-use buildings. This study was conducted to five universities aimed to evaluate the varied factors that influence electrical energy consumption through estimation of the effects of changes in the consumption of this higher educational institutions (HEI) in terms of their profiles using regression and correlation as a statistical tool. The result will provide preparation for energy management system that can properly identify energy conservation measures.

1 Introduction

The energy and electricity demand in the Philippines have increased drastically over the last decade, driven by the increasing economic activity, population growth, and heavily subsidized energy prices. Philippines is now implementing new policies that encourage adoption of the green technology incorporated to the generation of electricity. But, in spite of the large potential for renewable energy, the acceptance rate of such technology is low due to the expensive set-up costs, climate irregularities, and insufficient awareness of the costumers and trained professionals.

All schools are using large amounts of electricity to ensure that all facilities are safe, comfortable, secure, and conducive to learning for students. This leads to the high consumption of electricity and high electricity bills. But this consumption is not only acquainted with the useful consumption but also with the electrical losses due to the inefficient electrical system.

The integration of green technology may be a solution to address the increasing demand of electrical energy in a long-term goal, especially in schools. Hence, new structures should be designed and constructed in such a manner that there will be insignificant demand for electrical energy. And the existing structures should be retrofitted to reduce energy consumption [1]. But before engaging to the green technology, a means to conserve energy, there should be an execution of energy audit, particularly in electricity, which is the primary step towards improving energy consumption at the facility level and ensuring a degree of acceptable efficiency.

The first step in energy conservation is to execute a systematic audit and assessment in the energy consumption especially of the varied factors that influence the consumption. The energy audit of the electrical system may be obtained from the electrical energy equation in integral form and the time integration extended over a specified period (days, months, or years). The evaluation may allow accounting for all energy present and the varied factors in the electrical system showing that the energy balance is maintained at the specified time. This balanced system can be used to generate the different performance indicators to assess the electrical system from different perspectives and, thus, identify the improvement actions that will make the electrical system more efficient. This will give the management the audit results it needs to make strategies, decisions, and policies for energy conservation measures.

2 Profiles and Objectives

An efficient school facility should be in phase with the multi-faceted programs of education delivery to provide a physical environment that is well illuminated, well ventilated, and aesthetically pleasing. The school facility contains the variety of building systems (other than the

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physical structure, athletic fields, playgrounds, outdoor learnings, and vehicular access) such as plumbing, mechanical, electrical, telecommunications, fire suppressant, and security systems. Thus, a school building is an integral part in the formal education of the students. It is designed and constructed in a manner that will enhance the potential of every student and boost the teaching-learning process [2].

The increase of private and public educational institutions in the Philippines is a great indicator that Filipinos value education, but it also increases the energy demand. Most universities have numerous buildings to cater for instructions and these buildings use high energy consumption for lighting, ventilation, laboratory equipment, and the like. Recognizing the development in the education system, different methods and policies should be conducted parallel with building sustainability. And one way to address building sustainability is to evaluate the factors that influence electrical energy consumption as part of the management of efficient electrical energy systems.

University campus is a representation of diverse buildings with diverse and substantial energy consumption. And for the purpose of assessing an energy management audit, the university campuses provided an excellent testbed to identify the characteristics and comprehend the energy consumption of mixed-use buildings [3].

The management of energy-efficient measures is increasingly being incorporated into the entire building construction process as a measure of its economic efficiency. The energy conservation measures will be implemented with the goal of reducing electrical energy costs and losses because doing so will demand significant investments. This investment carries a significant amount of risk, and the quicker repayment, the lower the risk of implementing the steps. [4].

The gathered data in this study were analysed and interpreted using analytical reasoning that determined certain patterns, relationships, and trends among variables. The profiles of the higher educational institutions (HEIs) were the number of occupancies (students and personnel), operating hours, types, and number of building structures, building age, and the average energy consumption of each HEI per month. The operating hours were presented with emphasis on the number of weeks to complete one semester, the month covering each semester, the hour of operation per day, the total contact hours per lecture and laboratory course, and the total manhours stressing how many hours were spent by the students and the personnel per semester. The types of buildings showing the number of building structures per building type and the building age were considered so it can easily compare the numbers and frequencies of the building according to its year of operation. The average energy consumption per month was presented to show information that changes over time.

Thus, the study aimed to evaluate the varied factors that influence electrical energy consumption through estimation of the effects of changes in the consumption of the HEI in terms of their profile using regression as a statistical tool. Also, the study intended to evaluate the correlation between the energy consumption of the HEIs and the profiles of the respondents using the Pairwise Spearman Correlations Results and Discussions.

2.1. Number of Occupancy and Electrical Energy Consumption

Table 1 presents the combined number of occupancies in the five universities, and are classified as students and personnel, and the total number of electrical energy consumed from Academic Year (AY) 2016-2017 to 2020-2021. These ranges of AY were considered in the study when normal delivery of instructions and operation (pre-pandemic) in the HEI were being practiced. One semester covers eighteen weeks while one summer term covers six weeks.

Table 1. Total number of occupancy and energy consumption

Academic Year	Semester	Occupancy		Energy Consumption (kWhr)
		Students	***Personnel***	
2016 - 2017	1st	10159	552	100560.00
2016 - 2017	2nd	9665	536	224619.20
2016 - 2017	Summer	3403	352	209793.20
2016 - 2017	Summer (Transition)	2167	298	348537.26
2017 - 2018	1st	7680	443	496903.71
2017 - 2018	2nd	7382	427	390318.59
2017 - 2018	Summer	1950	284	171796.90
2018 - 2019	1st	8070	484	553795.01
2018 - 2019	2nd	10122	699	569375.34
2018 - 2019	Summer	2217	498	355109.03
2019 - 2020	1st	11002	736	2124727.32
2019 - 2020	2nd	10953	826	1920663.90
2019 - 2020	Mid	1990	441	545049.02
2020 - 2021	1st	22528	1525	6383076.66

2.2 Student and Energy Consumption Regression and Correlation Analysis

Equation (1) states that the coefficient for the predictor (student) is 247.9. The average energy consumption of the overall HEIs increases by approximately 247.9 for every 1 unit increase in students. The sign of the coefficient is positive, which indicates that as student increases, energy consumption also increases. The regression equation is:

$$\text{Energy consumption (kWhr)} = -906692 + 247.9\ \text{Student} \qquad (1)$$

In the model summary shown, the results show that the students explain 68.88% of the variation in energy consumption. The R-sq value indicates that the model fits the data well.

Table 2. Model summary for students

Model Summary		
S	R-sq	R-sq (adj)
964307	68.88%	66.29%

The analysis of variance table shows the results that the p-value for student is 0.000, which is less than the significance level of 0.05. These results indicate that

https://doi.org/10.1051/e3sconf/202343303004

the association between student and energy consumption is statistically significant.

Table 3. Analysis of variance for students

Analysis of Variance					
Source	DF	SS	MS	F	P
Regression	1	2.46976E+13	2.46976E+13	26.56	0.000
Error	12	1.11587E+13	9.29889E+11		
Total	13	3.58562E+13			

The fitted line plot for number of students and energy consumption shows the same regression results graphically. The red fitted line graphically shows the same information. If you move left or right along the x-axis by an amount that represents a student change in number, the fitted line rises or falls by 247.9 kilowatt-hr.

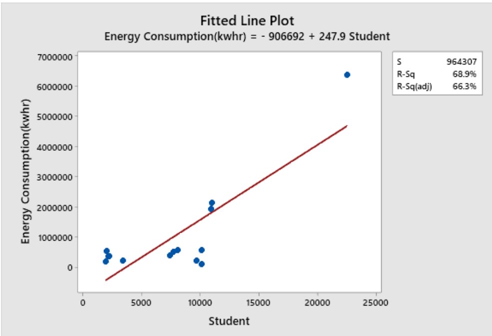

Fig. 1. Fitted line plot for students and energy consumption

Table 4 shows the correlation between student and energy consumption. The Spearman correlation between energy consumption (kWhr) and student is 0.574 which indicates the strong positive relationship between the variables. This means, as the number of student increases, energy consumption increases as well. The p-value between energy consumption (kWhr) and student is 0.032. Since the p-value is less than the significance level of 0.05, there is conclusive evidence about the significance of the association between the variables or the results indicating the association between student and energy consumption is statistically significant.

Table 4. Correlation between student and energy consumption

Pairwise Spearman Correlations			
Sample 1	Sample 2	Correlation	P-value
Student	Energy consumption (kWhr)	0.574	0.032

2.3 Personnel and Energy Consumption Regression and Correlation Analysis

Equation (2) states that 4978 is the coefficient for the predictor (personnel). The average energy consumption of the overall HEI increases by approximately 4978 for every 1 unit increase in personnel. And this is supported by the sign of the coefficient being positive which indicates that as personnel increases, energy consumption also increases. The regression equation is:

Energy consumption (kWhr) = -1852116 + 4978 Student (2)

In the model summary shown the results that the personnel explain 89.23% of the variation in the energy consumption. The R-sq value signifies that the model fits the data well.

Table 5. Model summary for personnel

Model Summary		
S	R-sq	R-sq (adj)
567206	89.23%	88.34%

In the analysis of variance table shows the results that the p-value for personnel is 0.000 and this is less than the significance level of 0.05. The results justify the association between personnel and energy consumption is statistically significant.

Table 6. Analysis of variance for personnel

Analysis of Variance					
Source	DF	SS	MS	F	P
Regression	1	3.19955E+13	3.19955E+13	99.45	0.000
Error	12	3.86068E+13	3.21723E+11		
Total	13	3.58562E+13			

The fitted line plot for number of personnel and energy consumption shows the same regression results graphically. Figure 2 provides the same information. The fitted line, whether it is moved left or right, presents the rise and fall by 4978 kilowatt-hours if the x-axis is altered by an amount that corresponds to a change in employee number.

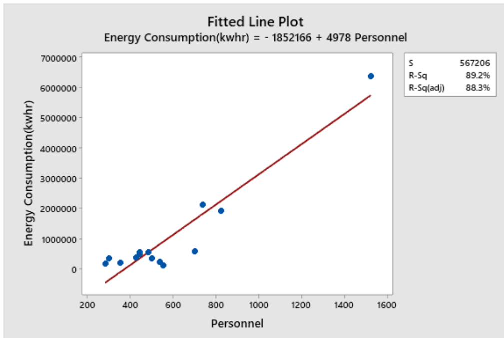

Fig. 2. Fitted line plot for personnel and energy consumption

Table 7 shows the correlation between personnel and energy consumption which is 0.648. The value justifies the strong positive relationship between the variables. Therefore, as the number of personnel increases, energy consumption increases. The p-value between energy consumption (kWhr) and personnel is 0.012, which is less than 0.05 significance level. There is conclusive evidence about the significance of the association between the variables or the results indicate that the association between personnel and energy consumption is statistically significant.

Table 7. Correlation between personnel and energy consumption

Pairwise Spearman Correlations			
Sample 1	Sample 2	Correlation	P-value
Personnel	Energy consumption (kWhr)	0.648	0.012

2.4 Total Occupants and Energy Consumption Regression and Correlation Analysis

Equation (3) shows that a unit increase in number of students is associated with a 76.4 unit decrease in energy consumption holding personnel constant. Each additional increase in personnel associated with a 6217 unit increase in energy consumption, holding number of students constant. The regression equation is:

$$\textit{Energy consumption (kWhr)} = -1973417 - 76.4\ \textit{Student} + 6217\ \textit{Personnel} \quad (3)$$

The model summary shows the results that both students and personnel explain 88.46% of the variation in the energy consumption. The R-sq value validates that the model fits the data well.

Table 8. Model summary for the total occupants

Model Summary			
S	R-sq	R-sq (adj)	R-sq (pred)
564162	90.24%	88.46%	68.16%

Table 9 shows that the p-value for both students and personnel is 0.000 and this is less than the significance level of 0.05. These results indicate that the association between both students and personnel and energy consumption is statistically significant. These findings suggest that there is a statistically significant correlation between energy consumption and the total occupants. The model estimated that at least one coefficient is different from zero.

Table 9. Analysis of variance for the total occupants

Analysis of Variance					
Source	DF	SS	MS	F	P
Regression	2	3.23552E+13	1.61776E+13	50.83	0.000
Student	1	3.59611E+11	3.59611E+11	1.13	0.311
Personnel	1	7.65760E+12	7.65760E+12	24.06	0.000
Error	11	3.50107E+12	3.18279E+11		
Total	13	3.58562E+13			

2.5 Operating Hours

Table 10 shows the operating hours of the higher educational institutions. These consist of the total students' manhours and personnel's manhours per semester of each academic year. On the average, each student would stay a total of 40 hours per week and the personnel 50 hours per week on the average in the campus.

Table 10. Student and personnel manhours

Academic Year	Semester	Occupancy		Energy Consumption (kWh)
		Students' Total Manhours	Personnel Total Manhours	
2016 - 2017	1st	7314480.00	496800.00	100560.00
2016 - 2017	2nd	6958800.00	482400.00	224619.20
2016 - 2017	Summer	816720.00	105600.00	209793.20
2016 - 2017	Summer (Transition)	520080.00	89400.00	348537.26
2017 - 2018	1st	5529600.00	398700.00	496903.71
2017 - 2018	2nd	4700800.00	383700.00	390318.59
2017 - 2018	Summer	460704.00	85100.00	171796.90
2018 - 2019	1st	5090384.00	435000.00	553795.01
2018 - 2019	2nd	6450144.00	628875.00	569375.34
2018 - 2019	Summer	432528.00	149400.00	355109.03
2019 - 2020	1st	6521784.00	661950.00	2124727.32
2019 - 2020	2nd	5538528.00	743400.00	1920663.90
2019 - 2020	Mid	998496.00	132150.00	545049.02
2020 - 2021	1st	12976128.00	1372500.00	6383076.66

2.6 Student Manhours and Energy Consumption Regression and Correlation Analysis

Equations (4) state that the coefficient for the predictor, student manhours, is 0.3265. For every additional unit of student manhour, the typical university's energy usage rises by around 0.3265. The claim is supported by the sign of the coefficient being positive. Thus, an increase in student manhour will lead to energy consumption increase. The regression equation is:

$$\textit{Energy consumption (kWhr)} = -471397 + 0.3265\ \textit{Student's total manhours} \quad (4)$$

In the model summary shown the results that the students manhours explain 50.72% of the variation in the energy consumption indicated by the R-sq value

Table 11. Model summary for student's manhours

Model Summary		
S	R-sq	R-sq (adj)
1213518	50.72%	46.61%

Table 12 shows 0.004 as the result of the p-value for student manhours and this is less than the significance level of 0.05. The value validates the association between student manhours and energy consumption being statistically significant.

Table 12. Analysis of variance for student's manhours

Analysis of Variance					
Source	DF	SS	MS	F	P
Regression	1	1.81847E+13	3.19955E+13	99.45	0.004
Error	12	1.76715E+13	3.21723E+11		
Total	13	3.58562E+13			

The fitted line plot for number of students' manhours and energy consumption shows the same regression results graphically. A movement to the left or right will result to the fitted line rise or fall by 0.3265 kWhr.

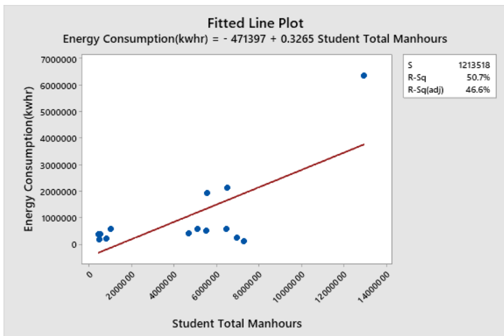

Fig. 3. Fitted line plot for student total manhours and energy consumption

Table 13 shows the Spearman correlation between student manhours and energy consumption being 0.389. Therefore, as the number of students manhours increase, energy consumption increases as indicated by the positive relationship between the student manhours and consumption. The p-value between energy consumption (kWhr) and student manhours is 0.169 which is greater than the significance level of 0.05. Thus, there is inconclusive evidence about the significant association between the variables. This can also mean that the association between student manhours and energy consumption is not statistically significant.

Table 13. Correlation between student's manhours and energy consumption

Pairwise Spearman Correlations			
Sample 1	Sample 2	Correlation	P-value
Students' total manhours	Energy consumption (kWhr)	0.389	0.169

2.7 Personnel Manhours and Energy Consumption Regression and Correlation Analysis

Equation (5) presents the value 4.106 as the result of the personnel manhours as the coefficient of predictor. This suggests that every increase in personnel manhours will lead to 4.106 increase in energy consumption of the universities. The regression equation is:

Energy consumption (kWhr) = -779896 + 4.106 Student's total manhours (5)

The model summary in Table 14 shows the results that the personnel explain 75.06% of the variation in the energy consumption and this indicates that the model fits the data well.

Table 14. Model summary for personnel manhour

Model Summary		
S	R-sq	R-sq (adj)
863304	75.06 %	72.98 %

Table 15 shows the p-value for personnel manhours is 0.000. This value, being less than the 0.05 significance level, indicates the statistical significance of the association between personnel manhours and the university's energy consumption.

Table 15. Analysis of variance for personnel manhour

Analysis of Variance					
Source	DF	SS	MS	F	P
Regression	1	2.69127E+13	2.69127E+13	36.11	0.000
Error	12	8.94352E+13	7.45293E+11		
Total	13	3.58562E+13			

The fitted line plot for number of personnel's manhours and energy consumption shows the same regression results graphically. A movement along the x-axis to the left or right will result to a rise or fall in energy consumption by 4.106 kWh.

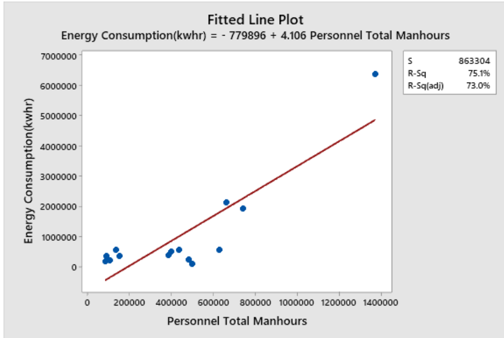

Fig. 4. Fitted line plot for personnel total manhours and energy consumption

Table 16 shows the correlation between personnel manhours and energy consumption. The Spearman correlation value, 0.670, indicates the very strong positive relationship between the variables. The p-value between energy consumption (kWhr) and personnel manhours is 0.009 which is less than the 0.05 significance level. Thus, there is conclusive evidence about the significant association between the personnel manhours and energy consumption.

Table 16. Correlation between personnel manhour and energy consumption

Pairwise Spearman Correlations			
Sample 1	Sample 2	Correlation	P-value
Personnel's total manhours	Energy consumption (kWhr)	0.670	0.009

2.8 Occupants' Manhours and Energy Consumption Regression and Correlation Analysis

Equation (6) shows that one unit increase in number of students manhours is associated with a 0.434 unit decrease in energy consumption holding personnel manhours constant. Each additional increase in personnel manhours is associated with an 8.33 unit increase in energy consumption, holding the number of students manhours constant. The regression equation is:

Energy consumption (kWhr) = -649606 + 8.33 Personnel's total manhours – 0.434 Student's total manhours (6)

The model summary shows the results that the students' manhours and personnel manhours explain 84.98% of the variation in the energy consumption. The R-sq value shows that the model successfully fits the data.

Table 17. Model summary for occupants' manhour

Model Summary			
S	R-sq	R-sq (adj)	R-sq (pred)
699826	84.98 %	82.24 %	49.12 %

Table 18 shows 0.000 as the result of the analysis of variance for both student manhours and personnel manhours and the total energy consumption of the universities. This being less than the significance level of 0.000, the association between the samples is statistically significant. Thus, the model estimated my regression indicates that at least one of the three coefficients is different from zero.

Table 18. Analysis of variance for occupants' manhour

Analysis of Variance					
Source	DF	SS	MS	F	P
Regression	2	3.04689E+13	1.52344E+13	31.11	0.000
Personnel's Total manhours	1	1.22842E+11	1.22842E+11	25.08	0.000
Students' total manhours	1	3.55620E+12	3.55620E+12	7.26	0.021
Error	11	5.38732E+12	4.89756E+11		
Total	13	3.58562E+13			

2.9 Type of Buildings and Grand Power Regression and Correlation Analysis

Equation (7) shows that one unit increase in academic building is associated with a 0.00 unit increase in grand power, holding all other types of building constant. Each additional increase in administrative building associated with a 13908 unit decrease in grand power, holding all other types of building constant. Each additional increase in assembly building is associated with a 19075 unit decrease in grand power, holding all other types of building constant. Each additional increase in business building is associated with an 89817 unit increase in grand power, holding all other types of building constant. Each additional increase in residential building is associated with a 6055 unit increase in grand power, holding all other types of building constant. Each additional increase in building serving other purposes building is associated with a 34422 unit decrease in grand power, holding all other type of building constant. The regression equation is:

Grand power (W) = 38242 + 0.0 Academic Building – 13908 Administrative Building – 19075 Assembly Building + 89817 Business Building + 6055 Residential Building – 34422 Serving other purpose (7)

The model summary shows the results that the type of building explains 21.68% of the variation in the grand power. The R-sq number shows how well the model matches the data.

Table 19. Model summary for types of buildings

Model Summary			
S	R-sq	R-sq (adj)	R-sq (pred)
31718.4	21.68 %	17.92 %	0.00 %

In the analysis of variance table presented in Table 20, it shows the results of the p-value for type of the building is 0.000. The result, being less than the significance level of 0.05, indicates that the association type of building and grand power is statistically significant. Likewise, the model estimated by the regression procedure is significant at the level of 0.05 and this indicates that at least one coefficient is different from zero.

Table 20. Analysis of variance for types of buildings

Analysis of Variance					
Source	DF	SS	MS	F	P
Regression	5	28966293489	5793258698	5.76	0.000
Building type	5	28966293489	5793258698	5.76	0.000
Error	104	1.04630E+11	1006054279		
Total	109	1.33596E+11			

Table 21 shows the correlation between the number of buildings and the grand power. The Spearman correlation result is 0.943 and this indicates the strong positive relationship between the variables. As the number of buildings increases, the energy consumption of the universities increases. There is also conclusive evidence on the significance of the association between the two.

Table 21. Correlation between types of buildings and grand power

Pairwise Spearman Correlations			
Sample 1	Sample 2	Correlation	P-value
Grand power (W)	Number of buildings	0.943	0.005

2.10 Gross Floor Area and Grand Power Regression and Correlation Analysis

Equation (8) states that the coefficient for the gross floor area (predictor) is 19.75. For every additional unit of gross floor area, the university's average grand power grows by about 19.75. The coefficient has a positive sign, which means that as gross floor area increases, so does grand power. The regression equation is:

Grand power (W) = 6781 + 19.75 gross floor area (m^2) (8)

The model summary shows the results that the gross floor area explains 50.68% of the variation in the grand power. The R-sq value shows that the model successfully fits the data.

Table 22. Model summary for gross floor area

Model Summary		
S	R-sq	R-sq (adj)
24699.3	50.68 %	50.23 %

The p-value for gross floor space is 0.000, which is less than the significance level of 0.05, as shown in the analysis of variance table. These findings suggest that there is a statistically significant correlation between gross floor space and grand power.

Table 23. Analysis of variance for gross floor area

Analysis of Variance					
Source	DF	SS	MS	F	P
Regression	1	6.77101E+10	6.77101E+10	110.99	0.000
Error	108	6.58859E+10	6.10054E+08		
Total	109	1.33596E+11			

The fitted line plot for the gross floor area and grand power shows the same regression results graphically. The same information is represented graphically by the red fitted line. The fitted line rises or falls by 19.75 watts if you move left or right along the x-axis by an amount that corresponds to a change in gross floor area.

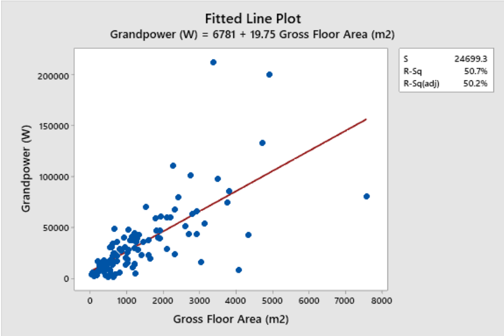

Fig. 5. Fitted line plot for gross floor area and grand power

Table 24 shows the correlation between the gross floor area and grand power. The grand power (W) and gross floor space Spearman correlation in these results is 0.793, indicating a very significant positive relation between the variables. Therefore, as the gross floor area increases, the grand power increases. The p-value between grand power (W) and gross floor area is 0.000. The results show that the correlation between gross floor area and grand power is statistically significant since the p-value is less than the significance level of 0.05. There is clear evidence concerning the relevance of the association between the variables.

Table 24. Correlation between the gross floor area and grand power

Pairwise Spearman Correlations			
Sample 1	Sample 2	Correlation	P-value
Gross floor area (sq.m.)	Grand power (W)	0.793	0.000

2.11 Building Age and Energy Consumption Regression and Correlation Analysis

Equation (9) demonstrates that the coefficient for the building age predictor in these results is 666.2. Every 1 unit rise in building age results in a loss of roughly 666.2 grand power in the university as a whole. The coefficient's sign is negative, indicating a decline in grand power with increasing building age. The regression equation is:

Grand power (W) = -48604 – 666.2 Age (years) *(9)*

In the model summary shown the results that the building age explain 5.78% of the variation in the grand power. The R-sq value shows that the model does not adequately fit the data.

Table 25. Model summary for building age and energy consumption

Model Summary		
S	R-sq	R-sq (adj)
34139.0	5.78 %	4.91 %

The p-value for building age is 0.011, which is less than the significance level of 0.05, as seen in the analysis of variance table. These findings show that there is statistically significant correlation between building age and grand power.

Table 26. Analysis of variance for building age and energy consumption

Analysis of Variance					
Source	DF	SS	MS	F	P
Regression	1	7.72467E+09	7724671764	6.63	0.011
Error	108	1.25871E+11	1165474692		
Total	109	1.33596E+11			

The same regression results are graphically displayed in the fitted line plot for the number of building ages and the grand power. The same information is represented graphically by the red fitted line. The fitted line rises or decreases by 666.2 watts depending on whether the movement is made left or right along the x-axis by an amount that corresponds to the building's age change in number.

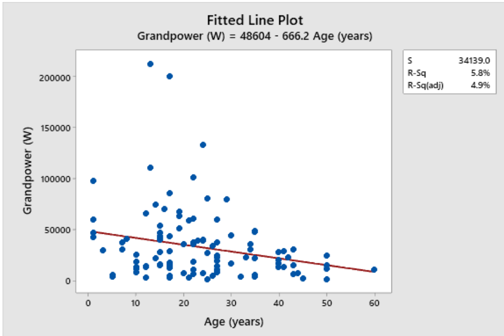

Fig. 6. Fitted line plot for building age and grand power

Table 27 shows the correlation between the building age and grand power. The grand power (kW) and building age Spearman correlation in these results is -0.223, indicating that there is only a marginally negative association between the variables. Therefore, as the building age increases, energy consumption decreases. The p-value between grand power (kW) and building age area is 0.019. The results show that the association between building age and grand power is statistically significant since the p-value is less than the significance level of 0.05, or there is clear evidence about the relevance of the association between the variables.

Table 27. Correlation between building age and grand power

Pairwise Spearman Correlations			
Sample 1	Sample 2	Correlation	P-value
Age (years)	Grand power (W)	-0.223	0.019

3 Conclusion

If the electrical energy conservation measures can be inculcated in the existing system of operation, the behavioural patterns of the occupants will be influenced towards conservation and saving of electrical energy. And these energy conservation measures can be designed through an electrical energy audit and integration of electrical energy management system in the institution. Thus, assessing the variables affecting electrical energy usage is the first step toward the management system.

The significant effect in the electrical energy consumption in terms of the profiles of the HEI are measured through regression analysis. This statistical tool provided a better comprehension on how much energy consumption will be increased per unit increase of the predictor. An additional student leading to additional student manhours can lead to a certain increase in consumption. The same behaviour will happen for every additional personnel and gross floor area.

There are different factors that are associated with electrical energy consumption. Correlation analysis was conducted to assess the relation between the consumption and the profile of the institutions. Among these different factors, students have a very strong positive relationship with energy consumption, there is conclusive evidence, and the two are statistically significant.

The author wishes to acknowledge all his colleagues, co-workers, friends, and family members.

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