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DETERMINANT FACTORS OF ENERGY CONSUMPTION SAVINGS IN URBAN HOUSEHOLDS

Sri Ambarwati[*)], Eka Sudarmaji[*)1]

[*)]Faculty of Economics and Management, University of Pancasila
Jl. Srengseng Sawah, Lenteng Agung Jakarta 12640, Indonesia

Abstract: Based on urban homes' typical features and socioeconomic characteristics, this experimental research examined consumer behavior patterns regarding energy efficiency and the factors influencing energy saving. This research investigated the idea of "nudge" with power conservation. This research used the word "Nudge" in the chosen architectural scheme to reduce residential power use to prevent the rebound effect. We found that 'nudged' households could lower their power usage costs by utilizing societal norms. The "Nudge" criteria we included discussed general knowledge of energy saving and the usage of societal norms that encourage replacing conventional lighting with energy-efficient ones. In this research, sixty-two homes were chosen and given a "nudge" over three months. The homes' sizes must range from 40 to 200 square meters and have had current electrical accounts for at least a year. This research in Bantul was intended to investigate the impact of "home energy reporting" and how social norms, curtailment, and energy conservation practices differ depending on shared traits like the home's features and the owner's socioeconomic status. According to this research, "social norms and curtailments" can lower home power usage, resulting in electricity cost savings of up to 16.305 percent for three months compared to typical consumption. On the savings that were realized, there was no rebound impact.

Keywords: rebound effect, household energy efficiency, social norms, nudge, saving behavior

Abstrak: *Penelitian ini menganalisis pola perilaku konsumen mengenai efisiensi energi dan faktor-faktor yang mempengaruhi 'penghematan energi' berdasarkan karakteristik umum rumah tangga dan karakteristik sosial ekonomi. Penelitian ini menggunakan istilah 'Nudge' dalam program arsitektur yang dipilih, yang bertujuan untuk mengurangi konsumsi listrik rumah tangga sehingga tidak terjadi 'efek rebound'. Dengan memanfaatkan norma dan kendala sosial, kami menemukan bahwa setiap rumah tangga dapat mengurangi biaya penggunaan listrik mereka. Penelitian ini memasukkan informasi tentang biaya listrik rumah tangga dan penggunaan norma sosial yang membahas tentang informasi umum tentang konservasi energi dan penggantian lampu konvensional dengan lampu hemat energi. Enam puluh dua responden rumah tangga di pilih didalam penelitian ini dan diberikan dorongan selama lebih dari tiga bulan. Penelitian ini kemudian mengamati hasil dari dorongan tersebut tersebut terhadap biaya energi setiap rumah tangga tersebut. Setiap rumah tangga harus memiliki rekening listrik aktif minimal satu tahun dan memiliki ukuran rumah antara 40 dan 200 meter persegi. Penelitian di Bantul ini diharapkan dapat mengeksplorasi pengaruh 'pelaporan pengunaan energi rumah tangga dan juga mengkaji bagaimana norma sosial, penghematan, dan praktik efisiensi energi bervariasi berdasarkan karakteristik umum seperti atribut rumah dan karakteristik sosial ekonomi pemiliknya. Penelitian ini menemukan bahwa 'norma dan pembatasan sosial' dapat mengurangi konsumsi listrik rumah tangga, dan terjadi penghematan biaya listrik dibandingkan konsumsi listrik rata-rata hingga 16,305 persen selama tiga bulan. Penelitian ini juga tidak ditemukan efek rebound pada penghematan yang terjadi.*

Kata kunci: *efek rebound, efisiensi energi, norma sosial, nudge, perilaku hemat*

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[1] Alamat Korespondensi:
Email: esudarmaji@univpancasila.ac.id

INTRODUCTION

The economic repercussions of climate change are extensive and multifaceted, and they may ultimately be far more severe, especially for human health. Numerous environmental issues have plagued Indonesia, particularly the possibility of climate change. According to the (World Bank, 2018), economic losses caused by climate change in Indonesia are projected to range between 2.5 and 7.0 % of the gross domestic product by 2100. Health issues caused by air pollution can cost the government over $400 million yearly. Along with population increase, fast urbanization, and economic growth, the housing sector's final energy consumption has contributed to an upward trend in CO^2 emissions. Indonesia is going on a road to cutting its greenhouse gas emissions by up to 26% unilaterally and 41% with international cooperation. Increasing energy efficiency can reduce the number of greenhouse gases emitted into the atmosphere, as it reduces the number of fossil fuels that need to be burned to generate energy. Reducing energy consumption through increased efficiency can have several benefits for the climate. Therefore, energy efficiency is evidence of energy-saving conduct. Energy efficiency indicators are beneficial because they link energy consumption to important activity metrics such as the gross domestic product and the value of a country's product output (Sudarmaji et al. 2022b). A tight relationship exists between increased energy consumption and economic expansion, products and services, population growth, and transportation. Thus, energy indicators are valuable tools for policymakers and can anticipate future energy consumption trends.

As Indonesia's population grows, there are more of these households, which raises the country's degree of urbanization. The country with the fastest rate of urbanization is Indonesia. In 1982, the urban population growth rate peaked at 5.2% and fell to 2.4% in 2017. The Ministry of Energy and Mineral Resources Republic of Indonesia (2018) estimates that there were 67,171 million homes and 261,891 million people in Indonesia in 2017. More than 55.33% of Indonesia's total population, or more than that, lives in urban areas, according to figures from the World Bank. The demand for and usage of electronic home appliances in Indonesia is significantly impacted by the rise in family income brought on by population growth. The desire for technology devices and residential appliances is driving up energy consumption. As a result, Indonesia's overall energy consumption has increased, with the household among the nation's primary energy consumers (Figure 1) the percentage of household energy usage increased to 15.45% in 2107.

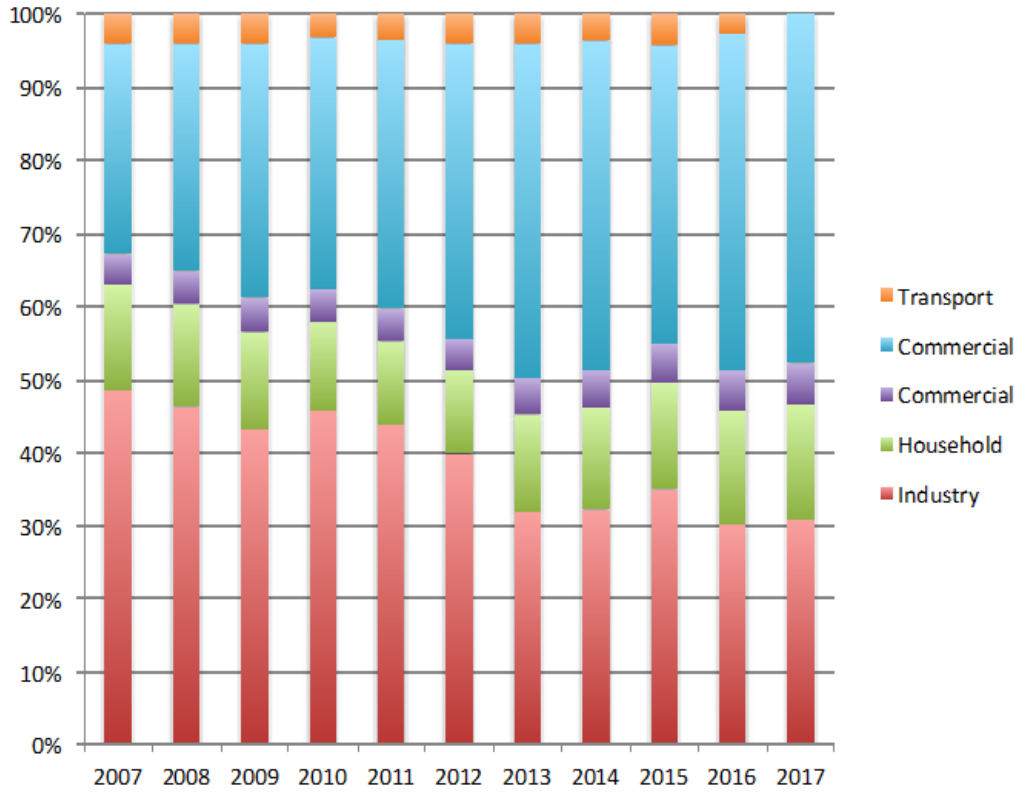

Figure 1. Presentation of energy use by Indonesia sector in 2016 (MEMR, 2017)

Without savings, Indonesia will have difficulty meeting its future energy demands (ASEAN Secretariat, 2019; Fünfgeld, 2020). Its fast economic expansion must be tempered with the need for substantial energy investments. The extremely high energy demand results from increased activity, which leads to increased customers, a persistent problem (Lee and Yang, 2015; PLN (Persero), 2018). A thorough energy efficiency program in the housing sector can cut energy demands, particularly in 2030 at peak loads. Unfortunately, many widely recognized energy efficiency initiatives and solutions fail to reduce energy use by the amount predicted by simple engineering models. The appearance of a rebound effect is one cause. Without a grasp of the impacts of rebound and savings, energy conservation initiatives cannot achieve their savings goals. By implementing a comprehensive program for energy efficiency in the housing sector, Indonesia can cut its peak demand in 2030. This research was interested in the existing barriers, why adopting energy-efficient technologies and programs in Indonesia is so tricky, and how to best deal with and reduce the rebound effect after savings have been realized.

According to earlier studies, adopting energy-efficient products was more common than following cultural norms in general (Ha and Janda, 2012). Therefore, individual behavior is the main factor affecting energy efficiency and does not directly depend on general cultural standards (Lingyun et al. 2011). (Cowan and Daim, 2013) propose integrating social elements within community groups, such as incentive-based government regulations and educational programs, to harmonize views of a healthy environment. Government involvement in educational initiatives or public awareness campaigns on green technology can boost neighborhood environmental protection efforts and cost-effectiveness (Malkani, 2012). The effectiveness of a clean and healthy environment campaign largely rests on government backing for the social norm approach to influencing behavior around the usage of energy-efficient items (Horne and Kennedy, 2017).

As described in the context of this research, several factors may influence the standard and socioeconomic characteristics of households in their adoption of energy efficiency. Several scientific results highlight the numerous barriers to energy efficiency and how to overcome them (Sudarmaji et al. 2021, 2022; Dobbs et al. 2013; Gerarden, Newell, and Stavins, 2015; Schleich, 2019). In neoclassical economics, "market barriers" and "non-market barriers" are two impediments to energy efficiency (O'Malley, Scott, and Sorrell 2003). Non-market obstacles can close societal energy efficiency disparities, according to O'Malley et al. (2003) and United States Environmental Protection (2008). However, this was not the case in China, where Wang, Wang, and Guo (2017) found that government policies did not influence the decision of Chinese homeowners to implement energy efficiency measures. Several elements, including energy performance, environment, and, most crucially, power pricing, will also influence the efficacy of energy expenses (Banfi et al. 2008).

In contrast, the 'nudge effect' notion is extensively employed due to its capacity to alter individuals' behavioral adoption (Thaler and Sunstein, 2008). The 'nudge effect' theory offers incentives to change people's behavior on multiple dimensions, such as their propensity to save money or switch to energy-efficient products. The United Kingdom, the United States, and Australia have established "Nudge units" to test and produce good consequences that outweigh low-cost implementations in terms of advantages. The term "nudging" is used by proponents of "libertarian paternalism" to improve the impact of policy thought. According to "libertarian" proponents, one of their tactics is the idea that decisions may be affected by "framing" or the words or methods of presentation (Thaler and Sunstein 2003). This research used the "framing" option to satisfy customer demands while using the most economical solutions. To achieve the intended goals, namely energy conservation and consumption reduction, and maximize their energy expenses. To lower the costs connected with family energy usage, the nudge theory is utilized to limit alternatives (framing). The claimed goal is to increase energy efficiency, practice energy conservation, and lower carbon emissions. This research answers the critical question of whether urban families can adopt the Nudge notion into their behavior. We must understand the numerous barriers that prevent the "nudge effect" endeavor from being implemented before we can respond to this question. Thus, it is possible to explore the applicability of the nudge theory in carrying out societal activities to reduce energy use using a qualitative manner. To reduce household power consumption, this research used the "nudge effect" in the chosen architectural scheme. A strategy to reduce

energy costs by evaluating the cost of home use against the national average. As discussed in this research, numerous factors may affect how families embrace energy efficiency in terms of their standard and socioeconomic features. This research examines the framework or factors influencing consumer behavior toward new technological devices that can lower energy expenditures to close the energy efficiency gap in the residential sector.

According to Karali et al. (2015), a policy targeted primarily at the housing industry might prevent billions of dollars from being invested in the energy sector. In Indonesia, many researchers have focused on studying the energy consumption characteristics of urban households and identifying the factors that affect their usage (Cahyani et al. 2022; Surahman et al. 2022). However, this research took a different approach and used the nudging technique to encourage energy-efficient habits among urban households. This technique involves using subtle prompts to encourage desirable behavior. The goal was to reduce urban household energy consumption by promoting small but impactful behavioral changes. One of the reasons this research researched the Nudging one energy efficiency is because research on energy efficiency is rarely found in Indonesia. This research has novelty (newness) because research on the behavior of regional individuals in urban household areas in Indonesia has never been studied before. These urban household consumers need a track record in energy absorption efficiency and have a relatively lower awareness of energy conservation.

This research aims to find a descriptive, theoretical approach to advise stakeholders on improving decision-making by establishing a framework, evaluating government regulations on energy sector development in households, and surveying household heads' expectations of energy efficiency and rebound effect on their judgment. It was hoped that the results of this research would help people better comprehend the idea of "nudges" and the architectural program alternatives available for energy conservation programs in the Indonesian home sector. When trying to understand the concept of "Nudges" and alternative program design in Indonesia's family sector and energy efficiency, policymakers would benefit from viewpoints incorporating regulatory, behavioral, knowledge, and cultural issues. This business will expand more quickly owing to limited energy supplies, significant energy investments, and increasing energy consumption caused by Indonesia's growing wealth and economic development.

METHODS

Beginning with the formulation of the problem, data collection, and data processing were followed by the preparation of research reports. The mixed qualitative and quantitative approach was derived from various population data from the Bantul region. This research restricts the investigation to the dispersed home environments in the Bantul Regency. In contrast, economic and non-economic impediments will also be examined to present a complete domain picture. This research examined how much money people save on average due to their energy-efficient behavior. This research only looks at what happens when an increase in equipment efficiency leads to a decrease in the relative cost of equipment maintenance. Standard criteria like dwelling features and the owner's socioeconomic status were also explored in this research. This research's focus on the urban environment, which comprises various residences, makes it novel. Based on 1) dwelling parameters, such as size, 2) equipment characteristics, and 3) the intensity of equipment used for recreational and domestic activities, the total household electricity consumption shows households' characteristics and socioeconomic features. These factors were considered critical determinants of how households reacted to the energy-saving information.

As seen in Figure 2, this behavioral element is exceptionally interactive. Examining and coding the research's detailed notes, including all data generated from surveys, questionnaires, interviews, and documentation, focuses on the factors influencing energy saving. This research offers new insights into the factors that influence common characteristics, such as house attributes and socioeconomic characteristics, within the urban community of the Bantul district.

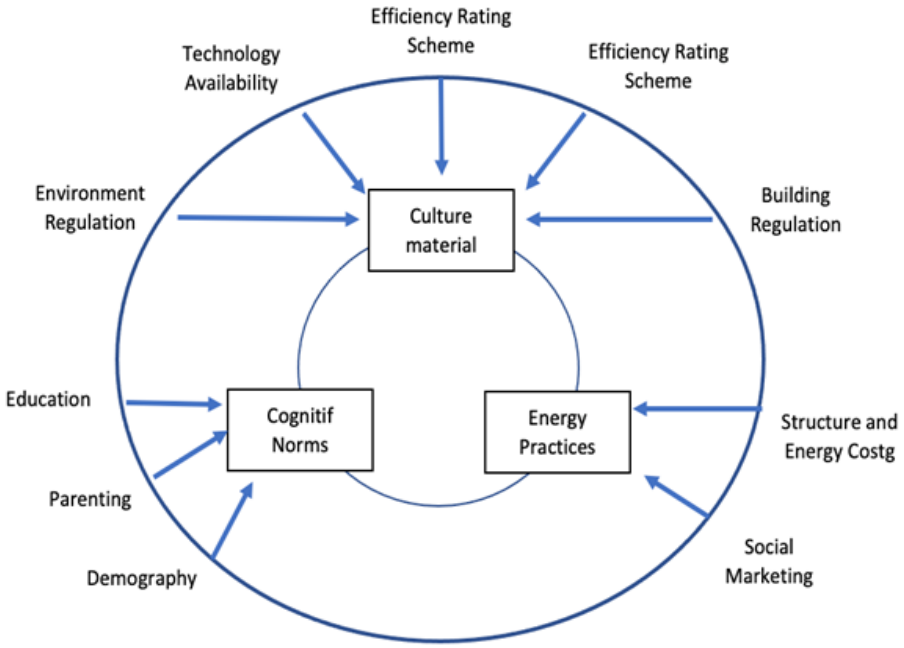

Figure 2. Cultural framework and energy efficiency (Stephenson, 2012)

Data gathering and processing were followed by compiling research reports, beginning with conceptualizing the problem. The researchers chose Bantul, Yogyakarta because its urban community represents the majority of urban communities on Java Island, where familiarity and cooperation among households are closely intertwined, marked by active deliberation among individuals in addressing issues in their area. The people of Bantul, Yogyakarta, also actively follow technological developments and have an open mindset in receiving feedback from outsiders, making it much easier for the research to be carried out. This hybrid qualitative and quantitative approach was used to observe and understand occurrences. The Data Sources and Determination Methods include a series of semi-structured interviews with multiple stakeholders from a purposefully selected sample. Secondary data were gathered from Bantul government records, power usage statistics, and other papers in the second stage. This research uses these data to understand better typical characteristics, such as house attributes and socioeconomic factors, and to determine the essential points to be addressed during interviews and observations.

A questionnaire was administered to a purposefully selected sample of stakeholders. In this method, the researcher collects data, analyzes it, and searches for a corresponding theory to determine the interconnectedness of the final results. Through interviews, this research intends to gather accurate information that can only be gained directly from household heads. Samples and responders were chosen with care to represent actual events accurately. Secondary data were gathered from Bantul government records, power usage statistics, and other papers in the second stage. This research uses these data to understand better common characteristics, such as house attributes and socioeconomic factors, and to determine the essential points to be addressed during interviews and observations. In the meantime, primary data was collected via surveys, discussions, and questionnaires designed between December 2021 and April 2022. This research used purposive sampling to select participants based on specific criteria relevant to the research question. It is due to the research wanting to target a particular group of individuals. The main advantage of purposive sampling is that it can provide highly targeted and relevant data for the research question. The duration of the interviews ranges from twenty to sixty minutes. Each responder was requested to provide feedback such as 1) their definition of energy-efficient products or energy-efficient equipment, 2) the beginnings of the notion of energy-efficiency technologies and energy-

efficient equipment and goods, 3) the notion of cutting behavior (curtailment) has been shown effective elsewhere in decreasing energy expenses, 4) adoption the execution or use of the new equipment technology of the energy-efficient product and how it relates to the implementation of the energy efficiency strategy on the equipment technology as a whole, and 5) confirm energy efficiency usage and significant success aspects of the equipment technology's energy efficiency plan.

The first and second steps were expected to identify critical dimensions, modify the model or framework established through the initial hypotheses, revise the initial questionnaire provided, and adopt the appropriate questionnaire covering all industrial, technical, and managerial aspects. Consequently, the third step is to utilize the primary data collected in the form of a questionnaire that has been revised from the initial questionnaire. In this research, either the initial or revised questionnaire was randomly distributed to business actors. The purpose of the original questionnaire was to assess the validity and reliability, followed by a final revision. Before revising the questionnaire, this research conducted a series of surveys and interviews to capture the reality of the natural environment, relate it to existing scientific theories (process induction), and match it with the questionnaire. The questionnaire was standardized, with respondents being given the same questions in the same sequence, and it was anticipated that the answers tended to be consistent. The comparative analysis was used to analyze the data, line by line, to capture the concepts and relationships between all variables.

Interviews, surveys, and preliminary questionnaires. In order to analyze the phenomena of energy efficiency implementation and research the background and applicable practices, existing programs, activities that have been carried out, and legislation, several respondents were randomly chosen in the form of case studies. Existing regulations and relevant relationships were being examined at this time. It was followed by collecting more detailed data or information via the subsequently revised questionnaire, which combines closed and open questions. Preliminary findings The rational decision through the induction process to add the perspective of using this case research was based on the expected increase in the ability to replicate the actual situation of the analysis to obtain confirmation of the existence of theoretical cases or contradictory findings from selected topics. The research population comprises family heads who own homes in the Bantul area. This research used the purposive sample, which included 62 households from 300 households under one community unit (RW) in the Bantul area, Jogjakarta districts. The selection of the research sample was based on 1) at least one year with an active electricity bill, 2) owning a home between 50 and 200 square meters in size, and 3) Because many household units launch their micro, small, and medium-sized enterprises (MSME) from their homes, the selected target respondents use only electrical energy sources for non-business purposes. To pick responders who utilize electrical energy as an input to provide comfort (such as interior temperature) and family entertainment. Building owners, managers, and responsible business and operational managers can represent building owners.

This research employs an experimental approach, the most common research design in social science (Sudarmaji and Munirah, 2019; Enkel et al. 2009; Shadish et al. 2002; Trochim, 2002). The main goal of this research was to give the home group more knowledge and instruction. Data was gathered using survey methods, including interviews and questionnaires. Utilizing both quantitative and descriptive techniques, the collected data were examined. The validity test was performed to ascertain whether or not each respondent's interpretation of each statement item on the research instrument was the same or entirely different. The research instrument was deemed legitimate if the respondent's interpretation was the same; if it was different, it was deemed invalid and had to be changed or replaced. While this was going on, a reliability test was carried out to assess how consistently respondents had answered the statement items on the instrument. This research provided the hypothesis that '**the Energy savings on energy consumption occur when urban households are given a nudge approach'.** This hypothesis is based on the energy framework that Stephenson et al. (2010) developed and evaluated using multiple linear regression equations. Multiple linear regression analysis was employed to create a model and investigate the influence of one or more independent variables (Independent Variable) on a single dependent variable. Stephenson et al. (2010) created an energy framework that consumer energy behavior could examine the interaction between cognitive norms (e.g., beliefs, understanding), material culture (e.g., technology, building form), and energy practices (e.g., activities, processes). The framework research can be seen in Figure 2.

RESULTS

This research investigates whether the rebound effect occurs when these households can reduce their energy costs through knowledge of adopting energy-saving equipment technology and proper consumption-saving programs. This research was expected to provide clear answers and insights about how common characteristics such as housing and socioeconomic factors were related to energy conservation policies in Indonesia. The pilot experiment occurred in the Bantul district; see Table 1.

Table 1. Bantul regency profile

Subdistrict	Village / Village Status		Area (Km^2)	Average Temperature		Head of Family
	Rural	Urban		Max	Min	
Srandakan	Poncosari	Trimurti	18.32	37	22	8,626
Sanden	SriGading	Gadingsari	23.16	35	25	9,126
	-	Gadingharjo				
	-	Murtigading				
Kretek	Tirtohargo	Donotirto	26.77	32	28	8,814
	Parangtritis	-				
	Tirtosari	-				
	Tirtomulyo	-				
Pundong	Seloharjo	Srihardono	24.30	30	24	9,440
	Panjang rejo	-				
Bambanglipuro	Sumbermulyo	Sidomulyo	22.70	32	23	11,794
	-	Mulyodadi				
Pandak	Caturharjo	Wijirejo	24.30	32	20	14,232
	Triharjo	-				
	Gilangharjo	-				
Bantul	Sabdodadi	Palbapang	21.95	32	23	17,804
	-	Ringin harjo				
	-	Bantul				
	-	Trirenggo				
Imogiri	Selopamioro	Kebonagung	54.49	36	23	17,158
	Sriharjo	Karangtalun				
	Karangtengah	Imogiri				
	-	Wukirsari				
	-	Girirejo				
Dlingo	Mangunan	Dlingo	55.87	32	24	10,320
	Muntuk	-				
	Temuwuh	-				
	Jatimulyo	-				
	Terong	-				
Jetis	Patalan	Trimulyo	21.47	30	25	15,461
	Canden	Sumberagung				
Pleret	Bawuran	Wonokromo	22.97	34	22	12,535
	Wonolelo	Pleret				
	Sgoroyoso	-				
Piyungan	Sitimulyo	Srimulyo	32.54	32	23	13,471
	-	Srimartani				
Banguntapan	Tamanan	Baturetno	28.48	37	24	28,591
	Jagalan	Banguntapan				
	Singosaren	-				

Table 1. Bantul Regency Profile (Continue)

Subdistrict	Village / Village Status		Area (Km^2)	Average Temperature		Head of Family
	Rural	Urban		Max	Min	
	Wirokerten	-				
	Jambidan	-				
	Potorono	-				
Sewon	Pendowoharjo	Bangunharjo	27.16	30	25	25,847
	Timbulharjo	Panggungharjo				
Kasihan	Tamantirto	Tirtonirmolo	32.38	34	22	2,700
	Ngestiharjo	-				
	Bangunjiwo	-				
Pajangan	Guwosari	Triwidadi	33.25	32	23	8,316
	-	Sendangsari				
Sedayu	Argodadi	Argosari	34.36	32,5	24,5	12,271
	Argomulyo	Argorejo				

Energy Conservation Experiment in Bantul

Households regard electricity as an input in creating comfort (such as indoor temperature), leisure activities, and home production activities. The amount of home power used within a specific period represents consumption for each activity. The choice of 1) dwelling qualities, such as size; 2) equipment attributes; and 3) intensity of equipment used for recreation and domestic activities, interior temperature control, and lighting will determine the overall household power consumption: climate, cost, and individual characteristics, such as ideology, influence these decisions. After reading the report, many households wish to reduce their bill. These households may reduce their consumption regardless of color, religion, class, or ethnicity. According to their firmly held ideas, these families might discover that information regarding the price of their energy usage was more reliable in their attempts to cut energy expenses (Costa and Kahn, 2013).

Additionally, they were impacted mainly by the people around them (Mark et al. 2019). This research in Bantul aims to investigate the impact of "home energy reporting" and how social norms, curtailment, and energy-saving practices differ depending on shared traits like the home's features and the owner's socioeconomic status. The focus on urban family environments as a crucial factor in how urban populations, particularly in Indonesia, adapt to new information stands out as a distinctive aspect of this research.

Characteristics of Respondents

After all information and data have been collected, the data processing process can be carried out. The head of the family dominated this research by 93.93% of the total respondents, and the use of post-paid or monthly payments by 72.73%. Then for respondents with electricity capacity in this research, 48.48% used electricity with a power of 900 watts and 39.39% for an electrical power of 450 watts. The results obtained for participation in this research indicate that respondents who own their own homes were 73%, and tenants were 27%. The average land area for the following respondents was 107 sqm, with a maximum land area of 147 sqm and a minimum of 36 sqm. The land area along with this house was reflected in the installed electricity capacity, mainly at 950 watts and 450 watts. Based on their monthly power usage, respondents' characteristics were dominated by those who use between 30,000 and 120,000 rupiahs and 210,000 and 300,000 rupiahs. It has to do with the fact that tiny households make up most of the household income. The respondent's land and the home area were dominated by a region between 96 and 126 square meters, then 126 to 156 square meters. Figure 3 demonstrates that respondents spend 10-15 hours daily using traditional incandescent bulbs as their primary lighting source. Conventional incandescent bulbs were used for 13.45 hours daily, whereas fluorescent lights were used for 7.47 hours daily. Meanwhile, 0 to 5 hours and 10 to 15 hours a day were spent on traditional fluorescent lighting. Fluorescent lighting was extensively employed in outdoor yard settings.

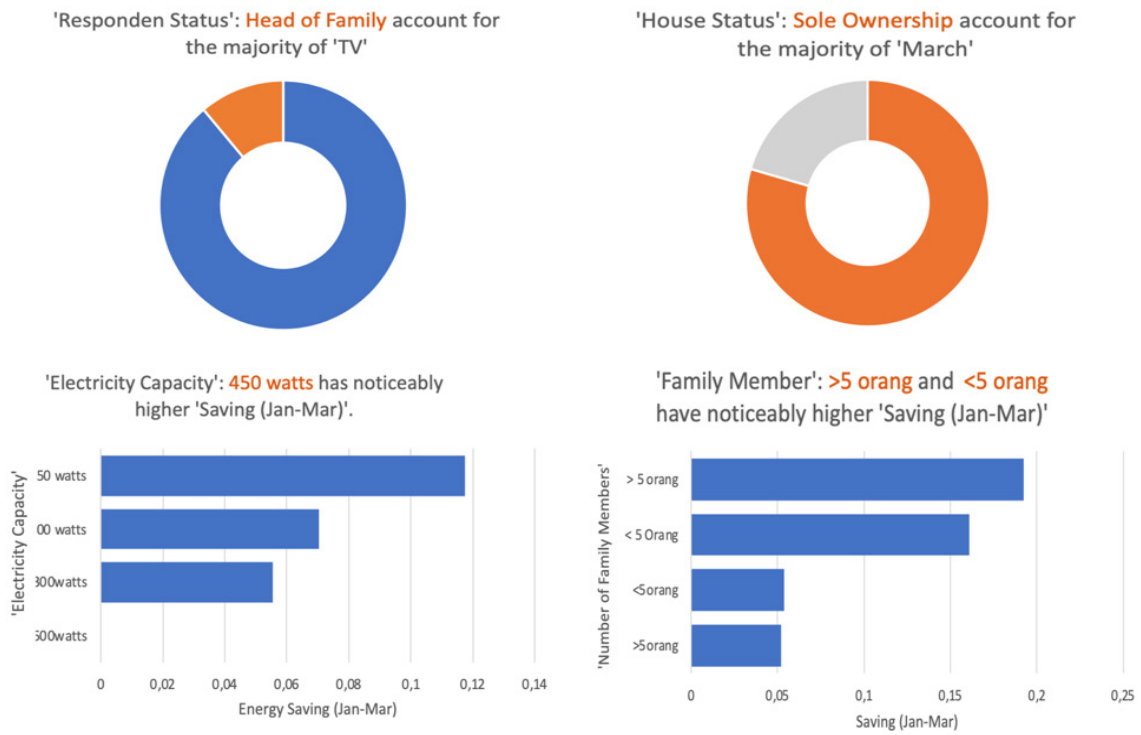

Figure 3. Characteristics of Respondents

Nearly all of the households surveyed by the respondent utilize TV equipment. The typical responder in Figure 3 above watches TV 10.30 hours daily, demonstrating that TV was regular entertainment for the respondent's household. This research, however, did not discover this response using air conditioning. In Bantul, fans were exceptionally universally used in homes. Each family uses a fan for 13.93 hours each day on average. It may be claimed that the typical usage of irons and washing machines was limited.

Regression Analysis – Household Saving

In this section, this research explores the effect of home energy reporting - through electricity cost savings variables for three months, starting from January to March. The study looks at how social norms, restraint, and energy efficiency impact change depending on shared traits like a home's features and the socioeconomic status of the owner. It demonstrates how Demand Side Management (DSM), as proposed by Gellings in 1985. Gellings, was implicitly consistent with the ideas of social norms, curtailment, and energy efficiency. It was using a washing machine during off-peak hours, shutting off lights or other electrical devices when not in use, and washing clothes when the laundry capacity was total were all examples of experiments with the "curtailment" (nudge) principle. Turn off the lights when you leave the room. This research also directly investigates hypotheses about the behavior of the rebound effect that may occur after the creation of electricity cost savings. This experiment tests the hypothesis of a rebound effect occurring when these households can reduce their energy costs through knowledge of the adoption of energy-saving equipment technology and consumption-saving programs that have been carried out correctly. The pilot experiment took place in an area outside the district of Bantul. The dependent variable was the factors in the typical characteristics and socioeconomic characteristics of the household that wishes to save energy efficiency and replace old equipment with new energy-efficient product technology. This research uses semi-structured, structured, question-and-answer questionnaires and case studies. It is a document analysis that may be needed to examine the behavior of individuals and company organizations in saving energy costs and replacing old equipment with new energy-efficient product technology.

Therefore the hypothesis test used was that each variable consists of a Washing Machine Variable, Electric Payment Variable, Neon Variable, House Status Variable, Ironing Variable, AC Variable, TV Variable, Respondent Status Variable, HOME Direction Variable, Number of Family Members Variable, Fan Variable, Refrigerator Variable, The LED variable, the house area variable, the electric capacity variable, and the

bulb variable explain their effect on electricity saving costs in urban communities in Yogyakarta. Based on Stephenson's (2010) energy framework, the multiple linear regression equation used was as follows:

$$HS = 0 + 1RE + 2LR + 3AK + 4SR + 5AR + 6KL + 7PL + 8BO + 9LE \times Nudge + 10NE \times Nudge + 11AC \times Nudge + 12KU \times Nudge + 13TV \times Nudge + 14KI \times Nudge + 15SE \times Nudge + 16MC \times Nudge + e$$

Information: Y (Household saving (HS)); 0_ (Constant); 1_ (Regression coefficient for Respondent Status (RE)); 2_ (Regression coefficient for the area of the house (LR)); 3_ (Regression coefficient for Number of Family Members (AK)); 4_ (Regression coefficient for Home Status (SR)); 5_ (Regression coefficient for HOME Direction (AR)); 6_ (Regression coefficient for Electric Capacity (KL)); 7_ (Regression coefficient for Electricity Payments (PL)); 8_ (Regression coefficient for Bulb usage per Hour in 1 day (BO)); 9_(Regression coefficient for Hourly LED Usage x Nudge in 1 day (LE)); 10_(Regression coefficient for Hourly Neon Usage x Nudge in 1 day (NE)); 11_(Regression coefficient for Hourly AC Usage x Nudge in 1 day (AC)); 12 _(Regression coefficient for Refrigerator Usage per Hour x Nudge in 1 day (KU)); 13_(Regression coefficient for TV Usage per Hour x Nudge in 1 day (TV)); 14_(Regression coefficient for Fan Usage per Hour x Nudge in 1 day (KI)); 15_ (Regression coefficient for Iron Usage per Hour x Nudge in 1 day (SE)); 16_(Regression coefficient for Washing Machine Usage per Hour x Nudge in 1 day (MC)).

In the multiple regression above, this research record the family's monthly income, the cost of saving electricity from January to March, as well as the total unit value of energy in Neon Lamps, Washing Machines, Irons, AC, TV, Fans, Refrigerators, and LED Lights, recorded for how many hours daily usage. Meanwhile, the characteristic block coefficient includes individual characteristics, characteristics of electricity payment methods, house status, respondent status, number of family members, house area, and direction of the house primary data obtained through surveys, interviews, and questionnaires designed for four months. Interviews lasted from twenty-five to thirty minutes. The implementation of the research begins with data collection until the final report takes ± 20 weeks.

Before the regression analysis, this research used the normality test to test whether the data used were usually distributed. A normality test was conducted to test whether, in a regression model, an independent variable and a dependent variable or both have a standard or abnormal distribution. This research uses PP Plot and Histogram, which shows that the data shows a normal distribution based on the two images (Figure 4).

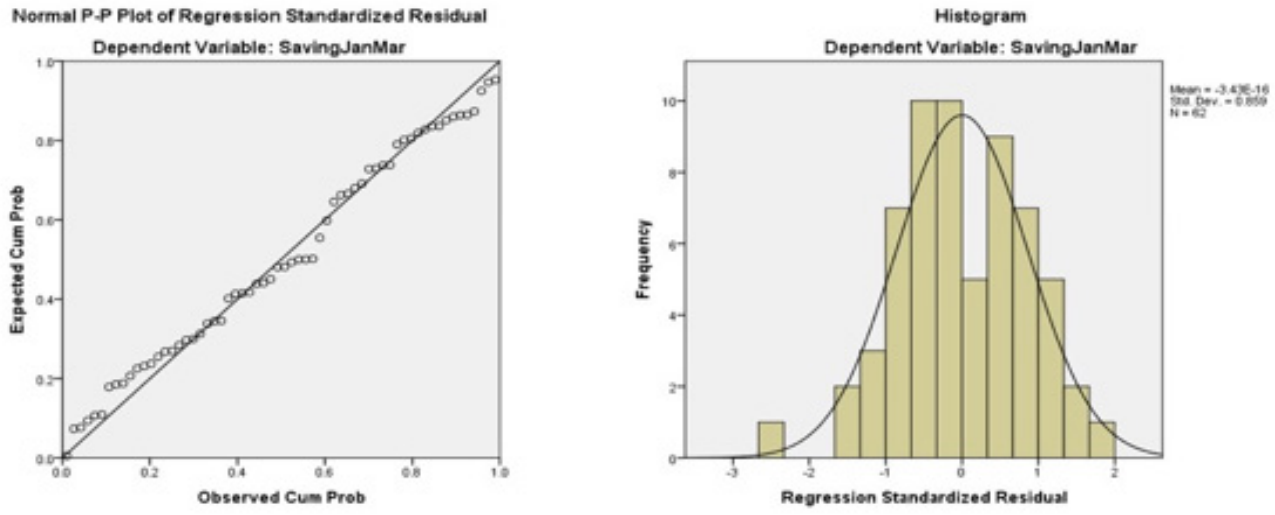

Figure 4. PP Plot and histogram – household saving

Meanwhile, the 't-test was conducted to determine the statistical significance of the research and whether there was an influence between the independent variable and the dependent variable with the provisions; if the significance level > 0.05, it can be said that the research variable is not significant. On the other hand, if the significance level is < 0.05, the research variable is significant. The results of the partial test (t-test) can be seen in Table 2. Based on the results of the multiple regression test in Table 3, the regression equation obtained is as follows:

$$Y = 30{,}196 + 2.417\,X_1 - 0.014\,X_2 + 1.675\,X_3 - 2.282\,X_4 - 1.392\,X_5 - 6{,}478\,X_6 - 1.384\,X_7 - 0.020\,X_8 - 0.080\,X_9 - 0.105\,X_{10} + 0.245\,X_{11} + 4.977\,X_{12} + 0.086\,X_{13} - 0.077\,X_{14} - 0.065\,X_{15} - 0.780\,X_{16} e$$

Information:
Y (Household saving (HS)); X0 (Constant); X1 (Regression coefficient for Respondent Status (RE)); X2 (Regression coefficient for an area of the house (LR)); X3(Regression coefficient for Number of Family Members (AK)); X4(Regression coefficient for Home Status (SR)); X5 (Regression coefficient for HOME Direction (AR)); X6 (Regression coefficient for Electric Capacity (KL)); X7 (Regression coefficient for Electricity Payments (PL)); X8 (Regression coefficient for Bulb usage per Hour in 1 day (BO)); X9 (Regression coefficient for Hourly LED Usage x Nudge in 1 day (LE)); X10 (Regression coefficient for Hourly Neon Usage x Nudge in 1 day (NE)); X11(Regression coefficient for Hourly AC Usage x Nudge in 1 day (AC)); X12 (Regression coefficient for Refrigerator Usage per Hour x Nudge in 1 day (KU)); X13(Regression coefficient for TV Usage per Hour x Nudge in 1 day (TV)); X14(Regression coefficient for Fan Usage per Hour x Nudge in 1 day (KI)); X15(Regression coefficient for Iron Usage per Hour x Nudge in 1 day (SE)); X16 (Regression coefficient for Washing Machine Usage per Hour x Nudge in 1 day (MC)).

Table 2. Coefficient of multiple regression test results

Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	30,196	15.525	-	1,945	0.058
StatusRespondent	2,417	4,314	0.073	0.560	0.578
area of the house	-0.014	0.057	-0.045	-0.249	0.804
Number of Family Members	1,675	3,321	0.078	0.504	0.616
StatusHome	-2.282	3,355	-0.088	-0.680	0.500
HOME Directions	-1,392	1.317	-0.138	-1.057	0.296
Electric Capacity	-6,478	2,977	-0.393	-2,176	0.035
PaymentElectricity	-1,384	3,797	-0.065	-0.365	0.717
Bulb //(Hours X Amount)	-0.020	0.043	-0.097	-0.465	0.644
LED //(Hours X Amount) - Nudge	-0.080	0.039	-0.380	-2,078	0.043
Neon //(Hours X Amount) - Nudge	-0.105	0.126	-0.116	-0.831	0.410
air conditioning //(Hours X Amount) - Nudge	0.245	0.628	0.047	0.390	0.698
Refrigerator //(Hours X Amount) - Nudge	4,977	3,003	0.249	1,657	0.104
TV //(Hours X Amount) - Nudge	0.086	0.151	0.085	0.571	0.571
Fan //(Hours X Amount) - Nudge	-0.077	0.091	-0.118	-0.850	0.400
Iron //(Hours X Amount) - Nudge	-0.065	5.037	-0.002	-0.013	0.990
Washing machine //(Hours X Amount) - Nudge	-0.780	1,207	-0.087	-0.646	0.522

Based on the results of the t-test in Table 2, it can be concluded that based on the t-test on the variable Electric capacity and LED lamps, the t-count values were -2.7160 and -2.078 with a significance value of 0.035 and 0.043. Therefore, the variable of electricity capacity and LED light were significant at 0.05. The variable power capacity and LED lights significantly affect saving electricity. At the same time, the other 14 variables were said to have no significant value. It is below 0.05; it can be stated that the variables of Washing Machine, Electricity Payment, Neon, House Status, Iron, AC, TV, Respondent Status, RUMAH Direction, Number of Family Members, Fan, Refrigerator, LED, House Area, Electric Capacity and The light bulb do not affect saving electricity costs in urban communities. It can be stated that the value of electricity savings that occurs in people who have a small electricity capacity is between 450 watts - 900 watts.

The 'f' test determines whether the independent and dependent variables influence each other simultaneously (together). The provisions stipulated in the f test, namely the significance level < 0.05, then there is significance; on the contrary, if the significance level is > 0.05, there is no significance. The results of the f test or simultaneous test can be seen in Table 3 below. Based on the results of the f (simultaneous) test in table 3, it is known that the significance level is 0.019 < 0.05, so it can be concluded that the model used is excellent and feasible for explaining the effect of the dependent variable on savings during January to March (Competitive Jan. -Mar) on the independent variables, namely Washing Machine, Electricity Payment, Neon, House Status, Iron, AC, TV, Respondent Status, HOME Direction, Number of Family Members, Fan, Refrigerator, LED, House Area, Electric Capacity and Light Bulb.

In Table 4, it can be seen that the Adjusted R2 value is 0.240 or 24.0%. From this value, it can be said that 24.0% of urban households have energy savings for two months. The saving was the cause of Washing Machine, Electricity Payment, Neon, House Status, Iron, AC, TV, Respondent Status, Direction of RUMAH, Number of Family Members, Fan, Refrigerator, LED, House Area, CapacityElectricity and Light Bulbs. At the same time, the remaining 76.00% was influenced by other variables that were not investigated in the research.

The above test measured how far the model can explain the dependent variable's variation. This test also looks at how the influence of the dependent variable on the independent variable. The value of the coefficient of determination was between 0 to 1. A small value of Adjusted R2 means that the ability of the independent variables to explain the dependent variable was minimal, and vice versa; if the coefficient was closer to 1, the stronger the model was in explaining the variation of the dependent variable. For the Durbin Watson (DW) statistic or autocorrelation test on the residuals from the statistical model or regression analysis, it was found to be 2.177. A value of 2.177 indicates that no autocorrelation was detected in the sample.

Table 3. ANOVA Test – Household Saving

	Sum of Squares	df	Mean Square	F	Sig.
Regression	3002.224	16	187.639	2,203	0.019b
Residual	3833.044	45	85.179		
Total	6835.268	61			

a Dependent Variable: SavingJanMar
b Predictors: (Constant), Washing Machine, Electric Payment, Neon, Home Status, Iron, AC, TV, Respondent Status, HOME Direction, Number of Family Members, Fan, Refrigerator, LED, Area of the House, CapacityElectricity, Bulb

Table 4. Model Summary – Household saving

R	R Square	Adjusted R Square	Std. The error in the Estimate	Durbin-Watson
0.663 a	0.439	0.240	9.22923%	2,177

a. Predictors: (Constant), Washing Machine, Electric Payment, Neon, Home Status, Iron, AC, TV, Respondent Status, HOME Direction, Number of Family Members, Fan, Refrigerator, LED, Area of the House, CapacityElectricity, Bulb
b. Dependent Variable: SavingJanMar

Managerial Implications

As Indonesia's energy consumption continues to grow, the results of this research provide an opportunity to effectively manage energy use in urban households. It is important to note that the investigation into urban household consumption and the nudge framework's effectiveness is ongoing. This research provides a solid foundation for future policy and investment decisions, which can ultimately contribute to a more sustainable energy future for Indonesia. Furthermore, investors and enterprises can also benefit from this research by exploring investment opportunities in the energy efficiency industry, particularly in developing innovative technologies and solutions that support the adoption of energy-saving practices by households.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The research focused on Indonesia's current and future energy consumption demands and the need to reduce energy consumption to meet these demands. The research found that the housing sector's comprehensive energy efficiency and conservation measures could minimize energy consumption. Understanding consumer behaviour and the adoption of energy-efficient household equipment were found to be crucial in lowering energy usage. The research highlighted the "nudge effect" to influence energy consumption patterns. The "nudge effect" involves using societal norms, restrictions, and information on energy expenditures to track all family expenses and compare them with those of neighbours living in the same area with houses of the same size. The research also looked at the impact of switching from standard bulbs to energy-saving ones and how the "nudge effect" could be used in architectural designs to reduce home energy consumption. The research analyzed the households' standard features and socioeconomic traits as motivators of energy efficiency initiatives in urban areas of Indonesia.

The research used two "nudge effect" theories to assess the relative effects of disclosing energy use costs and social norms on how much electricity residences use in a field experiment. The research found that energy savings occurred when urban households were given a nudge framing approach, with savings of up to 16.305 percent on typical family electricity consumption expenditures for more than three months. The research concluded that disseminating knowledge decreased home power usage, leading to energy savings. The study also found no rebound effect on 62 respondents from urban families in the Bantul, Jogjakarta area. The outcomes of this research aim to contribute to a greater understanding of the "nudge effect" idea and the choice of architectural programs that can be used for energy-saving and efficiency-promoting policies in Indonesia's residential sector. This research provides valuable insights for policymakers, investors, and enterprises in Indonesia's energy efficiency industry. The study highlights the potential of nudging as a subtle and practical approach to encourage urban households to adopt energy-efficient practices, which can help address the country's energy consumption challenges. The research results also indicate that disseminating knowledge and reminders about energy consumption can significantly reduce energy usage and cost savings for households. Therefore, implementing a nudge framework should be a key consideration for policymakers and regulators in developing energy-saving policies and programs. This framework can encourage the adoption of energy-efficient household equipment and behaviors, such as switching to energy-saving lamps, which can result in significant energy savings for households.

Recommendation

The research suggests that business owners and policymakers must understand a "nudge effect" and the program architecture of choice regarding Indonesia's home sector and energy efficiency from regulation, behavioural, knowledge-based, and cultural perspectives. The research focuses on urban family environments and how Bantul's urban culture responds to the "nudge effect" and aims to pinpoint a theoretical, descriptive approach for guiding stakeholders towards better decision-making. Further research is needed to identify other factors influencing households' adoption of energy-saving practices. Therefore, future scholars can examine and incorporate the many potential topics that must be considered for future research. The fact that there is little research on energy efficiency and nudging framework in Indonesia was one of the reasons the researchers studied the phenomenon in the Bantul area.

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