

Conference Paper

Occupants Conservation Attitudes on Energy Consumption: The Case in Isabela State University in Cabagan, Isabela

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Abstract

Heating and cooling electrical fixtures accounted to two thirds of a building's total energy consumption. Energy consumption is the number one contributor to global warming. The Isabela State University in Cabagan, Isabela has an internal policy on energy conservation, hence this study focused mainly on the practices and attitudes of occupants on energy conservation implementation in the campus. It has been observed that there is an increasing trend in the annual energy consumption of the buildings from 2012 to 2015. The occupants of the buildings were surveyed on their responses on how they implement, observe and practice the policy on energy consumption and conservation of the university. The study revealed that the number of occupants, building design and area and the number of electrical fixtures are the major factors that influenced the energy consumption of the buildings. This study further evaluated the influence of the number of occupants on the energy consumption of the buildings in relation to their conservation attitudes on energy consumption. Occupants of the buildings are aware of the campus policy on energy conservation. This study revealed that their attitudes and practices on energy conservation is influence by their perception on the indoor environment quality of the building specifically on indoor temperature.

Keywords: occupants' conservation practices and attitudes on energy consumption

1. Introduction

Buildings are the biggest source of emissions and energy consumption. Buildings are responsible for more than 40 percent of global energy use and one third of global greenhouse gas emissions, both in developed and developing countries.

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Indoor temperature and humidity are important to public health. Environmental conditions inside the buildings have the potential to make people sick and cause them discomfort and inhibit their ability to perform. Moderately high temperatures and humidity in buildings may cause discomfort and perceived as poor indoor quality. This may result to unsolicited occupants complaints, reduce productivity and may also cause other health problems. The ability of buildings to mitigate the heat and moisture, effects of climatological conditions on indoors, particularly for susceptible populations, is therefore a concern.

Studies have revealed that determinants and factors that influence the energy consumption of buildings includes the number of occupants and the fixtures and equipment used for cooling and ventilation to improve the indoor temperature inside the buildings.

Occupants inside the buildings have significant role in the energy consumption of the buildings. Their attitude towards the energy consumption is an important factor to consider in the evaluation of building energy consumption.

The Isabela State University is an institution which serves a population of students, faculty and personnel which require in maintaining and growing their own facilities. The growing population in the university will need additional buildings to support the various activity of the university in terms of instruction, research, extension, production and administration. The very main objective of the university to offer quality education would necessitate buildings that will provide quality environment both on the outdoor and indoor. Equipment for cooling and ventilation is imperative to provide good indoor temperature inside the buildings. The increasing trend on the building energy consumption in the campus resulted in coming up with a policy on energy conservation in order to control and lessen the amount for the increasing building energy consumption.

2. Significance of the Study

The result of this study will provide researchers data on how occupants of the buildings will influence the energy consumption. Awareness, and compliance of the occupants on the campus policy on energy conservation are the variables that were considered. The result of this study may be utilized as a source and basis for the improvement and creation of a better policy for energy conservation.

3. Objectives of the Study

This study evaluated specifically, the awareness and compliance of the occupants of the buildings in the implementation on energy conservation policy of the campus. It aims to determine the energy consumption of the buildings and the most conservative occupants among the five academic buildings that were evaluated in the study. It seeks to determine the relationship of the energy consumption and the occupants' awareness and compliance to the energy conservation policy of the campus.

4. Methodology

Primary data on the awareness and compliance to the implementation on energy conservation policy of the campus were sourced out from the respondents who were the occupants of the buildings from the five academic buildings.

Secondary data on energy consumption of the buildings were sourced out from Isabela Electric Cooperative (ISELCO) II, Ilagan, Isabela. Other secondary data on the number of occupants from each buildings were sourced out from ISU Registrar and, Personnel Office.

4.1. Research design

This study made use of descriptive and inferential statistics which was conducted in five academic buildings in Isabela State University, Garita, Cabagan, Isabela. Occupants' evaluation was done with the aid of a questionnaire. The Five Point Likert Scale was used to determine their responses. The collected data were compiled, processed and analyzed both in qualitative and quantitative ways. The Statistical Package for the Social Science (SPSS) version 20 Software was used to analyze the social components of the study. Frequency, percentage, weighted mean and rank were used on the responses of the occupants. Analysis of variance was used to determine the significant difference in the energy consumption of each building. Chi-square was used to test the relationship of occupants' compliance to the campus policy on energy conservation. Table 1 & 2 below shows the Five Point Likert Scale on respondents' awareness on campus policy on energy conservation and implementation.

TABLE 1: Five point Likert Scale on Awareness of the Occupants on Campus Policy on Energy Conservation and Implementation.

Scale	Intervals	Descriptive Rating	Qualitative Description
5	4.20-5.00	Fully Aware	Possesses proficiency and knowledge on the issue
4	3.40-4.19	Aware	Can adequately understand the issue
3	2.60-3.39	Neither Aware or Not Aware	Can understand some aspects of the issue
2	1.80-2.59	Not Aware	Can understand the issue only with the guidance of the experts
1	1.00-1.79	Fully Not Aware	Can hardly understand the issue even with guidance from the expert Never observe and implement the policy

TABLE 2: Five point Likert Scale on Compliance of the Occupants on Campus Policy on Energy Conservation.

Scale	Intervals	Descriptive Rating	Qualitative Description
5	4.20-5.00	Full Compliant	Strictly Observe and implement the Policy
4	3.40-4.19	Compliant	Adequately Observe and implement the policy
3	2.60-3.39	Neither Compliant or Not Compliant	Sometimes observe and implement the policy
2	1.80-2.59	Not Compliant	Hardly observe and implement the policy
1	1.00-1.79	Fully Not Compliant	Never observe and implement the policy

5. Results and Discussion

The study site of the Isabela State University in Garita campus, Cabagan, Isabela is situated at 17°24'45" latitude and 121°49'15" longitude and with a total area of 254 hectares. The campus is about five (5) kilometers away from the poblacion of Cabagan, Isabela. A total of five (5) buildings were included, specifically big academic buildings were evaluated

namely College of Teachers Education (CTE) Building, College of Forestry and Environmental Management (CFEM) Building, College of Development Communication and Arts and Sciences (CDCAS) Building, Department of Social Sciences (DSS) Building and Provincial Technical Institute of Agriculture (PTIA) Building and one(1) office building which is the administration building. The map of Cabagan, Isabela is shown in Figure 1 below indicating the location of Isabela State University.



Figure 1: Map of Cabagan Isabela showing the location of ISU Cabagan.

5.1. Respondents of the study

The respondents of the study were the occupants of the buildings composed of faculty, students and staff. A total of one-hundred-seven (107) respondents were evaluated wherein 29% (31) were composed of faculty and staff while 71% (76) were composed of students. The respondents were composed of 47%(50) males and 53%(57) female. Table 3 below shows the distribution of respondents per building and gender.

5.2. Annual energy consumption of the buildings from 2012 to 2015

As can be gleaned on Table 4, there is an increasing trend in the energy consumption of the five(5) academic buildings for the past four years starting from 2012 to 2015. For the four year period, the increase in the annual energy consumption in kw/hr is about 75%.

Table 5 is the result on the Analysis of variance on the significant difference of the energy consumption of each building from 2012 to 2015. As can be seen in table 3a, the average difference in the energy consumption of the paired buildings increases annually. In the analysis of variance, it revealed that there is a significant difference in the energy consumption of all the buildings annually which started from year 2012 to 2015. From year 2012 to 2015, most buildings have significant difference at 0.05 level except for PTIA building to DSS building wherein no significant difference were observed. However, the differences were caused by increase and decrease of the number of occupants and the number of electrical fixtures on cooling and ventilation installed in the buildings. Table 6 shows the multiple comparisons on the energy consumption of the buildings from 2012 to 2015. As can be observed on the table, it clearly indicates

TABLE 3: Distribution of respondents per building and gender.

Occupants of the Buildings	Gender	Name of Buildings					TOTAL	Percentage (%)	
		CTE	CFEM	CDCAS	DSS	PTIA			
FACULTY/ Staff	Male	2	3	2	2	3	12	39%	29%
	Female	7	4	3	3	2	19	61%	
	Total	9	7	5	5	5	31	100	
STUDENTS	Male	8	4	3	10	13	38	50%	71%
	Female	14	3	6	5	10	38	50%	
	Total	22	7	9	15	23	76	100	
TOTAL	Male	10	7	5	12	16	50	47%	100
	Female	21	7	9	8	12	57	53%	
	Total	31	14	14	20	28	107	100	
	%	29	13	13	19	26	100		

TABLE 4: Annual Energy Consumption of the Buildings in 2012 to 2015.

ANNUAL ENERGY CONSUMPTION FROM 2012 TO 2015 (KW/HR)				
MONTH	2012	2013	2014	2015
January	1807	1968	1748	2061
February	2912	3398	3194	2430
March	3512	4348	4511	4925
April	2021	3301	2893	2524
May	3392	3535	3239	3596
June	3506	4333	5771	7106
July	6884	6194	8078	8414
August	4976	4696	7847	8857
September	6564	6545	7120	8895
October	4748	5510	5999	5093
November	3223	4210	4187	4567
December	2933	2235	4180	3845
TOTAL	46478	50273	58767	62313

that there is significant differences on the change in the annual energy consumption of each building.

TABLE 5: Analysis of Variance on the Energy Consumption of the Buildings per Year for four year period 2012 to 2015.

	SV	Df	Sum of Squares	Average Square	F	Sig.
2012	Year	5	43,154,169.74	8630834	38.157**	0
	Error	66	14,928,671.58	226192		
	Total	71	58,082,841.32			
2013	Year	5	28,017,602.94	5603521	24.031**	0
	Error	66	15,389,781.67	233178.5		
	Total	71	43,407,384.61			
2014	Year	5	35,888,972.61	7177795	22.351**	0
	Error	66	21,195,616.50	321145.7		
	Total	71	57,084,589.11			
2015	Year	5	44,179,933.24	8835987	20.218**	0
	Error	66	28,845,049.08	437046.2		
	Total	71	73,024,982.32			

**Significant at 0.05 level

5.3. 2015 Energy consumption of the buildings per occupant

Table 7 below shows the 2015 annual energy consumption of each building. As can be observed in the table, it shows that per occupant from the DSS building has the lowest energy consumption per capita (per occupant) with 1.16kw/hr while the occupants from the CDCAS building has the highest with 5.63 kw/hr. The CTE building with the highest energy consumption among the five buildings has only 3.14 kw/hr per occupant.

5.4. Occupants awareness on the campus policy on energy conservation

Based on the result regarding awareness on the campus policy on energy conservation of the occupants of the building shows that most of the occupants are aware of the policy. The occupants from the CTE building being the most informed and aware of

TABLE 6: Multiple Comparisons on the Energy Consumption of Buildings from 2012 to 2015.

Energy Consumption of Buildings from 2012 to 2015									
(I) building	(J) building	2012		2013		2014		2015	
		Average Difference (I-J)	Sig.	Average Difference (I-J)	Sig.	Average Difference (I-J)	Sig.	Average Difference (I-J)	Sig.
CTE	PTIA	1198.750*	0	802.583*	0	889.083*	0	1165.833*	0
	DSS	1009.167*	0	922.500*	0	1130.833*	0	1576.417*	0
	CFEM	1511.500*	0	1407.917*	0	1564.333*	0	2102.083*	0
	DEVCOM	1713.667*	0	1526.333*	0	1825.167*	0	2275.000*	0
PTIA	DSS	-189.583	0.332	119.917	0.545	241.75	0.3	410.583	0.133
	CFEM	312.75	0.112	605.333*	0.003	675.250*	0.005	936.250*	0.001
	DEVCOM	514.917*	0.01	723.750*	0	936.083*	0	1109.167*	0
DSS	CFEM	502.333*	0.012	485.417*	0.016	433.5	0.065	525.667	0.056
	DEVCOM	704.500*	0.001	603.833*	0.003	694.333*	0.004	698.583*	0.012
CFEM	DEVCOM	202.167	0.302	118.417	0.55	260.833	0.264	172.917	0.524

*. The average difference is significant at the 0.05 level.

the policy rank 1st with a mean of 4.48 and occupants from the CDCAS building with a mean of 4.21 being the lowest. Based from the result on the compliance survey as to observation and implementation of the policy, the CTE is the highest with a mean of 4.38 and the 4.05 being the lowest from the occupants from the DSS building. The result is shown on Table 8.

5.5. Occupants compliance on energy conservation policy

Based from the result on compliance survey as to observation and implementation of the policy, the CTE is the highest with a mean of 4.38 and the 4.05 being the lowest from the occupants from the DSS building this is shown in Table 9.

TABLE 7: 2015 Energy Consumption per Occupant.

Month	2015 Energy Consumption of Buildings per month (kw/hr)					
	CDCAS	CFEM	DSS	PTIA	CTE	TOTAL
January	316	198	484	442	847	2,287
February	371	220	481	495	1,137	2,704
March	761	414	886	1,310	2,205	5,576
April	565	162	384	566	1,393	3,070
May	444	182	513	777	2,109	4,025
June	974	501	1,087	1,545	3,709	7,816
July	760	564	1,335	2,088	4,031	8,778
August	985	602	1,391	2,280	4,200	9,458
September	1,222	560	1,498	2,105	4,301	9,686
October	948	473	1,175	1,448	1,783	5,827
November	743	248	714	1,295	2,195	5,195
December	544	200	684	1,208	1,639	4,275
Annual Total Energy Consumption	8,633	4,324	10,632	15,559	29,549	68,697
Estimated Annual number of Occupants	1,534	2,938	9,195	8,560	9,406	31,633
Energy Consumption per occupant	5.63	1.47	1.16	1.82	3.14	2.17

TABLE 8: Occupants Awareness on Campus Policy on Energy Conservation.

Occupants from the Building	Mean	Qualitative Description	Rank
CDCAS	4.21	Fully Aware	5
CFEM	4.43	Fully Aware	2
CTE	4.48	Fully Aware	1
DSS	4.3	Fully Aware	4
PTIA	4.32	Fully Aware	3
Total	4.35	Fully Aware	

TABLE 9: Occupants’ Compliance on the Policy on Energy Conservation Policy of the Campus.

Occupants from the Building	Statements				Descriptive Quality	Rank
	1	2	3	Mean		
CDCAS	4.14	4.43	4.21	4.26	Full Compliant	3
CFEM	4.36	4.57	4.14	4.36	Full Compliant	2
CTE	4.42	4.61	4.10	4.38	Full Compliant	1
DSS	4.25	4.50	3.40	4.05	Compliant	5
PTIA	4.25	4.32	4.11	4.23	Full Compliant	4

5.6. Relationship of building energy consumption to occupants behavior on energy consumption

The questions being verified was the compliance and degree of the occupants on energy consumption policy. Specifically the occupants were asked to rate their compliance as reflected in Table 1 on Likert Scale.

Table 10 below shows the distribution of occupants’ frequency of response to their implementation of the policy. The buildings were grouped to the annual level of energy consumption to Very high (20,000 kw/hr/year and above), Average (below 20,000 to 10,000 kw/hr/yr) and low (Below 10,000 kw/hr/yr) consumer of energy.9

TABLE 10: Distribution of Occupants’ Compliance and Buildings Level of Energy Consumption.

Buildings’ Level of Energy Consumption	Frequency of Response as to the Compliance to the Policy on Energy Conservation								
	Strongly Agree	%	Agree	%	Neither Agree or Dis-Agree	%	Disagree	%	Total
Very High (20,000 kw-hr/year and above)	15	41%	11	24%	3	25%	2	20%	31
Average (Below 20,000 to 10,000 kw-hr/year)	13	35%	24	52%	5	42%	6	60%	48
Low (Below 10,000 kw-hr/ year)	11	30%	11	24%	4	33%	2	20%	28
TOTAL	39	100	46	100%	12	100	10	100%	107

Based on the result and analysis of the survey, two independent variables were tested using Chi-Square as shown in Table 10. The analysis was undertaken to see which can be accepted based on the following hypothesis:

H₀: The Occupants compliance and implementation of the policy on energy consumption of the buildings has no effect on the energy consumption of the buildings

H₁: The Occupants compliance and implementation of the policy on energy consumption of the buildings has significant effect on the energy consumption of the buildings

It was statistically tested at alpha level of 0.05 at the degree of freedom of 12 which is 21.026 and at alpha level of 0.010 which is 26.217. As shown in Table 11, the computed result was 32.764 which is greater than 21.026 and 26.217 and since the computed value is greater therefore there is enough evidence to conclude that the occupants' compliance and implementation of the policy on energy consumption of the buildings has significant effect on the energy consumption of the buildings

This clearly indicates that occupants' attitude and compliance to the energy consumption policy and building energy consumption has relationship.

TABLE 11: Chi-Square tests between two independent variables.

	Occupants Compliance on Campus Policy on Energy Conservation—Energy Consumption of buildings
Computed Value	32.76
Chi-Square Test	21.026
	26.217
$\alpha = 0.050, df = 12; 21.026$	
$\alpha = 0.010, df = 12; 26.217$	

6. Conclusion and Recommendation

The result from the computation of per occupant on the annual energy consumption, revealed that occupants from the DSS building has the lowest energy consumption per capita (per occupant) with 1.16kw/hr while the occupants from the CDCAS building has the highest with 5.63 kw/hr. The CTE building with the highest energy consumption among the five buildings has only 3.14 kw/hr per capita (occupant).

The result of this study revealed that most of the occupants were aware of the campus policy on building energy conservation. The occupants of the buildings mostly

observe and implement the campus policy on energy consumption. The occupants from the CTE building ranked 1st as being the most informed and aware of the policy with a mean of 4.48 and occupants from the CDCAS building with a mean of 4.21 being the lowest. This justified the computation on the energy consumption of 5.43kw/hr per occupant from the CDCAS building as being computed with the highest building energy consumption per occupant.

Based from the result on compliance survey as to observation and implementation of the policy, the CTE is the highest with a mean of 4.38 and the 4.05 being the lowest from the occupants from the DSS building. It can be noted that CTE Building is the highest building energy consumer among the five buildings but it only has 3.14kw/hr of energy consumption per occupant. This indicates that the occupants from the CTE building properly observe the policy on energy consumption.

The findings of this study point out that the attitude and compliance to the building energy conservation policy by the occupants has significant influence on the energy consumption. It was statistically tested at alpha level of 0.05 at the degree of freedom of 12 which is 21.026 and at alpha level of 0.010 which is 26.217. The computed result was 32.764 which is greater than 21.026 and 26.217 and since the computed value is greater therefore there is enough evidence to conclude that the occupants' compliance and implementation of the policy on energy consumption of the buildings has significant effect on the energy consumption of the buildings. This clearly indicates that occupants' attitude and compliance to the energy consumption policy and building energy consumption has relationship.

The researcher further recommends to conduct follow up research to this study to include the succeeding years in the energy consumption of the buildings. It is also recommended to determine if there is difference between genders (male or female), age distribution on their attitude and behaviour on the energy consumption of the buildings.

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