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Awareness and Attitudes of Lecturers Towards Phantom Load Management: A Survey at the Department of Electrical Engineering, Politeknik Seberang Perai

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ABSTRACT – This study investigates the awareness and attitudes of lecturers towards phantom load management at the Department of Electrical Engineering, Politeknik Seberang Perai. Phantom load, also known as standby power, contributes significantly to unnecessary energy consumption and increased utility costs. The research employed a quantitative approach, utilizing a survey methodology with 49 respondents across three programs. Findings reveal a high level of awareness among lecturers regarding phantom load, with an overall mean score of 4.27. Similarly, attitudes towards energy management related to phantom load were found to be positive, with an overall mean score of 4.23. The study highlights a strong understanding of phantom load concepts and its implications, but also identifies a gap between awareness and consistent implementation of energy-saving practices. These results underscore the importance of continued education and training programs to bridge this gap and promote more efficient energy management practices within educational institutions. The findings contribute to the broader discourse on energy conservation and sustainability in academic settings, offering insights that can inform policy and practice in reducing unnecessary energy consumption and associated carbon footprints.

KEYWORDS: Phantom load, Energy management, Lecturer awareness, Sustainability

1.0 INTRODUCTION

Energy management and carbon footprint reduction are crucial areas in combating climate change in Malaysia. In the electric power generation industry, the carbon footprintarises from the combustion of fossil fuels such as coal and natural gas. In Malaysia, the use of natural gas and petroleum-based sources contributes up to 76% of the total resources used in the electric power generation industry [1]. In addressing carbon emissions, energy management is essential in managing and reducing unnecessary energy consumption.

Energy management refers to activities that ensure efficient energy use within an organization [2]. One often overlooked component in energy management is phantom load. Phantom load, also known as standby power or vampire load, is defined as the electrical energy consumed by electrical appliances that are not performing their primary function or are not turned off [3]. Additionally, electrical devices that have been turned offbut not properly unplugged and remain in standby mode also contribute to current leakageor standby power, creating the phenomenon of phantom load [4].

2.0 BACKGROUND OF THE STUDY

The phenomenon of phantom load contributes to unnecessary energy consumption, leading to significant energy wastage. This indirectly contributes to increased utility bills and operational costs due to inefficient energy use. In educational institutions such as polytechnics, lecturers play a crucial role in educating and promoting effective energy management practices. Their awareness and attitudes towards phantom load management will influence the effectiveness of efforts to reduce unnecessary energy wastage and utility costs.

Efficient energy management is essential in educational institutions like Politeknik Seberang Perai (PSP) to ensure environmental sustainability and reduce operational costs. This study aims to assess the level of awareness and attitudes towards phantom load management at Politeknik Seberang Perai, specifically in the Department of ElectricalEngineering (JKE). This is important in reducing unnecessary energy consumption and promoting wise energy use practices among lecturers, thereby contributing to efforts to reduce unnecessary energy wastage and utility costs at Politeknik Seberang Perai, particularly in the Department of Electrical Engineering.

3.0 LITERATURE REVIEW

Various modern electrical appliances with standby modes are now available in the market, and their energy consumption is usually small. However, the prolonged use of these appliances makes their energy consumption in this mode significant. Although theseappliances can enhance flexibility and performance, they still consume energy when not performing their primary function [5]. Electrical appliances with standby modes and usingstandby power include remote-controlled televisions, cordless phones, printers, laptops,and photocopiers.

Studies conducted in several countries such as Germany, Japan, and the United States concluded that 10% of residential electricity consumption is due to phantom load [6]. In Australia, studies show that phantom load accounts for 12% (90W) of total residential electricity consumption [5]. Similar findings were reported in studies involving residentialareas in California, USA, where phantom load contributes to 13% (112W) of total energy consumption [7]. Comparatively, standby mode electricity consumption is small, around
0.5 to 30 watts [8]. However, collectively, the total electricity consumption is significant because standby power or phantom load is used 24 hours a day, and more appliances with standby mode features are entering the market.

With the widespread and advanced use of electrical appliances and the increasing development of homes and office networks, the increase in phantom load can be expectedin the future if not addressed at the national and international levels [9]. Managing energyuse to be more efficient and reducing wastage should be prioritized by organizations or institutions. Through efficient energy management, savings can be achieved by avoidingthe phenomenon of phantom load. Energy management through systematic control andoptimization of energy use in buildings and organizations aims to reduce energy consumption and costs while minimizing environmental impact [10]. The use of devices such as advanced power strips (APS) can eliminate phantom load by completely cuttingoff the power supply when not in use [11]. In the context of energy management, the useof APS in the United States for home entertainment and workspaces can save up to 106.1kWh per year [12]. This clearly shows that managing phantom load can address unnecessary energy consumption and avoid wastage.

Wasting electricity through unnecessary energy use directly impacts the environmentthrough the carbon footprint resulting from greenhouse gas emissions. The carbon footprint is defined as the emission of greenhouse gases such as carbon dioxide (CO_2),methane (CH_4), and nitrous oxide (N_2O) measured in metric tons of carbon dioxide equivalent (CO_2e) due to human or organizational activities in generating electricity basedon the combustion of fossil fuels such as natural gas and coal [13]. The main contributorto the carbon footprint through greenhouse gas emissions in Malaysia is the electric powergeneration industry [14]. Therefore, efficient and optimal energy management can significantly impact electricity savings in efforts to reduce the carbon footprint through greenhouse gas emissions and provide financial returns from the savings made. The primary cause of climate change is greenhouse gas emissions resulting from human activities [15], particularly in the electric power generation industry.

4.0 PROBLEM STATEMENT

Politeknik Seberang Perai (PSP) is the 10th polytechnic established by the Malaysian government to provide a workforce based on TVET, which is Technical and Vocational Education and Training. The Department of Electrical Engineering at Politeknik SeberangPerai offers three study programs based on disciplines in electrical and electronic engineering, and the teaching and learning processes are conducted in laboratories, workshops, and lecture rooms around the Department of Electrical Engineering. With the presence of laboratories and workshops, workspaces are filled with various electrical appliances used in teaching and learning activities, such as computer sets, laptops, printers, photocopiers, mobile phones, webcams and many more.

Generally, the increase in electrical appliances in each workspace in laboratories and workshops will increase utility costs and indirectly increase the use of phantom load or standby power. Approximately 48% of the total energy generated is used by the buildingsector, making it the highest energy consumer [16]. The increase in overall electricity consumption will contribute to an increased carbon footprint. In the context of educationalinstitutions, a carbon footprint of 234,765 tCO2 can be produced with a population of 31,302 people solely through electricity use [17].

The increase in utility costs is not a good indicator in the management of an organization. Efficient and optimal energy management can reduce and save utility costswhile addressing wastage through unnecessary energy use. Inefficient energy use due tophantom load is an issue that receives little attention in educational institutions. Althoughmuch focus has been given to energy management, there is still a lack of understandingof the actual impact of phantom load or standby power and effective measures that can be taken to reduce it.

There is a need to assess the level of awareness and attitudes towards phantom load management among the staff of the Department of Electrical Engineering at Politeknik Seberang Perai. Changes in attitudes, practices, and awareness are essential in reducing unnecessary energy consumption and promoting wise energy use practices among lecturers.

5.0 RESEARCH OBJECTIVES

The implementation of this study aims to achieve the following objectives:

1. Identify the level of awareness among lecturers in the Department of Electrical Engineering at Politeknik Seberang Perai (JKE PSP) regarding phantom load.
2. Examine the attitudes of lecturers towards energy management related to phantomload.

6.0 RESEARCH OBJECTIVES

The research questions are as follows:

1. What is the level of awareness among lecturers in the Department of Electrical Engineering at Politeknik Seberang Perai (JKE PSP) regarding the concept of phantom load?
2. What are the attitudes of lecturers towards energy management related to phantomload?

7.0 SIGNIFICANCE OF THE STUDY

The implementation of this study aims to achieve the following objectives:

1. Assist educational institutions in understanding the level of awareness andattitudes of lecturers towards the issue of phantom load.
2. Provide recommendations for educational and training programs that can be implemented to reduce unnecessary energy consumption.
3. Foster efforts towards more efficient and sustainable energy use, besides savingutility costs and reducing the carbon footprint.

8.0 SCOPE OF THE STUDY

The Department of Electrical Engineering at Politeknik Seberang Perai (JKE PSP) hastwelve laboratories, four lecture rooms, and a workshop to support practical work, workshops, and lectures related to disciplines in electrical engineering. This study only involves the level of awareness, attitudes, and recommendations for managing phantomload in the daily electricity use of lecturers at JKE PSP. However, this study does not focuson the usage rate of each electrical appliance at JKE PSP, work schedules, class schedules, research activities, and building design due to time and cost constraints for conducting further studies.

9.0 METHODOLOGY

The research findings are determined by the methodology and study design. The research design serves as a guide to the appropriate methodological approach for the study [18]. For this study, a quantitative approach through a survey was used. The surveymethod is simple and popular among researchers. It involves studying current issues or scenarios, with data collection conducted within a specific period.

For this study, a questionnaire was used as the data collection instrument. This type of instrument is more suitable due to the large population size. The questionnaire was constructed using a Likert Scale, where respondents' answers are measured as shown in Table 1. The questionnaire is divided into three sections: Section A for demographics, Section B to assess awareness levels, and Section C to evaluate respondents' attitudes.

Table 1: Likert Scale

Score	Scale
1	Strongly Disagree
2	Disagree
3	Slightly Disagree
4	Agree
5	Strongly Agree

The primary source of data for a study is through sampling [19]. The sample for this study consists of lecturers at JKE PSP. The respondents for this study comprise 52 individuals selected through purposive sampling, a type of non-random sampling. This method was chosen to obtain a sample size that represents the population and can contribute to the desired research findings. The questionnaires were distributed online viaJotform using a quick-response (QR) code.

Table 2: Mean Score Interpretation

Mean Value	Evaluation Level
1.00 - 2.00	Low
2.01 - 3.00	Moderately Low
3.01 - 4.00	Moderately High
4.01 - 5.00	High

10.0 RESEARCH FINDINGS

The discussion of the research findings is divided into three sections. The first sectioninvolves the profile of the respondents, who are lecturers in the Department of ElectricalEngineering at Politeknik Seberang Perai. The second and third sections respectively discuss the level of awareness and attitudes among lecturers towards phantom load and energy management involving phantom load.

10.1 Section A: Respondent Profile

A total of 49 out of 52 respondents provided feedback through an online questionnaire distributed via Jotform. Table 3 shows the breakdown of respondents by program.

Table 3: Breakdown of Respondents by Program

Program	Number	Percentage
Diploma in Electrical & Electronic Engineering (DEE)	22	44.9%
Diploma in Electronic Engineering (Communication) (DEP)	12	24.5%
Diploma in Electronic Engineering (Computer) (DTK)	15	30.6%

From the findings, 22 respondents (44.9%) are from the Diploma in Electrical & Electronic Engineering (DEE) program, 12 respondents (24.5%) are from the Diploma in Electronic Engineering (Communication) (DEP) program, and 15 respondents (30.6%) arefrom the Diploma in Electronic Engineering (Computer) (DTK) program.

10.2 Section B: Lecturers' Awareness of Phantom Load

Table 4 presents the overall findings regarding the respondents' awareness of phantom load. The findings shown in Table 4 are responses from all respondents acrossthree programs in the Department of Electrical Engineering at Politeknik Seberang Perai. The data indicates that awareness of phantom load is high among respondents, with anoverall mean score of M=4.27 and a standard deviation of SD=0.54.

Table 4: Overall Findings on Awareness Level

No.	Item	N	Mean (M)	Standard Deviation (SD)	Level
1	I know what phantom load is.	49	4.20	0.50	High
2	I am aware that phantom load contributesto energy wastage.	49	4.43	0.61	High
3	I am aware that electrical appliances consume energy even in standby mode.	49	4.63	0.49	High
4	I am aware of the importance of reducing unnecessary electrical energy consumption.	49	4.20	0.50	High
5	I understand the impact of phantom load on electricity bills.	49	4.51	0.51	High
6	I frequently check electrical appliances toensure they are not continuously consuming energy.	49	4.04	0.71	High
7	I know the steps that can be taken toreduce phantom load.	49	4.16	0.66	High
8	I often practice efficient energy use at homeand work.	49	4.12	0.39	High
9	I believe that reducing unnecessary energy consumption can lessen the negative impact on the environment.	49	4.27	0.45	High
10	I am aware that using energy-efficient technology is important in managing phantom load.	49	4.18	0.49	High
	Overall Mean		**4.27**	**0.54**	

Item 3, "I am aware that electrical appliances consume energy even in standby mode,"recorded the highest mean score of M=4.63 with high response consistency (SD=0.49). The lowest mean score was for Item 6, "I frequently check electrical appliances to ensurethey are not continuously consuming energy," with M=4.04 and the lowest response consistency (SD=0.71). Item 8, "I often practice efficient energy use at home and work,"showed the lowest response consistency with SD=0.39 compared to other items tested.

10.3 Section C: Lecturers' Attitudes Towards Energy Management Related to Phantom Load

Table 5 presents the overall findings regarding the respondents' attitudes towards energy management related to phantom load. The findings shown in Table 6 areresponses from all respondents across three programs in the Department of Electrical Engineering at Politeknik Seberang Perai. The data indicates that respondents' attitudestowards energy management related to phantom load are high, with an overall mean score of M=4.23 and a standard deviation of SD=0.69.

Table 5: Overall Findings on Attitude Levels

No.	Item	N	Mean (M)	Standard Deviation (SD)	Level
1	I consider managing phantom load important for saving energy.	49	4.22	0.47	High
2	I am concerned about energy wastagedue to phantom load.	49	4.22	0.55	High
3	I am willing to change my energy usage habits to reduce phantom load.	49	4.27	0.60	High
4	I believe it is important to reduce theenergy consumption of electrical appliances in standby mode.	49	3.96	0.50	Moderately High
5	I turn off electrical appliances after use.	49	4.41	0.84	High
6	I unplug unused appliances to avoid phantom load.	49	3.96	0.79	Moderately High
7	I always ensure my computer is in sleep or shutdown mode when not inuse.	49	3.98	0.48	Moderately High
8	I believe that training and education onenergy management are important forall lecturers.	49	4.41	0.76	High
9	I am willing to encourage my colleagues to participate in efforts toreduce phantom load.	49	4.29	0.74	High
10	I am willing to participate in phantomload management efforts at work.	49	4.55	0.77	High
	Overall Mean		**4.23**	**0.69**	

Item 4, "I believe it is important to reduce the energy consumption of electrical appliances in standby mode," shows a moderately high attitude level (M=3.96, SD=0.50).The highest mean score is for item 10, "I am willing to participate in phantom load management efforts at work," with M=4.55 and SD=0.77. Items 1 (M=4.22, SD=0.47) and2 (M=4.22, SD=0.55) have the same mean score but slightly different standard deviations.The highest response consistency is for item 5 (SD=0.84), "I turn off electrical appliances after use," despite its relatively high mean score (M=4.41).

11.0 DISCUSSION

Overall, the data in Table 4 indicates that awareness of phantom load is high among respondents, with an overall mean score of M=4.27 and a standard deviation of SD=0.54. Respondents exhibit a high level of awareness about phantom load and its impact on energy wastage. This high level of awareness is reflected in items 1 (M=4.20), 2 (M=4.43),and 3 (M=4.63). Items 1 and 2 address the fundamental concepts of phantom load. Mostrespondents have a strong understanding of the concept of phantom load and the associated energy wastage. However, item 6, “I frequently check electrical appliances athome/office to ensure they are turned off when not in use,” has the lowest mean score of
M=4.04. This suggests that while respondents are aware of the issue, the practice of regularly checking electrical appliances may not be as prevalent.

From the findings in Table 5, it is evident that respondents have a positive attitude towards energy management related to phantom load. This is demonstrated by the overallmean score for the 10 items, which is high at M=4.23. The mean scores for items 3 (M=4.27) and 10 (M=4.55) indicate that respondents are willing to change their behaviourfor better energy management related to phantom load. Respondents show a high levelof concern and attitude towards energy saving through phantom load management, as indicated by item 1 (M=4.22). However, for item 6 (M=3.96), the attitude or behaviour towards implementing energy-saving measures is at a moderately high level. Thisindicates that the attitude or behaviour towards addressing phantom load, as reflected initem 6, is not yet fully aligned with the concern and attitude shown in item 1.

12.0 CONCLUSION

The analysis conducted indicates that respondents generally have a high level of awareness about phantom load. Respondents understand what phantom load is, its effects, and the importance of reducing unnecessary power consumption, with most mean scores ranging between 4.01 and 5.00. The overall mean score (M) of 4.27 reflectsa good understanding of this concept. In terms of attitude analysis, the overall mean scoreis 4.23, indicating that respondents have a positive attitude towards managing phantom load. They are concerned about energy wastage due to phantom load and are willing tochange their energy usage habits.

The small difference in overall mean scores suggests that the level of awareness andattitudes towards phantom load are almost the same among respondents. This implies that respondents who are aware of phantom load also tend to have a positive attitude towards its management. The standard deviation (SD) for attitude (SD=0.69) is higher than for awareness (SD=0.54). This indicates that while perceptions of phantom load arerelatively uniform among all respondents, there is a wide variation in how respondents view and respond to this phenomenon. This may be due to factors such as personal beliefs, experiences, and in-depth knowledge about phantom load management measures derived from these findings.

REFERENCES

[1] *Malaysia Energy Statistics Handbook 2021*., Suruhanjaya Tenaga., Putrajaya,2022, pp. 28–35.

[2] *Mengenai Pengurusan & Kecekapan Tenaga – SEDA Malaysia* [Online]. Available: https://www.seda.gov.my/ms/tuntutan-pengurusan-tenaga-edm/about-energy- management-efficiency/.

[3] B. Mohanty, "Standby Power Losses in Household Electrical Appliances and Office Equipment," in *Regional Symposium on Energy Efficiency Standards and Labelling*, Bangkok, Thailand, May 29–31, 2001, pp. 1–25.

[4] K. Clement, I. Pardon and J. Driesen, "Standby Power Consumption in Belgium," in *2007 9th International Conference on Electrical Power Quality and Utilisation*, Barcelona, Spain, 2007, pp. 1-4

[5] L. Harrington, H.-P. Siderius, and M. Ellis, "Standby Power: Building a Coherent International Policy Framework," in *2008 ACEEE Summer Study onEnergy Efficiency in Buildings*, Washington, 2008, pp. 134–149.

[6] J. P. Ross, and A. Meier, “Whole-House Measurements of Standby Power Consumption,” in *Energy Efficiency in Household Appliances and Lighting*. Berlin:Springer, 2001, pp. 278–285.

[7] A. Meier and B. Nordman, “Low Power Mode Energy Consumption in CaliforniaHomes," in *2008 ACEEE Summer Study on Energy Efficiency in Buildings*, Washington, 2008, pp. 211–220.

[8] P. Bertoldi, B. Aebischer, C. Edlington, C. Hershberg, B. Lebot, J. Lin, T. Marker, A. Meier, H. Nakagami, Y. Shibata, H. P. Siderius, and C. Webber, "Standby poweruse: How big is the problem? What policies and technical solutions can address it?" in *2008 ACEEE Summer Study on Energy Efficiency in Buildings*, Washington, 2008, pp. 41–60.

[9] W. Mungwititkul and B. Mohanty, “Energy Efficiency of Office Equipment in Commercial Buildings: The case of Thailand,” *Energy*, vol. 22, no. 7, pp 673-680,1997.

[10] S. A. Roosa, S. Doty and W. C. Turner, “Effective Energy Management,” in *EnergyManagement Handbook*, Kentucky: River, 2018, pp 17-26.

[11] L. Earle and B. Sparn, “Results of Laboratory Testing of Advanced Power Strips,” in *ACEEE Summer Study on Energy Efficiency in Buildings*, California,2012, pp 1-12.

[12] K. Koser and C. Uthe, "Advanced power strip research report," NYSERDA, Albany,New York, 2011.

[13] M. J. Franchetti and D. Apul, “Denitions of Carbon Footprint Analysis and RelatedConcepts” in *Carbon Footprint Analysis: Concepts, Methods, Implementation, andCase Studies*, 1st ed., Florida: CRC Press, 2012, pp. 2–22

[14] T. M. I. Mahlia, “Emissions from Electricity Generation in Malaysia,” *RenewableEnergy*, vol. 27, no. 2, pp 293–300, 2002.

[15] N. Stern, “Climate Change – Our Approach,” in *The Economics of Climate Change:The Stern Review*, Cambridge: Cambridge University Press, 2007, pp. 1-46.

[16] N. Zamri and N. K. Mohamad, "Study of Building Energy Index in Universiti Tun Hussein Onn Malaysia," *Academic Journal of Science*, vol. 1, no. 2, pp. 429-433,2012.

[17] A. Kadaruddin, M. J. Jamaluddin, A. Kadir, and A. Azahan, "Climate Change andCarbon Reduction Initiatives," in *Proceedings of the International Conference on Human Habitat & Environmental Change*, Bangi, Malaysia, 3-4 Dec. 2008, pp. 388-395.

[18] M. Othman, *Penulisan Tesis dalam Bidang Sains Sosial Terapan*. Serdang,Malaysia: Penerbit Universiti Putra Malaysia, 2001.

[19] M. N. A. Ghafar, *Penyelidikan Pendidikan*, 1st ed. Johor Bahru, Malaysia: UniversitiTeknologi Malaysia, 1999.