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Assessment of Energy Culture at a University and a Paper Mill for Energy Saving Opportunities

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Abstract

This work was intended to examine the existing energy culture in a university and in a paper mill of Bangladesh. 75 participants from a public university and 50 participants from a paper mill were surveyed to collect data using a three-segment questionnaire on energy consumption, conservation behavior, and general technical aspects. Responses were analyzed based on gender, age, and education to identify the artifacts that affect and impact the energy use pattern of two organizations. The possibilities of energy conservation through change in organizational norms like attitude, energy management strategy, material culture, and energy practices were assessed for both the commercial and industrial institutions. Key findings showed that the impacts of socio-demographic and psychological factors are found influential on the daily energy saving attitudes. The study also finds that energy conservation behaviors and tendency of reporting on energy wastages among the employees were influenced by the gender, age, and education of the respondents for both the university and the paper mill. For the university case, the analyses of the several statements reveal that women participants hold more positive attitude for saving energy than men. Expressions from the respondents of the university and industry on moral obligation for sensible energy consumption, habitual facts and efficacy are often influenced by education, age, and work experiences. This work suggests for the potential energy saving opportunities by changing behaviors through awareness and material culture through knowledge.

Keywords: Energy Use Pattern; Gender; Age; Education; Attitude; Management Strategy; Material Culture.

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1. Introduction

Continuous energy supply is considered as the backbone for the economic growth and sustainable development of a nation. Developing country like Bangladesh is facing the challenge to meet up the increasing energy demand for the rapidly growing economy. It is due to price hikes of energy and depletion of conventional sources are occurring all around the world [1]. The growth in energy demand around the world was met 70% from fossil fuels such as oil, coal, natural gas etc. in 2017. The global demand for oil, coal, and natural gas has increased by 1.6%, 1%, and 3.7% respectively since 2010. Global energy-related CO_2 emissions grew by 1.7% in 2018 since 2013. In 2018, energy consumption worldwide grew nearly twice the average rate of growth since 2010 [2]. The energy consumption will increase in the world by 33% from 2010 to 2030 [3, 4]. This indicates that the existing energy crisis prevailing in the developing countries will get more intensified in the near future if appropriate counter measures are not being initiated. Along with uncertainty of the future power supply by conventional sources, the consumption of excessive fossil fuel is threatening the environmental safety. Irreversible prices are being paid by degradation of climate change, global warming, which are not only causing the extinction of endangered species but also putting the fate of human race on the brink [5]. To meet up the present demand and considering the future rapid rise in energy consumption, Bangladesh government has set goals to ensure electricity for all by 2021. hence electricity generation is projected to be 38600MWe by 2030 and 60000MWe by 2041. To fulfill this expectation, government is mainly focusing on the conventional energy sources i.e. gas, coal, nuclear [6]. To realize the country's energy vision, the government requires a mammoth investment in this sector. Beside this, with increasing energy consumption, it is required to build more power stations. It will create constraints on natural resources. However, managing energy in a smart and efficient ways is more cost effective than generating energy. It has already been identified that a huge amount of energy waste occurs in the residential, commercial, and industrial sectors [6]. Behavioral changes to reduce the energy wastages caused by ignorance and irresponsible energy consumption will decrease the necessity of building more power stations. Educating the mass population is important to overcome the barriers to adopt energy conservation in daily life. To create mass awareness, it is required to study the behavioral pattern of consumers. For successful behavioral shift toward energy conservation, it is also required to study the psychological facts for successful implementation of behavioral corrective measures. In this study, we considered awareness, attitude, efficacy, and habit for assessing the existing energy culture in a university and in a paper mill. Energy conservation trends of the organizations were analyzed in respect to each target psychological factor. Based on the psychological factors, scopes for energy conservation possibilities were identified. Energy efficiency and conservation potential in residential sector is estimated at 36%, which can be achieved by replacing energy efficient home appliances [6]. Moreover, there are ample chances to save energy in residential sector by behavioral corrective measures. According to a theoretical study conducted in residential building with few behavioral corrective measures suggested that there are potential opportunities to save around 4683 GWh of electricity [7]. In industrial sector, annually 13.5 GWh of energy is wasted in the textile and garments factories due to use of old machineries, inefficient lightings, boilers etc. In chemical fertilizer industries and steel making re-rolling mills, wastages of energy are 5 GWh and 1.8GWh respectively [6, 8]. These huge amounts of energy waste occur because of behavioral conundrum and inert mindset in adopting proper technologies. The conservation of energy is possible with behavioral changes while ensuring sensible energy consumption and use

of energy efficient technology. An important observation was made that a few behavioral correctional measures as a part of the energy culture development among the mass population can be effective. This results in improvement of the demand side management strategy to reduce the waste of energy [9]. Public awareness on rational use of energy, switching the choices related to material culture etc. at home or at the workplace can immensely reduce the upcoming energy demand. Study based on behavior change theory has assumed that the intention of energy consumption is related to habit [12]. Maintaining electronic equipment's related habits in commercial buildings like school, university, offices, medical buildings, can save substantial amount of electricity. Researchers conclude that less than 50% of the equipment's are turned off, and less than 10% of desktop computers enter low power mode, while 53% successfully initiate power management in monitors. It indicates that there are opportunities not only for energy management but also for behavioral change in services buildings. [10-11]. The use of behavior change wheel in order for evaluating the possibility of energy saving behavioral interventions revealed that the energy saving in the workplaces is dependent on both individual and collective actions of the employees and engagement of the management [13-14]. Real time feedback technology can also encourage and promote awareness on energy conservation [17]. In the case study of Oyelaran, an energy audit was done in a Nigerian metal fabrication and casting company to examine energy consumption. From his observation of collected data, behavioral misconducts were found and suggested for behavioral corrective measure along with technical improvements [18]. Studies conducted on energy efficiency potential in different industries in Bangladesh showed that there are scopes for reducing energy waste with existing technology if companies focus on organizational behavior and awareness building program [19-20]. Five clusters were identified in a study to analyze the demographic groups based on Theory of Planned Behavior identified that there is a gap in the perception and efficacy of energy saving actions in older and younger employees. To spread energy efficient energy practices in the organization, internal campaigns should aim in the middle level management [16]. Psychological determinants like attitude toward energy saving, perceived behavioral control, knowledge, habit, belief and awareness described in different behavioral models, were seen to have direct effect on energy saving behavior compared to other determinants [21]. Self-efficacy and social norm are also found to be influential among the employees' behaviors [15]. Positive attitude toward a certain energy saving behavior can be influential on energy saving performance. For example, a study found that positive attitude is closely related to behavioral intentions toward energy conservation behaviors [22]. In a hospital, similar findings were found which influenced on the energy conserving intentions [23]. According to a study, self-efficacy is found to be effective tool for measuring the capability of respondents and strongly linked with conservation intention [24]. A research has shown that the adoption of technology alone is not enough as social and behavioral considerations are important in that they shape and constrain the decisions to adopt technology, technology choices and operation, and how these technologies are used on a day-to-day basis. Author has argued that along with adoption of new technology, behavioral change can also reduce energy consumption more directly by changing habits, lifestyles, and everyday energy use practices [25]. Therefore, it is an important subject matter to map out how behavior of the employees in the target institutions can affect and impact the overall power consumption of the organizations. This study attempts to read the energy users' mind-set, beliefs, and attitudes towards energy saving opportunities using survey questionnaires. Considering gender, age and educational background of the employees in a commercial and an industrial institution, assumptions were made by relating them to the psychological determinants. This comparative study on energy use behavior

of the employees has helped to depict the existing energy use culture within the organization.

2. Methodology

Qualitative exploratory study was conducted in a commercial institution and a paper mill industry. Ethical approval was obtained from the competent authority before data collection. The study was conducted at a public university as a commercial institution. Seventy-five (75) participants were surveyed, consisting of students, staffs, and teachers. Fifty (50) employees of a private paper mills were surveyed for industrial data. To conduct the study, a three-tier survey questionnaire was prepared for both the commercial and industrial sector. Questionnaires were structured emphasizing on the sensible consumption strategy, energy conservation techniques and energy efficient technologies along with basic demographic information. Questionnaires for the commercial sector, energy consumption behavior and attitude is decorated with 27 close ended statements on office environment such as, switching off lights, fan, air conditioner, computer monitor, role of management in energy saving, competency of employee in operating energy efficient technology etc. Energy conservation and efficiency section is decorated with 25 close ended statements on importance of energy management team and major barriers for adoption of energy efficient technologies in the institution. Industrial survey questionnaires were asked for the energy consumption behavior and attitude perspectives, arranged with 27 closed ended statements on responsible use of electrical appliances, participation in meeting on energy conservation, role of management in energy saving, competency of the employees in operating energy efficient technology. The section on energy conservation and efficiency include 25 close ended statements to identify the impacts of awareness for energy saving initiatives in the workplace, barriers for adopting energy saving technologies and perception on energy management system. In the questionnaires, the statements involved with assessing people attitude, behavior or opinion, a scale with a range of multiple responses were preferred. Five-point Likert scale was used for the respondents to express their feelings on a particular statement. Questionnaires were distributed among the participants and were asked to answer regarding the topic in the scale that best reflect their opinions. After data collection, Microsoft Office was used to organize the data. A few statements were selected for the data interpretation to find the reasons for energy and power wastages in the commercial and industrial sectors from existing energy use pattern. Analysis of behavioral factor was done based on demographic information.

3. Results and Discussion

3.1. University

At the beginning, gender-based analysis of energy saving indicators is represented in Table 1. In the total 75 participants, 60 were male and 15 were female. Considering the habit of switching off unused lights, it is found that 42.4% male and 50% female respondents did it very often. But 5.1% male and 14.3% female never paid attention to it. Though 25.4% male did it often and 25.4% did it sometimes but female respondents' response was 21.4% and 14.3% respectively. Skylight is used for natural light in the workplace. 33.9% male and 35.7% female responded "very often" as a proof of their preference for natural light. 10.2% male and 7.1% female responded "Never" as they preferred artificial lightings. Checking for switching off appliances before leaving the office is considered as a good energy saving habit. 47.1% male and 57.1% female responded for "very often"

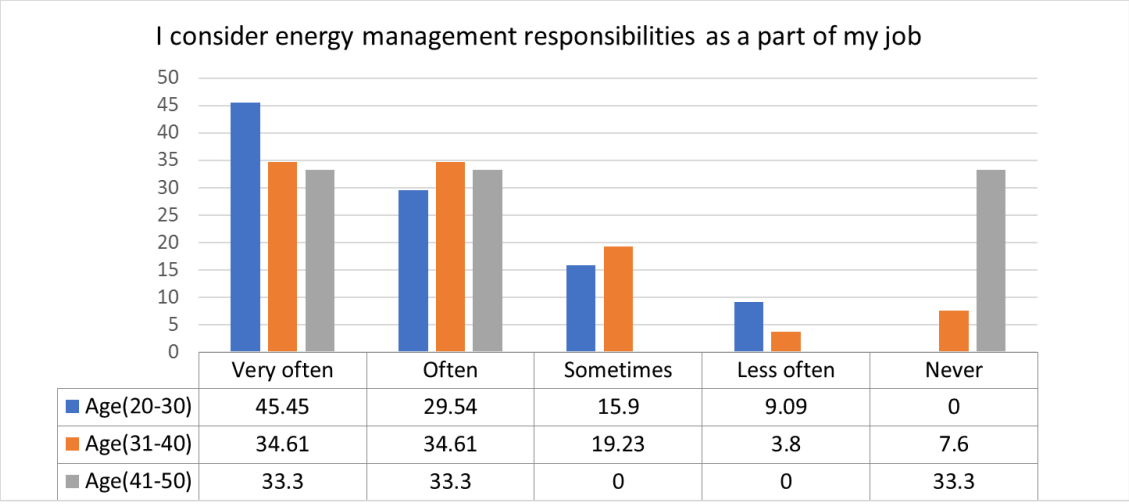
and though 5.1% male opted for never but none of the female respondent rarely misses to check for running appliances before leaving the office. Shutting off unused computer monitors and using power saving mode are the indicators for good energy practicing behavior. 44.1% male strongly supported shutting down of unused computer but 25.4% male very often set computers in power saving mode. 20.3% and 22% male shut off unused computer often and sometimes respectively and 25.4% male used power saving mode often and another 25.4% used it sometimes. 8.5% male and 20.3% male never shut off computers nor set power saving mode. On the other hand, 57.1% and 7.1% female respondents strongly supported switching off unused computers and setting of power saving mode respectively. 22% female shut off computer monitors often and 35.7% female set power saving mode in their computers. 7.1% female shut off unused computers sometimes and 42.9% female used power saving mode sometimes. Indicator on sensible use of electronic equipment's reflected that 50.8% male and 64.3% female respondents shut off electronic equipment after use. Though 6.8% male never did that but female respondents never left any equipment running after use. Considering the habit of keeping the doors and windows closed when AC is on, it is found that 52.5% male and 64.5% female strongly supported this habit. 20.3% male and 35.7% female did it often. 8.5% male never did it but from the responses it is seen that none of the female respondent opposed to this idea. Using shades for light and heat control in the workplace is strongly supported by 40.7% male and 28.9% female. It was often done by 22% male and 42.9% female respondents. Encouraging colleagues for energy conservation were very often done by 37.3% male and 35.7% female respondents. 23.7% male and 21.4% female respondents did it often. 25.4% male and 21.4% female respondents did it sometimes. It was done less often by 6.8% male and 21.4% female. From the above discussion it is observed that percentage of women contributing to energy conservation seems to higher than the male participants. Statements indicating the material culture such as, use of computers, air conditioners etc. showed that female participants are more responsible than the male participants. Statements indicating the energy conserving manners are also better practiced by the female participants.

Participants were divided into three age groups to identify the attitude in managing the energy responsibility. From Figure 1, it is found that 44 participants belong to the age range of 20-30, are more cautious about energy management. In response to the statement on proper energy management, participants age ranging from 20 to 50 provided their opinions in a five-point Likert scale indicating "Very often", "Often", "Sometimes", "Less often" and "Never". From Figure 1, 45% participants in the age group of 20-30 provided their opinion that energy management prevent misuse of energy. 29% of this group opted for "often". 26 participants belong to the age group of 31-40 and 35% of them expressed their opinion for being responsible in energy management is important and 35% opted for 'often" implies that their conscious about proper management of energy. From the age group of 41-50 containing 5 participants provided their opinions which indicated equal percentage of 33.3% for very often, often, and never.

Table 1: Comparison of energy saving awareness between male and female based on indicators.

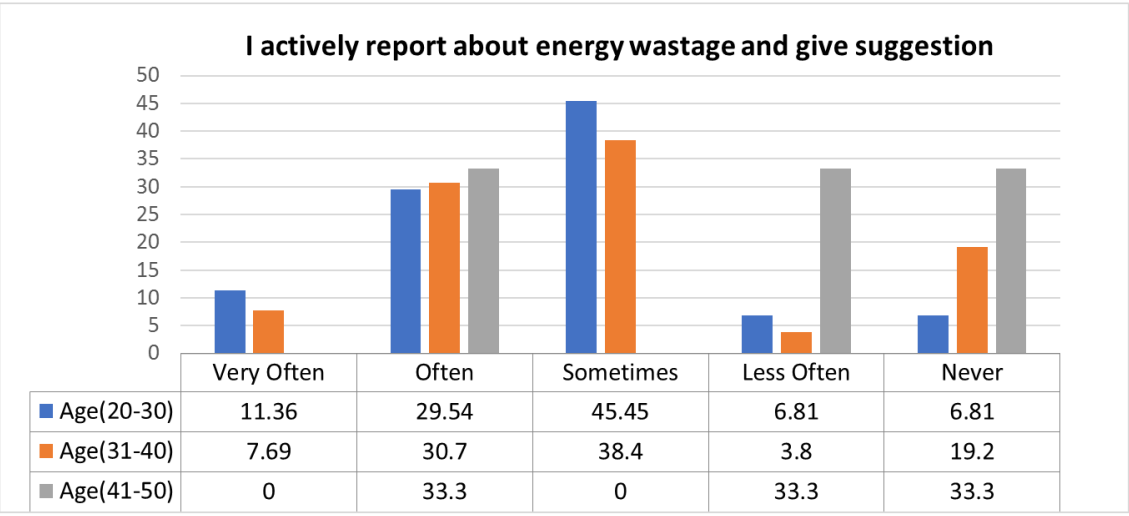
Energy using indicator	Very Often		Often		Sometimes		Less Often		Never	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Switch off lights in a hallway or restroom when not needed.	42.4%	50%	25.4%	21.4%	25.4%	14.3%	1.7%	0%	5.1%	14.3%
Using skylight whenever possible to minimize lighting cost	33.9%	35.7%	15.3%	35.7%	32.2%	21.4%	8.5%	0%	10.2%	7.1%
When leaving office, arrange for the last-man-out to check and switch off the power source to all air conditioning, lighting and office equipment that are not in use.	47.5%	57.1%	22%	21.4%	22%	21.4%	3.4%	0%	5.1%	0%
Shut off computer monitors when not needed	44.1%	57.1%	20.3%	28.6%	22%	7.1%	5.1%	7.1%	8.5%	0%
Set computer power to 'save mode' to minimize power use when idle.	25.4%	7.1%	25.4%	35.7%	25.4%	42.9%	3.4%	14.3%	20.3%	0%
Shut off electronics equipment that is not in use, except those in stand-by mode for power saving.	50.8%	64.3%	20.3%	35.7%	11.9%	0%	10.2%	0%	6.8%	0%
Keeping doors and windows closed when AC or central cooling is on	52.5%	64.3%	20.3%	35.7%	16.9%	0%	1.7%	0%	8.5%	0%
Use shades and blinds to control direct sun through windows in both summer and winter to prevent or encourage heat gain	40.7%	28.6%	22%	42.9%	18.6%	14.3%	6.8%	14.3%	11.9%	0%
Instructing/encouraging/advocating colleagues to adopt energy saving.	37.3%	35.7%	23.7%	21.4%	25.4%	21.4%	6.8%	21.4%	6.8%	0%
Wear informal and lighter clothes during summer season.	35.6%	42.9%	27.1%	35.7%	27.1%	14.3%	3.4%	7.1%	6.8%	0%
Wear formal and additional clothes during winter season	49.2%	71.4%	22%	28.5%	18.6%	0%	5.1%	0%	5.1%	0%

Participants' feedback is next analyzed based on age groups, for the statement indicating the reporting tendency to the governing authority if they had come across to any wastage of energy in the university premise. It is shown in Figure 2 that in the age group of 20-30, 45% participants opted for "sometime" and 29% opted for often. In the age group of 31-40, 38% and 31% are expressed their opinions "sometimes" and "often" respectively. In the age group of 41-50, equal percentage of 33.3% came for "often", "Less often" and "Never". From Figure 2, it is observed that participants are not used to reporting energy wastages. They frequently avoided this feedback process and the authority was bit incoherent in this regard.



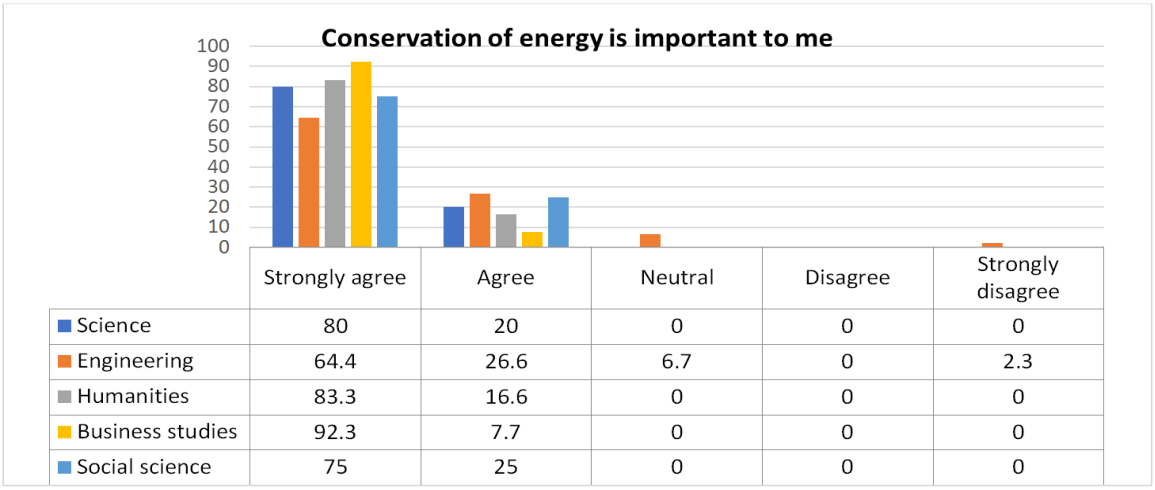
	Very often	Often	Sometimes	Less often	Never
Age(20-30)	45.45	29.54	15.9	9.09	0
Age(31-40)	34.61	34.61	19.23	3.8	7.6
Age(41-50)	33.3	33.3	0	0	33.3

Figure 1: Energy management attitude among different age groups.



	Very Often	Often	Sometimes	Less Often	Never
Age(20-30)	11.36	29.54	45.45	6.81	6.81
Age(31-40)	7.69	30.7	38.4	3.8	19.2
Age(41-50)	0	33.3	0	33.3	33.3

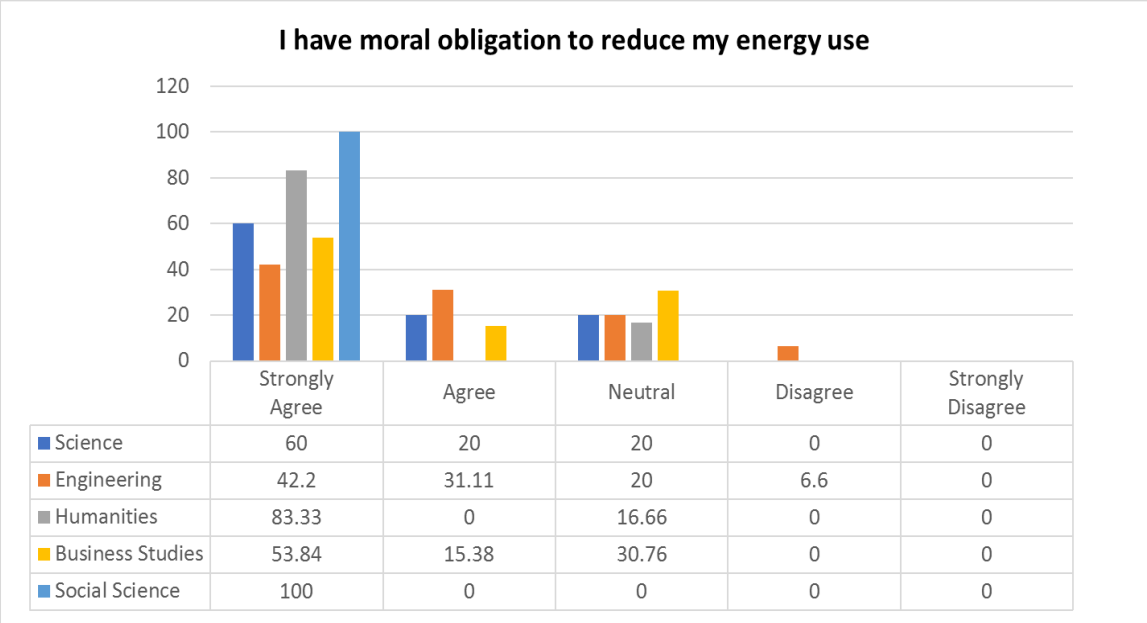
Figure 2: Reporting tendencies to the authority on energy wastages among different age groups.



	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Science	80	20	0	0	0
Engineering	64.4	26.6	6.7	0	2.3
Humanities	83.3	16.6	0	0	0
Business studies	92.3	7.7	0	0	0
Social science	75	25	0	0	0

Figure 3: Energy conservation attitude related to educational background.

Statement representing the priority for energy conservation reveals in Figure 3 that the conservation of energy is given high priority by the maximum respondents from business, humanities, and science disciplines respectively. Though maximum respondents from engineering background have strongly agreed upon energy conservation but a few responders have disagreed with this statement.



	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Science	60	20	20	0	0
Engineering	42.2	31.11	20	6.6	0
Humanities	83.33	0	16.66	0	0
Business Studies	53.84	15.38	30.76	0	0
Social Science	100	0	0	0	0

Figure 4: Moral obligation to reduce energy use among different educational background.

Moral obligation to reduce energy consumption or sensible use of energy enables a person to abstain from energy wastage. This theme was depicted in a statement in the questionnaires and participants provided their opinions on that statement. In Figure 4, participants from different educational background responded according to their basic understandings. Majority of the respondents strongly agreed upon the sensible use of energy irrespective of their educational background. Based on the above results, four energy saving psychological characteristics such as awareness, attitude, efficacy, and habit are discussed in details for assessments of energy saving organizational trends in an academic institution.

Awareness

Based on the participant's opinion, general engagements of participants in energy saving activities are dependent on personal view and organizational environment. Communication gap about energy saving in the institution, can lead to wastages of energy. In Figure 3, it is depicted that there are variations of awareness level for energy conservation. Variations were found in respect to gender, age, and educational background. Female participants showed more consistency in the energy saving activities as compared to male (Table 1). On the other hand, young participants responded positively than the aged participants on energy saving responsibility (Figure 1). Awareness related to reporting energy wastages seems little bit poor in the majority of participants irrespective of age and educational background. But respondents are well aware of about energy conservation, it will ultimately compel them to act rationally (Figure 1) and this will create a feeling of moral obligation about their

actions toward energy saving or the decisions they make during purchasing products (Figure 4).

Attitude

Attitude is the personal way of thinking or performing a certain behavior. Overall attitudes of majority of the participants toward energy conservation are satisfactory. Positive attitude toward energy conservation can define energy conservation as a responsibility rather than taking it as a liability (Figure 1). Though the reporting of energy wastage is not a trending culture of the organization (Figure 2) but majority of the participants holds strong positive attitude to conserve energy (Figure 3). Their motivation to save energy can help to mold positive attitude among them and can yield maximize output in energy conservation if authority guides them with proper direction. Motivation for energy conservation in the organization is closely related to organizational and personal benefit. An organization can set its goals to save energy to reduce energy bills but for an individual it can be pictured as a social and corporate responsibility to earn reputations.

Efficacy

In the existing energy culture of this academic institution, majority of the participants including students and employees are responsible for primary energy consumption. But the energy management and wastage reduction are in the hand of authority, who are mostly elderly persons. From the analysis, it is appeared that one third of the participants from this age group showed inert attitude toward energy responsibilities (Figure 1), reporting energy wastage (Figure 2) and energy conservation (Figure 3). Moreover, efficacy is the resultant of knowledge and experience which is related to energy saving. Enablement of an individual toward energy saving is also dependent on energy saving knowledge [26]. Lack of knowledge on energy conservation practices can hinder an individual in changing his behavior and attitude toward energy saving. On the other hand, energy knowledge provided by feedback on personal behavior or on the policy of the organization, can motivate employees. With proper knowledge on energy conservation practices, an individual will feel the obligation to immoral energy consumption. This feeling of guilt or obligation can also drive an individual to efficiently use energy. This study reflects, though many of the respondents hold good moral status but a few respondents still need guidance toward behavioral changes (Figure 4). Lack of efficacy can be a barrier for the organization to energy conservation related policy making, motivation, and responsibility distribution. To build a good energy culture and to create energy efficient mind set, top management should reduce communication gap emphasizing on behavioral change.

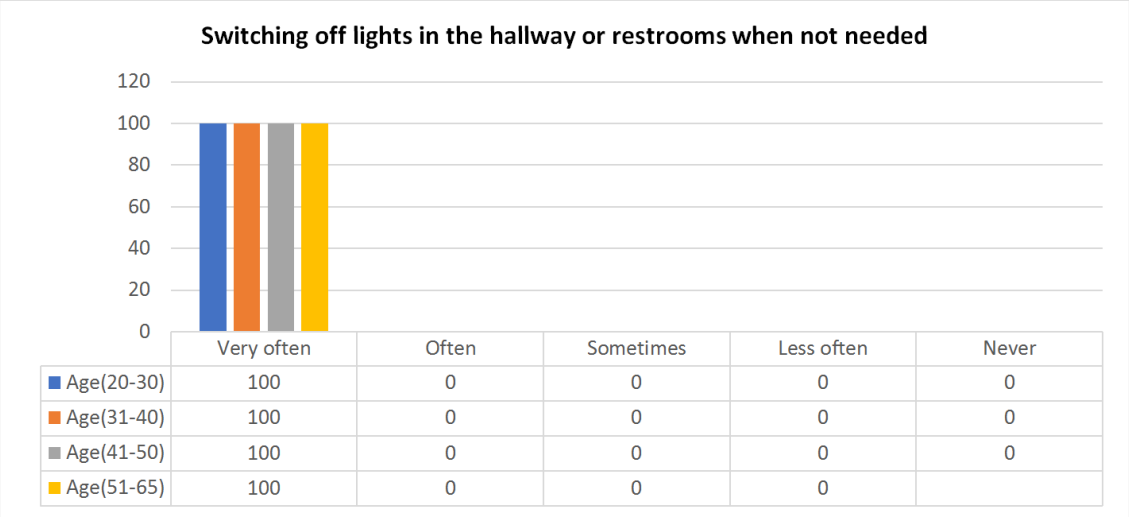
Habit

Repeated activities of an individual can be described as habit. Habit and lifestyle play a vital role in influencing an individual or society toward energy conservation [27]. Based on the analysis conducted, effects of subjective norms in the participants were found influential in the age group. Younger participants who are clustered in the age group of 20-30, are responded positively toward energy conservation and reporting tendency (Figure 2). It implies that the practicing behavior in this age group is developed as they can freely talk about energy saving and practice on the shared knowledge on energy conservation. Habit related to energy conservation among the

respondents enable them to think about energy conservation and it creates a positive mindset that compel them to think energy conservation are unavoidable responsibilities, which is depicted in Figure 2. From their habit and behavioral tendency to think energy conservation as responsibilities, these also generate a sense of moral obligation for wastages due to irresponsible energy use. Respondents emphasizing on energy conservation (Figure 3), also responded positively on minimizing energy use as they felt it as a moral obligation (Figure 4).

3.2. Paper Mill

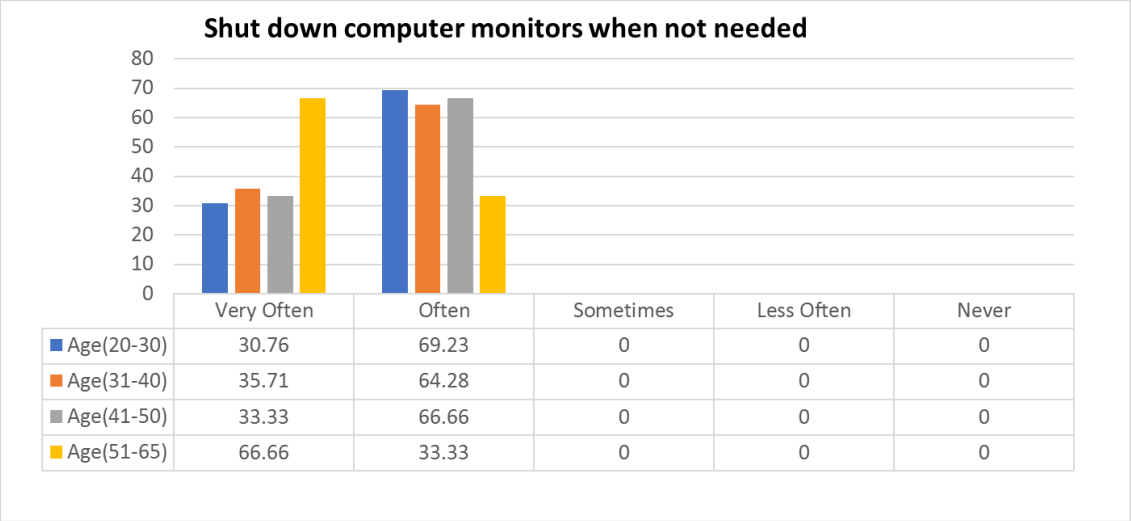
To analyze the explorative data from a paper mill, participants were clustered into three different groups based on demographic information such as gender, age, and educational background. Feedback collected from the participants based on different statements or indicators on energy conservation attitudes were then depicted in graphical ways to observe the level of motivation in adopting behavioral change as a tool for energy saving for an individual or collectively. In this Industry, proportions of female employees compared to male are insignificant. For this reason, the conducted survey only considered the male employees. Hence gender based behavioral analysis was not done. Total 50 participants attended in this survey. Among them, there were 15 participants in the age group of 20-30, 27 participants in the age group of 31-40, 05 participants in the age group of 41-50 and 03 participants in the age group of 51-60. Participants were also clustered based on their educational background. Among them, 16 were from Engineering, 06 from Science, 10 from Humanities, 10 from Business Studies and 08 from Social Science background.



	Very often	Often	Sometimes	Less often	Never
Age(20-30)	100	0	0	0	0
Age(31-40)	100	0	0	0	0
Age(41-50)	100	0	0	0	0
Age(51-65)	100	0	0	0	

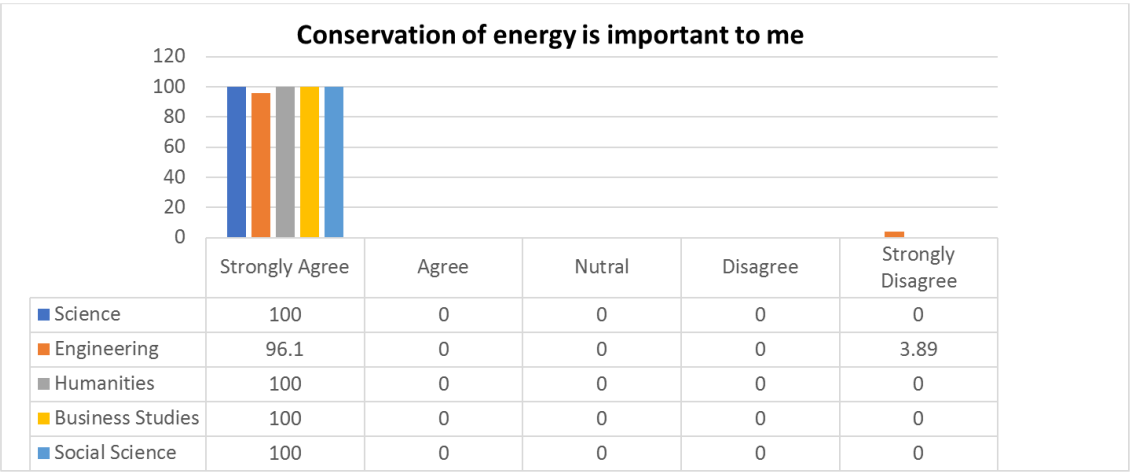
Figure 5: Engagement of participants to switch off the unused lights among different age groups.

In Figure 5, representation on the statement of the material culture for minimizing the wastage of energy by simply switching off unused lights wherever possible yields extremely positive attitude in the respondents. Irrespective of all age groups, respondents opted “Strongly agree” option according to their basic understandings.



	Very Often	Often	Sometimes	Less Often	Never
Age(20-30)	30.76	69.23	0	0	0
Age(31-40)	35.71	64.28	0	0	0
Age(41-50)	33.33	66.66	0	0	0
Age(51-65)	66.66	33.33	0	0	0

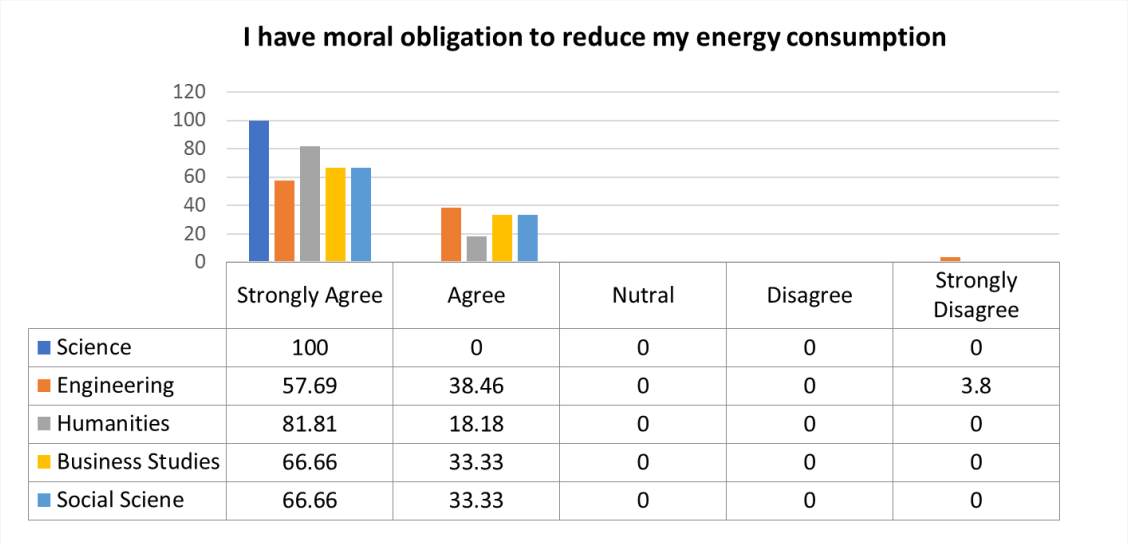
Figure 6: Tendency to shut down unused monitors among different age groups.



	Strongly Agree	Agree	Nutral	Disagree	Strongly Disagree
Science	100	0	0	0	0
Engineering	96.1	0	0	0	3.89
Humanities	100	0	0	0	0
Business Studies	100	0	0	0	0
Social Science	100	0	0	0	0

Figure 7: Energy conservation attitude related to the educational background.

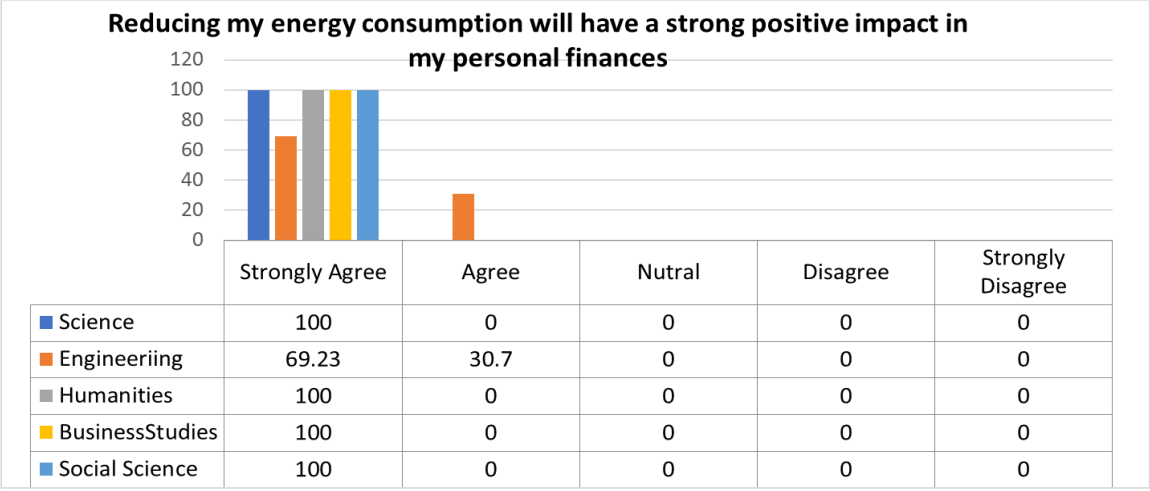
Shut down unused computers instead of keeping it on or use of sleep mode can substantially minimize the amount of energy consumption of an organization [28, 29]. Figure 6 represents the behavioral tendency of respondents what they used to practice in their organizations or in daily life. Respondents' reaction was limited to "Very often" and "Often". In the age group of 20-30, it is 31% and 69% respectively. In age group of 31-40, it is 36% and 64% respectively. Respondents in the age group of 41-50, the percentages are 33 and 66.66 respectively. 66.66% and 33.33% respondents are opted for "Very Often" and "Often" respectively. From a paper mills, participants were chosen from different educational background. Statement representing the energy conservation attitude reveals that participant irrespective of educational background, they are more conscious about energy conservation. Strong energy culture prevails among the participants. Figure 7 illustrates that almost all the respondents felt the urgency to conserve energy but a few respondents from engineering background stated opinion against the statement.



	Strongly Agree	Agree	Nutral	Disagree	Strongly Disagree
Science	100	0	0	0	0
Engineering	57.69	38.46	0	0	3.8
Humanities	81.81	18.18	0	0	0
Business Studies	66.66	33.33	0	0	0
Social Sciene	66.66	33.33	0	0	0

Figure 8: Moral obligation to reduction energy use among the participants with different educational background.

The idea of having moral obligation to reduce energy use is represented in Figure 8. Though all participants from science background thinking moral obligation can result in sensible consumption of energy but a few participants from engineering background disagreed upon the statement. The participants from other background mostly strongly agreed upon the concept. Respondent's beliefs and attitudes toward the reduced energy consumption and its impact on personal finances are represented in Figure 9. Mostly participants from all disciplines strongly agreed with this statement except engineering background employees. However, respondents from engineering background have expressed mixed feelings in between strongly agree and agree which means engineering background participants are more realistic and causious in expressing feedback.



	Strongly Agree	Agree	Nutral	Disagree	Strongly Disagree
Science	100	0	0	0	0
Engineeriing	69.23	30.7	0	0	0
Humanities	100	0	0	0	0
BusinessStudies	100	0	0	0	0
Social Science	100	0	0	0	0

Figure 9: Participants belief between energy consumption vs personal finances.

Based on the above results, four energy saving psychological characteristics such as awareness, attitude, efficacy, and habit are discussed in details for assessments of energy saving trends in a paper industry.

Awareness

Participant's opinion from a paper mill indicates that there are good organizational culture prevails which allow an individual actively follow energy saving activities and grow awareness of responsibility for energy conservation among the employees. Statements representing the behavioral analysis on tendency of switching off unused lights wherever possible in the office (Figure 5) and the habit of shutting down unused computer monitors (Figure 6) reveal that employees are aware of about cumulative effect of small waste of energy due to unnecessary lightings and equipment use and its ancillary costing. The findings associated with the material culture of the surveyed organization demonstrate that awareness of consequences grown within the employees, compel them to think energy conservation as a part of their job (Figure 7) and it also has created a sense of moral duty (Figure 8) about not to ignore any opportunity for energy conservation. This ultimately helps in build energy saving material culture in the industry.

Attitude

Individual with a positive attitude toward energy saving consistently push him/her to perform a certain behavior [30]. Almost all of the participants from a paper mill hold good positive attitudes toward energy conservation. Irrespective of their age and educational background, energy conservation gets top most priority. Moral obligation to reduce the energy consumption is actually the influence of knowledge on climate change and pro-environmental behavior to limit the impacts on the environment. Results suggest that moral obligation has created a sense of responsibility among the individuals to act upon humanitarian causes rather than emphasizing on personal benefits. Behavioral factors like moral obligation (Figure 8), awareness of financial benefits (Figure 9), and responsible use of energy (Figure 7) drove employees to act upon the intended energy saving action.

Efficacy

Energy saving attitude should not lead to any reduction of productivity rather it would be helpful for doing the jobs efficiently and energy management simultaneously. In the existing culture of this industry, efficacy in completion of organizational responsibilities toward energy saving material culture (Figures 5 and 6) was found dominant among the participants. Strong organizational communication was the leading contributor to high efficacy among the participants. Top level management and employees were found to be self-motivated and supportive to energy conservation in their related fields (Figure 7). Respondent's tendency to reporting any kind of energy wastages to the authority taken as a feedback on the trending activities. Such a feedback provided the opportunities to find out the gaps between the willingness and effort toward energy conservation. On the other hand, moral obligation developed from the awareness and knowledge (Figure 8) revealed that respondents, who were aware, witnessed as more efficient in their energy management capabilities. Respondents also believed that sensible consumption of energy could benefit them both in financial (Figure 9) and environmental aspects.

Habit

Organizational culture is the measuring tool for the influences of energy conserving behavior and habits practiced by the employees. Effects of norms among the participants were found dominant in all age groups and

educational background. Respondents were tending to prioritize their own behavior to reduce the total energy consumption at the organization (Figure 9). Norms are crucial to organizational policy on energy management. Results indicate that the strong organizational policy implementation regulates the behavior of employees in sensible use of energy (Figure 5) and equipment including personal appliances (Figure 6). This persuades them to adopt energy conservation habit (Figure 7). Habits are often guided by the moral obligation and conservation attitude (Figure 8). Repeated practice of energy conservation action by an individual has turned into trending habit of the employees inside the organization.

4. Conclusion

This exploratory study on the energy consumption behavior and conservation attitudes in a commercial institution and in an industry is an effort to find out the linkages between human behavior and psychological determinants. Impacts of psychological determinants have been linked with the trending organizational behavior and attitudes in respect to material culture and conservation strategies of the organization and utmost effort was given to insightful explanations on these terms to provide more clarification. Different statements were taken representing the importance of energy conservation and initiative toward energy conservation behavior and attitudes both for material culture and behavioral factors. Those statements were used to capture trending organizational culture and opinions at the individual and organizational level. According to this study, reporting tendency of the employees seems to get less priority in the University. 45% of the respondents in the age group of 20-30, less frequently provide this feedback to authority but 33.3% of the respondents in the age group of 41-50 avoid reporting of energy waste. Priority on energy conservation in respect to educational background showed much hope but it is often given less importance along with other job responsibilities and even ignored mostly by the elder employees. In the paper mill, overall energy culture seems to be very good as employees are driven by the moral obligation and knowledge on the benefits of reduced energy consumption. Good communications have created a sense among them to set energy conservation as a high priority. Psychological factors such as awareness on energy conservation, positive attitude toward energy saving, personal and collective efficacy of the organization, could drive them to follow the energy conserving habits within the organization and beyond. To be successful in implementing the good energy culture within the organization, management should focus on the awareness, attitude, and formulation of feedback strategies in individual and management levels. From the study, it is found that there were ample scopes for removing communication gaps. Proper policy formulation by the authority can guide the understanding of employees about moral obligation and financial aspects to adopt energy conserving habits in their lifestyle. For both industrial and commercial organizations, conservation is given high priority by the respondents irrespective of their educational background except a few respondents of engineering background. But as an intensive energy use institution, almost all of the respondents of the industry seem to be more cautious than that of the commercial institution. On moral obligation to reduce energy consumption, respondents from both the organizations expressed their mixed feelings. Majority of them holds altruistic attitude to conserve energy by reducing energy consumption. Based on prevailing material culture in the industry and university considering indicators like conservation attitude, habit of proper use of appliances, and the level of efficacy, it can be said that the existing energy culture is the cumulative effort of the management and the willingness among the employees. Simultaneous utilization of these steadfast effort and

willingness have raised awareness and knowledge related to energy conservation and sensible consumption of energy. There are fair chances for both the organizations to overcome the limitations in order to attain a sustainable energy culture environment. The work can be extended by adopting multidimensional approaches including other psychological determinants and human behavioral factors for other types of commercial and industrial organizations.

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