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Energy Conservation Behavior of Thai University Students

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Abstract

An estimated 1.2 billion people, or 16% of the global population, did not have access to electricity in 2015. ***Therefore, access and the conservation of energy have become critical issues in a country's quest for economic prowess and sustainability.*** This research, therefore, aimed to study the energy-conservation behavior of university students, and compare their energy-saving behavior categorized by gender and university group. The sample of 900 undergraduate students came from 15 Thai public universities under the Office of the Higher Education Commission [OHEC] in the 2013 academic year. The sample was randomly selected using a multi-stage sampling method. The instrument used to collect data in this research was a 5-level rating-scale questionnaire with reliability which was between 0.86-0.94. Data were analyzed using mean, standard deviation, t-test for independent sample and one-way ANOVA. The findings revealed that the students exhibited energy-conservation behavior in a family context at a high level, while energy-conservation behavior for themselves, and for the public was at a moderate level. Male and female students had different energy-conservation behaviors, and students under different university groups had distinct energy-conservation behaviors.

Keywords: energy conservation, energy consumption, family energy conservation, personal energy conservation

1. Introduction

1.1 Thailand's Energy Consumption

Energy has become the basic necessity for the economic development of a country, which has become part of the critical infrastructure in a society's development. Globally, 1.2 billion people, or 16% of the world's population, did not have access to electricity (***World Energy Outlook, 2016).*** In Thailand, like most places, the search for energy and how it consumed, and more recently, how it is conserved, have become critical issues in the sustainable growth for the Kingdom's economic prosperity. Although energy consumption increase is associated with factors such as urbanization, industrialization, and technological progress, other human factors are in play as well (Pimdee, 2017). These factors include a lack of knowledge concerning the need for conservation and knowledge of environmental issues surrounding the use of various energy forms. Research has proven that studying university student energy use and conservation behavior can be a powerful predictor of future energy trends and potential problems/solutions in a nation's energy requirements, as education plays a strategic role in improving energy efficiency (European Commission, 2005; Department of Energy and Climate Change, 2012).

In 2018, according to the Electricity Generating Authority of Thailand [EGAT], there was a total of approximately 42.5 megawatts [MW] of installed capacity from various sources throughout Thailand (Figure 1). These sources include 15.757 MW from EGAT's power plants, and 14.948 MW from independent power producers (IPPs) (EGAT, 2018). The remaining power generation came from small power producers [SPPs] (7.866 MW), and the purchase of 3.877 MW from other regional countries such as Laos and Malaysia.

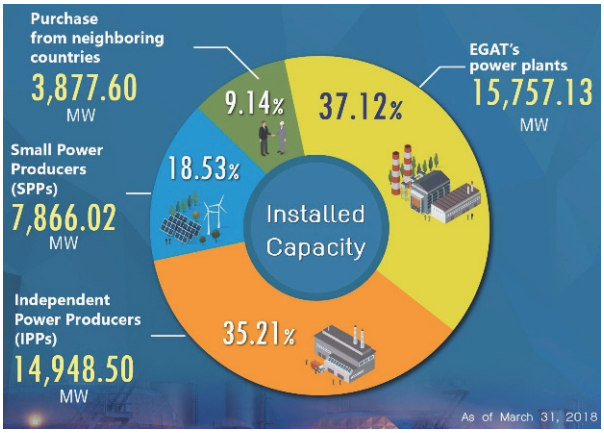

Figure 1. 2018 EGAT power generation resources and capacity

1.2 Thailand's Domestic and Regional Energy Conservation Processes

In Thailand, various private and public instructions and companies have become aware of the ever-increasing importance of energy conservation. Under the *Thailand Energy Efficiency Development Plan* [EEDP] (2015 – 2036), public education and awareness objectives are outlined in which the stated goal is a 30% reduction in energy use between 2010 and 2036 (Pichalai, 2015). The specifics of the plan calls for greater public support for human resource energy conservation development, the creation of public awareness and behavioral change process, and by supporting energy efficiency technology research and development.

Furthermore, energy conservation has defined under the EEDP has two meanings (Ministry of Energy, 2016). The first meaning refers to the economical use or reduced expendable use of energy. The second meaning is energy efficiency improvement, which refers to doing the same activities with less energy. These elements included hot water production, cooling systems, transportation, and machines utilized in the manufacturing processes.

Also, Thailand's EGAT has undertaken programs to educate students about the importance of energy conservation. One such program is called the '*Green Learning Room Project*, in which the stated goals are to raise student awareness on the efficient use of power. In 2018, EGAT was working with 414 schools with the stated goal of reducing electricity consumption by 1.7 million units, while reducing carbon dioxide emissions by 900 tons (EGAT, 2018).

Also, at the *Asia-Pacific Economic Cooperation* (APEC) Summit in 2007, Thai government officials ratified the beginnings of an energy collaboration plan to meet the agreed targets by 2030 (Ministry of Energy, 2016). Subsequently, APEC delegates quantified this by signing an agreement to reduce APEC's aggregate energy intensity by 45% from 2005 levels by 2035 (APEC, 2018). This is not an insignificant number as APEC accounts for 60% of the world's energy demand, which includes four of the world's five largest energy users including China, the USA, Russia, and Japan. In 2013, the region consumed the equivalent of over 8,000 million tons of oil worth of energy (Mtoe) and was a net energy importer of over 650 Mtoe, of which 90% was oil. Therefore, Thailand's goals have taken on international importance as well. This the reasons for the following study's research objectives.

1.3 Research Objectives

1.3.1 To examine energy-saving behaviors of university students categorized by university group.

1.3.2 To compare energy-saving behaviors of university students categorized by gender.

1.3.3 To compare energy-saving behaviors of university students categorized by university group.

2. Literature Review

2.1 Energy-Conservation Behavior

"Behavior" is a psychological action or response to a psychological action of individuals and interactions that are a response to internal and external stimuli as well as activities with noticeable aims or activities carried out through deliberation or unconsciousness (Royal Institute Dictionary, 2011; Goldenson & Glanze, 1989). Energy-conservation behavior is a type of human behavior that is expressed physically or verbally in contexts related to surroundings (Staddon, Cycil, Goulden, Leygue, & Spence, 2016), which also entails the public's behavior concerning the environment and public conservation benefits concerning a nation's resources.

The study of energy-conservation behavior emphasizes energy conservation, which is associated with an individuals' actions to use electric power for their benefit efficiently. It has been suggested that the conservation adoption is influenced by how strong the argument to conserve energy is, the source credibility, if the message is understood and retained, and the degree to which an individual is able and willing to install conservation devices in their home (Costanzo, Archer, Aronson, & Pettigrew, 1986).

Additionally, Ajzen's Theory of Planned Behavior (TPB) has been used to explain a wide range of environmental behaviors (Abrahamse & Steg, 2009; Cordano & Frieze, 2000; Harland, Staats, & Wilke, 1999; Scherbaum, Popovich, & Finlinson, 2008), with Kaiser and Gutshcer (2003) reporting that the TPB variables explain 81% of variance in the intention to perform conservation behaviors. In the United Kingdom, Greaves, Zibarras, and Stride (2013) researched worker environmental, behavioral intentions and determined that the TPB explained 61% of variance in employees' intentions to turn off their computers when leaving their desk, 46% of variance in intentions to use video-conferencing rather than travel to meetings, and 53% of variance in intentions to recycle at work.

Furthermore, in Thailand Piasiri (2002) examined green school projects, and indicated good student energy conservation behavior included correctly turning off electrical appliances, maintaining appliances in good working condition, and reminding others not to waste energy. It was further determined that there were three types of energy conservation behavior, which include personal, within a family environment, and within the public environment.

2.1.1 Personal Energy Conservation Behavior

Various studies have determined that different factors shape personal energy conservation behavior, with Scherbaum et al. (2008) focusing on individual-level factors, and reported that public environmental consciousness is an essential predictor of personal environmental norms.

2.1.2 Family Energy Conservation

From a review of the literature, there seems to be an accumulated body of evidence that suggests that a households' energy – conservation behavior is tied to outside intervention. Verification of this comes from Abrahamse, Steg, Vlek, and Rothengatter (2007), which determined that energy consumption and conservation behavior was significantly higher when households were exposed to interventions. In Sweden, Ek and Söderholm (2010) also confirmed the importance of providing specific information on energy saving, as it plays an important role in energy conservation. Furthermore, the willingness to save electricity differs by age group, with older, retired people appearing more willing to save than the average individual.

2.1.3 Public Energy Conservation

Wang, Wang, Guo, Zhang, and Wang (2018) determined that in urban China, public energy conservation behavior was determined by altruism while stating that saving energy is an important guarantee for sustainable development. Furthermore, social norms and the policy environment have a significant impact on residents' daily energy-saving behavior.

2.2 Variables Affecting Energy-Conservation Behavior

Earlier studies have identified and classified various individual factors responsible for the increment in household energy consumption, and have also analyzed the effect of socio-economic factors such as standard-of-living and income on overall household energy consumption (Bhattacharjee & Reichard, 2011). For example, do Paço and Varejão (2010) found that women display more desirable conservation behavior than do men. It was also determined that educational levels are not significant for distinguishing the more pro-environmental individuals from the others.

Meanwhile, Janda (2008) surveyed 1,064 Thai vocational students and determined that students of gained their greatness willingness and knowledge about energy conservation from their families and school. Furthermore, women were found to have higher energy conservation habits than their male counterparts. Additionally, energy conservation behavior appeared to be also related to the student's faculty and their seniority within it.

Pimdee, Thiengkamol, and Thiengkamol (2012) investigated student energy conservation psychological trait variables, including locus of control, mental health, future orientation and self-control, and achievement motive. The most essential predictors from the study were concluded to be future orientation, self-control, and mental health. Moreover, the situational group variables (instructional, social support, family role model perception, and media perception) better-predicted group energy conservation behavior over the group psychological trait variables. The most important predictors were the family role model perception and media perception.

2.3 Research Hypotheses

2.3.1 Students of a different gender will have different energy-conservation behavior.

2.3.2 Students of different university groups will have different energy-conservation behavior.

3. Methodology

The sample for the study was drawn from a population of 1,328,920 undergraduate students in regular programs from public universities and other universities under the Thai government's Office of the Higher Education Commission (OHEC) in the academic year 2013. The sample was selected from determining the size of clusters based upon use of Yamane's (1973) indicative table, with 95% reliability and a 3% deviation from the size of the population ∞.

3.1 Research Instrument

The main instrument employed in this research for data collection was a questionnaire on demographic information and energy-conservation behavior of students which used a 5-point rating scale (except demographic information) format. A pilot study was conducted beforehand with 45 students, and the obtained data were analyzed to find Cronbach's α - coefficient. The questionnaire's reliability ranged from 0.86-0.94.

3.2 Data Collection

The researchers collected data from the samples and received 60 completed questionnaires from each of the 15 universities surveyed. From the 900 copies collected, the subsequent analysis categorized each questionnaire by gender and university group.

3.3 Data Analysis

The researchers analyzed energy-conservation behaviors using descriptive statistics including mean and standard deviation. To compare energy-saving behavior, the researcher used a t-test for independent samples and a one-way ANOVA F-test and tested the difference of mean in pairs by use of the Scheffe's method (Kao & Green, 2008).

4. Results

4.1 Student Demographic Information

From the 900 students participating in the survey (Table 1), it was determined that enrollment in science and non-science curriculum was nearly equal (51% compared to 49%, respectively). Additionally, 73.44% of the students were residing in university student accommodations or their off-campus apartment. It was also interesting to note that 30.11% of the students (the majority) reported their family's monthly income at 20,000 baht ($US 609) or less.

Table 1. Student demographic information

Student demographic information	**Student totals**	(%)
1. Program		
• Science	459	51.00
• Non-science	441	49.00
Total	900	100
2. Type of student's accommodation upon studying		
• Personal home	190	21.11
• Apartment/ dormitory	661	73.44
• Relative's / acquaintance's home	45	5.00
• Others places such as temples	4	.44
Total	900	100
3. Family's revenue (per month)		
• Not over 10,000 Baht	187	20.78
• 10,001 – 20,000 Baht	271	30.11
• 20,001 – 30,000 Baht	174	19.33
• 30,001 – 40,000 Baht	112	12.44
• More than 40,000 Baht	156	17.33
Total	900	100

4.2 Student Energy-Conservation Behavior by Aspects

An analysis by use of mean and S.D. determined that energy-saving behavior in the family was at a high level (Table 2). This was followed by a moderate level for both personal energy conservation behavior and energy conservation behavior for the public.

Table 2. mean, standard deviation [S.D], level and rank of student energy-conservation behavior by aspects

Aspects	student (n=900)		Level	Rank
	M	S.D.		
1. Personal energy conservation behavior	3.47	.97	Moderate	2
2. Energy conservation behavior in family	3.73	.70	High	1
3. Energy conservation behavior for the public	3.43	.87	Moderate	3

4.3 Student Energy-Conservation Behavior by Gender

Table 3 shows the results of the analysis of both male and female student participation in energy-conservation behavior by aspects. From it, it was determined that females in a family environment were most prone to exhibit energy-conservation behavior.

Table 3. Comparison of Mean of Student Energy-Conservation Behavior by Gender

Aspect	Gender	n	M	S.D.	t	Sig.
1. Personal energy conservation behavior	Female	450	3.55	.96	2.53*	.01
	Male	450	3.39	.97		
2. Energy saving in family	Female	450	3.80	.69	3.16*	.00
	Male	450	3.66	.70		
3. Energy saving for the public	Female	450	3.51	.82	2.98*	.00
	Male	450	3.34	.91		

Note. *Sig. < .05

4.4 Student Energy-Conservation Behavior by University Groups

Table 4 shows the results of the comparison analysis of energy-conservation behavior between students from different university groups. From it, it was determined that females in a family environment were most prone to exhibit energy-conservation behavior.

Table 4. Variance analysis to compare student energy-conservation behavior between university groups

Aspect	Source of Variance	SS	df	MS	F	Sig.
1. Personal energy conservation behavior	Between Groups	10.45	2	5.22	5.63*	.00
	Within Groups	832.35	897	.93		
	Total	842.79	899			
2. Energy conservation behavior in family	Between Groups	4.38	2	2.19	4.56*	.01
	Within Groups	430.94	897	.48		
	Total	435.33	899			
3. Energy conservation behavior for the public	Between Groups	16.49	2	8.24	11.19*	.00
	Within Groups	660.91	897	.74		

	Total	677.40	899

According to the one-way ANOVA, the students under different university groups had distinct energy-saving behaviors with a statistical significance at .05. The test of difference in pairs with Scheffé's method was shown in Table 5. The students from public universities had personal, family, and public energy-conservation behavior higher than students in the Rajabhat University system (originally founded as teacher colleges). Furthermore, the students from public universities had energy-conservation behavior in a family environment higher than the students in the Rajamangala University of Technology (RMUT) system (nine universities). Meanwhile, the students from the RMUT system had energy-conservation behavior in a public setting higher than students in the Rajabhat University system.

Table 5. Mean comparison of the student energy-conservation behavior under different university groups

Aspect	University	M	Public	Rajabhat	RMUT
1. Personal energy conservation behavior	Public	3.61		.26*	.15
	Rajabhat	3.35			-.11
	RMUT	3.46			
2. Energy conservation behavior in family	Public	3.83		.15*	.14*
	Rajabhat	3.68			-.01
	RMUT	3.69			
3. Energy conservation behavior for the public	Public	3.59		.33*	.15
	Rajabhat	3.26			-.18*
	RMUT	3.44			

Note. *Sig. < .05

4. Discussion

The study's Thai university students exhibited energy conservation behavior to the greatest degree while they were in their family's home environment. Secondary to this was the student's energy conservation behavior in a personal and public setting, which were both at a moderate level. This is consistent with other research in Pakistan in which Khan, Shah, and Khan (2016), indicated that public sector student hostels had significantly higher energy consumption than their private student counterparts.

Mongkhonvanit, Panklib, and Bhalla, S.K. (2015), also determined that universities substantially driven by their students are anticipated to continue reporting an increased focus on sustainability. Universities have long been agents of change, catalysts for social and political action, as well as centers of learning. Universities not only educate most of the world's leaders, decision makers and teachers and advance the boundaries of knowledge, but as major employers and consumers of goods and services, they play a significant economic role nationally and globally.

In the analysis of this study's 900 male and female students, it was also determined that females in a family environment were more prone to exhibit energy-conservation behavior over their male counterparts. This is consistent with research from do Paço and Varejão (2010), which also found that women display energy conservation behavior better than men. Additionally, Janda (2008) also showed that Thai vocational students showed a high level of knowledge concerning energy-conservation behaviors. However, male and female students in different faculties had dissimilar energy-saving behaviors. Additionally, how students learn about energy saving from their family and educational institutions could explain the variations in the energy-conservation behavior of the students.

5. Conclusion

The choices we make about how we use energy have environmental and economic impacts. There are many things students can do to use less energy and use it more wisely. These actions include both energy conservation and energy efficiency. From this study concerning Thai university student energy conservation behavior, it was

determined that there was a significant difference in both male and female student energy conservation behavior across all three aspects of the study (personal, family, and public), with a statistically significant difference at .05. Furthermore, students from the different university system groups studied had distinct energy-conservation behaviors with a statistical significance at .05. Additionally, the data showed that students from the public university system had higher energy conservation behavior than that of students from the schools within the Rajabhat University system. Furthermore, the students from public universities had better energy conservation behavior within the family higher than the students from RUT system. Meanwhile, the students from the RUT system had energy conservation behavior in a public environment higher than students from the Rajabhat University system.

References

Abrahamse, W., & Steg, L. (2009). Attitudes toward energy conservation scale. *PsycTESTS Dataset.* https://doi.org/10.1037/t22866-000

Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2007). A review of intervention studies aimed at household energy conservation. *Journal of Environmental Psychology, 25*(3), 273-291. https://doi.org/10.1016/j.jenvp.2005.08.002

APEC. (2018). *Energy working group*. Asia-Pacific Economic Cooperation. Retrieved from https://tinyurl.com/ybdog9pp

Bhattacharjee, S., & Reichard, G. (2011). Socio-Economic Factors Affecting Individual Household Energy Consumption: A Systemabtic Review. *ASME 2011 5th International Conference on Energy Sustainability*, Parts A, B, and C. https://doi.org/10.1115/es2011-54615

Cordano, M., & Frieze, I. H. (2000). *Pollution reduction preferences of U.S. environmental managers: Applying Ajzen's theory of planned behavior*. *Academy of Management Journal, 43*(4), 627-641. https://doi.org/10.2307/1556358

Costanzo, M., Archer, D., Aronson, E., & Pettigrew, T. (1986). Energy conservation behavior: The difficult path from information to action. *American Psychologist, 41*(5), 521-528. https://doi.org/10.1037//0003-066x.41.5.521

Department of Energy and Climate Change. (2012). *The energy efficiency strategy: The energy efficiency opportunity in the UK*. Retrieved from http://tinyurl.com/o4lg5ce.

do Paço, A., & Varejão, L. (2010). Factors affecting energy-saving behaviour: A prospective research. *Journal of Environmental Planning and Management, 53*(8), 963-976.

EGAT. (2018). *EGAT overview*. Electricity Generating Authority of Thailand. Retrieved from https://tinyurl.com/y7ykq2el

Ek, K., & Söderholm, P. (2010). The devil is in the details: Household electricity saving behavior and the role of information. *Energy Policy, 38*(3), 1578-1587. https://doi.org/10.1016/j.enpol.2009.11.041

European Commission. (2005). *Education on Energy*. Retrieved from http://tinyurl.com/h67rf7x.

Goldenson, R. M., & Glanze, W. B. (1989). Longman Dictionary of Psychology and Psychiatry. New York, NY: Kaplan Publishing.

Greaves, M, Zibarras, L. D., & Stride, C. (2013). Using the theory of planned behavior to Explore environmental, behavioral intentions in the workplace. *Journal of Environmental Psychology, 34*, 109–120. http://dx.doi.org/10.1016/j.jenvp.2013.02.003

Harland, P, Staats, H, & Wilke, H. A. M. (1999). Explaining pro-environmental intention and behavior by personal norms and the theory of planned behavior. *Journal of Applied Social Psychology, 29*, 2505–2528. http://dx.doi.org/10.1111/j.1559-816.1999.tb00123.x

Janda, T. (2008). *A comparison of behavior towards power consumption of vocational students in Khon Kaen with different characterization.* Unpublished master's thesis, King Mongkut's University of Technology Thonburi, Thonburi, Thailand. Retrieved from https://tinyurl.com/yau9drr7

Kaiser, F. G., & Gutscher, H. (2003). The proposition of a general version of the theory of planned behavior: predicting ecological behavior. *Journal of Applied Social Psychology, 33*(3), 586–603. http://dx.doi.org/10.1111/j.1559-1816.2003.tb01914.x

Kao, L. S., & Green, C. E. (2008). Analysis of variance: Is there a difference in means and what does it mean? *Journal of Surgical Research, 144*(1), 158-170. https://doi.org/10.1016/j.jss.2007.02.053

Khan, K., Shah, A., & Khan, J. (2016), Electricity consumption patterns: Comparative evidence from Pakistan's public and private sectors. *The Lahore Journal of Economics, 21*(1), 99–122. Retrieved from https://tinyurl.com/y72r6vuk

Ministry of Energy. (2016). *Thailand Energy Efficiency Development Plan.* Retrieved from https://tinyurl.com/ybruqny5

Mongkhonvanit, P., Panklib, T., & Bhalla, S.K. (2015). A survey of green university: Challenges and opportunities. *International Journal of the Computer, the Internet and Management, 23*(2), 20-26. Retrieved from https://tinyurl.com/ybbd24ku

Piasiri, T. (2002). *Psycho-Social Correlates of Electric Energy Saving Behavior of Students in Green School Projects.* Unpublished master's thesis, National Institute of Development Administration, Bangkok, Thailand.

Pichalai, C. (2015). *Thailand Energy Efficiency Development Plan (2015-2036).* Ministry of Energy.

Pimdee, P. (2017). *Causal relationship model* of *Thai student energy conservation behavior. Journal of Sustainability Science and Management, 12*(2), 218-227. Retrieved from https://tinyurl.com/yck59ppn

Pimdee, P., Thiengkamol, N., & Thiengkamol, T. (2012). Psychological trait and situation affecting through inspiration of public mind to energy conservation behavior of undergraduate student. *Mediterranean Journal of Social Sciences, 3*(3), 81-87. https://doi.org/10.5901/mjss.2012.v2n3p81

Royal Institute Dictionary. (2011). Bangkok, Thailand: The Royal Society of Thailand.

Scherbaum, C., Popovich, P. M., & Finlinson, S. (2008). Exploring individual-level factors related to employee energy-conservation behaviors at work. *Journal of Applied Social Psychology*, *38*(3), 818–835. https://doi.org/10.1111/j.1559-1816.2007.00328.x

Staddon, S. C., Cycil, C., Goulden, M., Leygue, C., & Spence, A. (2016). Intervening to change behaviour and save energy in the workplace: A systematic review of available evidence. *Energy Research & Social Science, 17*, 30-51. https://doi.org/10.1016/j.erss.2016.03.027

Wang, B., Wang, X., Guo, D., Zhang, B., & Wang, Z. (2018). Analysis of factors influencing residents' habitual energy-saving behaviour based on NAM and TPB models: Egoism or altruism? *Energy Policy, 116*, 68-77. https://doi.org/10.1016/j.enpol.2018.01.055

World Energy Outlook. (2016). Retrieved from https://tinyurl.com/oex5ctd

Yamane, T. (1973). *Statistics: An introductory analysis* (3rd ed.). New York, NY: Harper and Row.