"Pro Environment" Behavior Towards a Green Economy: An Analysis of Household Energy Consumption

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ABSTRACT

The environmental degradation and global warming resulting from unsustainable economic development pose a threat to the future economy. Households represent the smallest environmental unit, and household activities can involve pro-environmental practices such as reducing electricity usage, conserving water, or switching to more efficient cooking fuels. Moreover, households constitute the largest group of energy consumers. By examining households, we can identify the factors influencing pro-environmental behavior. The aim of this research is to examine the effect of energy-saving behavior on reducing energy consumption expenditure at the household level in Indonesia. This research is quantitative research using data from IFLS (Indonesian Family Life Survey). Testing was carried out using OLS regression to find the correlation between household pro-environment behavior and electricity consumption, controlling the household characteristics to prevent biased results. The results show interesting findings which states that the so-called "pro-environment" behavior somehow lead to higher electricity spending, though different result shows on rural cohort. Further research needs to be carried out using data on electricity use, not just energy expenditure. The government needs to think about long-term alternative environmentally friendly sources of electrical energy, because electricity demand tends to continue to increase along with the use of various electrical equipment.

1. INTRODUCTION

Energy use is one of the focuses in efforts to overcome environmental pollution because of the relationship between energy use and numbers in environmental problems, although often from the perspective of energy users this is not realized [1]. Therefore, conservation of energy use is a focus in the formulation of sustainable development policies. One of the goals for the energy sector is listed in point seven of the Sustainable Development Goals (SDGs) which has the goal of ensuring access to affordable, reliable, sustainable and modern energy for all. This goal is based on economic activity impossible to do without sufficient modern energy. Specifically, there is a concept for achieving economic development that reduces social inequality and environmental damage by carrying out sustainable economic activities called the "Green Economy" [2].

Energy use is the main focus to reduce environmental damage in implementing green economy [3]. The implementation of green economy and energy use in Indonesia has not shown harmony between the concept of green economy and the facts that exist in the largest group of energy users in Indonesia, that is, households.

The Indonesian government actually realizes that the need for electrical energy will continue to increase and become society's primary need (Figure 1).

The problem is that people are not wise enough in using electrical energy, and the dominant source of electricity generation in Indonesia uses coal (Figure 2).
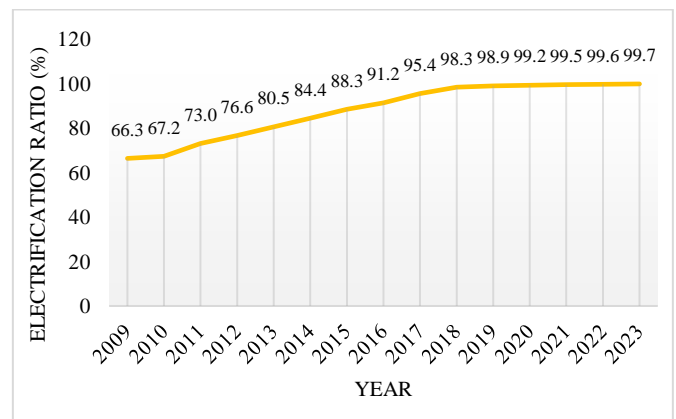
Figure 1. Indonesia electrification ratio
Source: Ministry of Energy and Mining of Republic of Indonesia, 2024
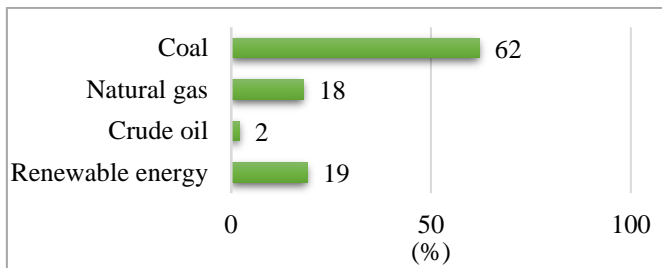
Figure 2. Percentage of electrical energy source mix in Indonesia, 2021
Source: Climate Transparenct Report, 2022

Coal is still playing a significant role in the production of electricity around the world [4]. However, coal reserves in the world continue to decline. This is because coal formation takes around 300 years. Apart from that, coal emits quite a lot of carbon dioxide emissions (air pollution) and is one of the causes of global warming [4].

Households are the largest group (reached 91.71 percent) of electricity users in Indonesia [5]. Per capita electricity consumption for households increases year by year. In 2021, per capita electricity consumption is 1,109kWH, it increases 5.82 percent from 2020. Other energy sources, namely fossil fuels, will also experience an increase in 2021, namely 40.82 percent compared to 2020. The increase in energy consumption that occurs in household groups in Indonesia needs to be considered to prevent environmental damage. Apart from being the largest group in terms of energy use, this study uses households as objects because households are the smallest level of the environment, and household activities can involve pro-environment activities such as reducing the use of electrical energy.

Energy behavior and energy consumption decisions are complex, cognitive, and social processes [6]. Inefficient energy consumption in household groups can cause a decrease in environmental quality [7]. The complexity in the behavior of energy consumption inefficiencies can be explained through the knowledge action gap concept, namely the actions taken are not the same as the knowledge one has [8]. Teaching pro-environmental behavior or behavior that protects the environment often results in a knowledge-action gap and fails to produce pro-environmental impacts in the long-term [9].

To apply pro-environmental behavior in realizing a green economy, the most important factors are intrinsic and extrinsic factors from households to produce the expected energy consumption behavior [10]. Realizing pro-environmental behavior in implementing green economy, it is necessary to know the characteristics of policy recipients, namely in the form of an analysis of household behavior.

Kluger and Denisi [11] state that an analysis of energy consumption behavior is needed to develop a policy mix related to energy use. The use of behavioral analysis to build pro-environmental behavior in implementing green economy is supported by several studies. Behavior is an important element in household energy consumption [12] where there are two behaviors in energy use: saving through habits or by installing practical tools. Research conducted by Ramos et al. [7] states that socio-demographic factors can play a role in household behavior in energy consumption. In line with the research of Brandon and Lewis [1], namely social-demographic factors are very influential on energy consumption patterns compared to socialization from the government given to households. Pro-environmental behavior

can also be identified by analyzing a series of factors in the energy consumption patterns of individuals and households as the largest unit of energy users [13]. There is research that supports the perspective of behavioral economics as a basis for compiling a policy mix such as research by Lange [14] which states that the latest behavioral analysis will produce a mix of indicators that are useful for policy design compared to analysis that is carried out based on observation of behaviors.

Krstic et al. [15] conducted a review of research methods related to factors that influence electricity consumption. Furthermore, Krstic et al. [15] classified these factors into groups of four:

- Cognitive and affective factors-value systems, norms, beliefs, attitudes, knowledge and skills, motivation and commitment;
- Socio-demographic factors-demographic characteristics of households, social status, life style, living standard, income, place of residence;
- Behavioral factors-habits, routines, behavioral patterns, previous experience;
- Contextual factors-incentives, policy instruments, community actions, electricity price changes, advertising campaigns, communications initiatives, available energy options, technological options.

"Pro-environment" behavior has recently become a trend in society, such as activities to collect rubbish with the community, waste banks, and reducing the use of single-use plastic. However, a big question arises as to whether these activities have been followed by "pro-environment" activities in daily life at home. One of the indicators is electricity spending. Meanwhile, electricity is a basic need which is believed to continue to increase along with the use of electronic equipment in households.

Thus, the formulation of the research question in this study is: what is the influence of pro-environment behavior on expenditure of electricity? Pro environmental behavior is proxied by participation in waste management by the community. Household characteristics were also tested for their influence on expenditure of electricity. Based on the preceding arguments, we examine the effect of energy-saving behavior on reducing energy consumption expenditure at the household level in Indonesia, especially electricity spending.

2. THEORETICAL FRAMEWORK

2.1 Sustainable development and energy regulation

Energy use is increasing every year, raising concerns about environmental impacts caused by inefficiency in energy consumption, especially by household groups. In a short span of time, the impact of excessive energy use cannot be felt from the community side. However, the impact of environmental damage will be felt in the long term or between generations. As the main source of the economy, unsustainable economic growth is one of the causes of detrimental environmental degradation. Green regulation of economic policies has explicitly reduced environmental problems and degradation, while increasing social welfare, equity and economic prosperity.

Sustainable development can produce a comprehensive performance strategy, and measurable improvements for social inclusion, environmental sustainability and economic development. Energy behavior and energy consumption

decisions are complex, cognitive, and social processes [6]. Previous research from Abrahamse et al. [16] shows that the interventions that have been carried out do result in increased knowledge, but do not necessarily result in changes in behavior.
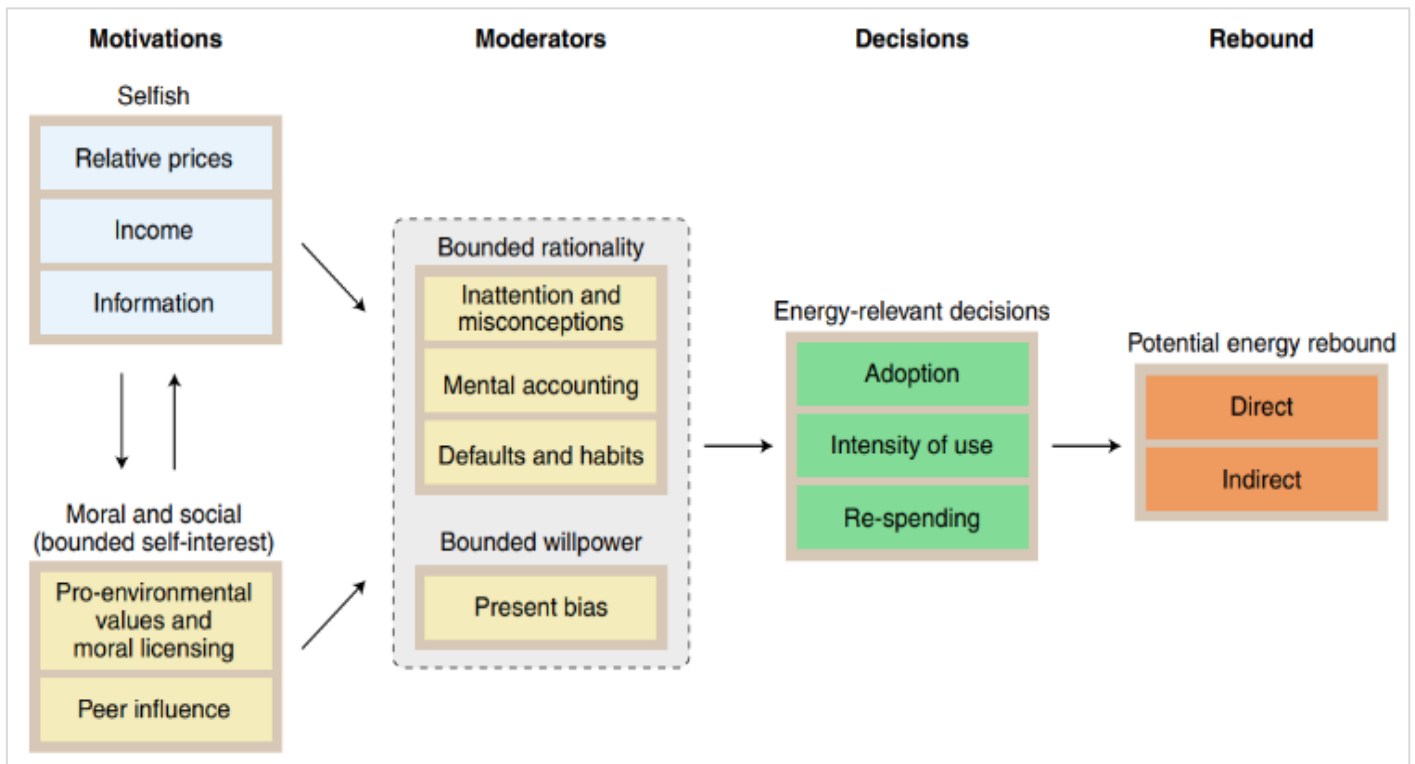
2.2 Energy related behavior

In contrast to traditional economic assumptions, a growing body of scientific research shows that humans are rarely the rational decision makers envisioned by traditional economic models of human behavior.

Empirical evidence from psychology and behavioral economics suggests that consumer choices and actions often deviate systematically from the rationality assumptions of neoclassical economics, and that there are certain fundamental and persistent biases in human decision making that regularly produce behavior that cannot be explained by these assumptions. Previous research has indeed examined the impact of policy interventions on energy consumption, but often ignores the psychological factors underlying energy use [16].

Selfish, moral and social motivations, moderated by bounded rationality and willpower, affect energy-relevant decisions, which in turn influence direct and indirect rebound (Figure 3).

Figure 3. Schematic representation of energy-related behaviour
Source: [17]

2.3 Household energy consumption and behaviour

A better understanding of the factors that influence household energy consumption practices is essential for better design by policy makers [18]. Although environmental problems are thought to be important determinants in household decision-making processes and can explain differences in energy consumption levels of households with similar characteristics [19, 20], none of the above-mentioned papers includes the variable. Research conducted by Bergh [21] emphasizes a small number of empirical studies that combine the socio-economic and psychological determinants of green behavior. Until now only a few papers have introduced different variables to measure the possible effect on general energy-related decisions, such as Khan [22], who studied the relationship between green political ideology and personal consumer choices, or Kotchen and Moore [23] who used attitude variable nine household environment as one of the explanatory variables determining participation in the green electricity program Energy demand for households is not a direct demand for energy, but a derived demand for the production of energy services-such as lighting, water heating, cooking, space heating, and air conditioning air-operating within a complex system involving technology adoption, behavioral economics, and elements from psychology [24].

Understanding the factors governing household energy consumption and conservation to determine how useful this behavior can be changed by policy initiatives, awareness campaigns and technology solutions, Households can reduce energy consumption and associated emissions by investing in energy efficiency solutions and/or by implementing energy saving behavior (pro-environment). In recent years, several studies have explored the differences between these two concepts. While energy efficiency refers to the application of specific technologies that reduce overall energy consumption without changing the relevant behavior and achieving maximum obtainable services, energy saving is simply a change in consumer behavior that leads to energy savings without investing in new technologies [25, 26].

Barr et al. [12] studying studies on the categorization of energy behavior at the household level, suggested that there are two fundamental groups of energy behavior. The first group consists of habitual or behavioral 'reducing' actions which all focus on specific, everyday energy use reductions

that do not require or structural adjustments. Energy-saving behaviors, such as turning off the lights in an empty room, turning off the heater when leaving the house for a few hours, and filling the water heater full before it boils, were found to be related to elements of the daily habits of individuals' lifestyles that they carry out every day. activity. These habitual actions vary both in their frequency and in the size of their impact on energy consumption. Moreover, even within one household, different family members may behave in opposite ways, and their behavior can have opposite effects on energy consumption [27]. The second type of energy behavior focuses on 'buying activities' and 'energy efficiency choices' [12, 28]. This group differs more from the first in that financial resources can vary widely, for example from installing wall insulation to purchasing energy-efficient certified equipment.

3. METHOD

The main objective of this study is to find out the correlation between household pro-environment behavior on its electricity consumption. Pro-environment behavior is proxied using household involvement in community waste management, if any.

3.1 Model and variable identification

Expenditure on electricity is influenced by behavior (household energy consumption), where behavior is proxied by pro-environment behavior. Apart from that, it is also necessary to calculate household demographics. We estimated an OLS regression to find the correlation between household pro-environment behavior and electricity consumption, controlling the household characteristics to prevent biased result. Let Y_i denote household's electricity consumption, pro-environment behavior are the main explanatory variables, and X is a vector matrix for household characteristics controls (Table 1). Thus, here is the regression equation.

$$Y_i = \alpha + \beta_1 Pro\_Env_i + \gamma X_i + \varepsilon_i$$

Some of the household characteristics that are used as controls are adapted from research regarding household behavior towards electricity consumption patterns and energy application [7]. The indicators used are demographic indicators such as number of family members, area of residence, age, and education and use other indicators such as tax spending. Through the results of this study, it was found that households with older members showed habits that were less environmentally friendly. In addition, energy-saving habits are driven by income levels, households with high income levels are more likely to invest in energy savings, although high-income groups tend to sacrifice comfort to save energy by setting lower heating temperatures. The same is true for higher levels of education: households with higher education pay more attention to pro-environmental aspects. In addition, indicators were taken through other literature studies [1] which stated that the work aspect in the form of benefits can influence household energy consumption behavior.

3.2 Data

This study uses the latest wave of data from the Indonesia Family Life Survey (IFLS) which can be freely accessed from www.rand.org. The IFLS sample includes more than 30,000 respondents and represents approximately 83% of the Indonesian population living in 13 of the 27 provinces. The weakness is that it is not representative of eastern Indonesia. The IFLS data level includes individual, household, and community group data (found in COMFAS data). For this study, the data used is the household level.

As expected from the dataset, out of all the household in the dataset, 95.38% has electricity, so almost all of the households have electricity. But in fact, in Indonesia, it might be overestimated. Because IFLS dataset only measure in Sumatera, Java, Bali, and several parts of Kalimantan.

Table 1. Variable identification

No	Variable	IFLS Data	Data Level	Section
Y	Expenditure on electricity	Household monthly expenditure on electricity (average from yearly report) in natural log	HH	
1	Household's waste participation in the community	Self-reported participation in the community waste management. Participation = 1, if household participates in their community waste management activities = 0, if otherwise	HH	KR
2	Household rural dummy (control)	Whether household located in the rural areas	HH	SC
3	Household characteristics (controls)	Including location dummies (Java-Bali), total household income for a month, type of house floor used, house floor size used, type of house wall, family water source (*own plumbing*), household size, household expenditure on social activities, household expenditure on medical needs	HH	AR

4. RESULTS AND DISCUSSION

This research examines the effect of energy-saving behavior on reducing energy consumption expenditure at the household level. The result took a strange turn as it shows that somehow, against our hypothesis, household participation dummy shows that a "pro-environment" household tends to spend higher on

electricity as opposed of those who don't. This research tried to seek further by separating two cohort; those who lives in the urban and rural region. Though the number of rural observations is vastly lower than the urban (237 v 1642 households), the pro-environment household tends to have lower spending on electricity, as shown on following Table 2.

Table 2. Results of OLS analysis

Variables	(1) Ols_r	(2) Ols_ur	(3) Ols_urban Cohort	(4) Ols_rural Cohort
garb_actv	0.334***	0.286***	0.371***	-0.309*
	(0.0769)	(0.0692)	(0.0749)	(0.180)
rural		-0.492***		
		(0.104)		
javbali		-0.0815	-0.211	0.232
		(0.141)	(0.169)	(0.238)
sumatra		0.348**	0.307	0.306
		(0.165)	(0.200)	(0.271)
ownplumbing		0.730***	0.818***	0.366*
		(0.0991)	(0.110)	(0.217)
ln_educ_exp		0.0869***	0.0883***	0.0612**
		(0.0102)	(0.0109)	(0.0271)
lnsocexp14		0.240***	0.247***	0.145***
		(0.0200)	(0.0214)	(0.0556)
lnmedexp14		0.0579***	0.0626***	0.0107
		(0.0136)	(0.0145)	(0.0374)
ln_total_incomeRT		-0.0130	-0.0137	-0.000261
		(0.0103)	(0.0110)	(0.0292)
Constant	8.357***	3.958***	3.838***	5.364***
	(0.0490)	(0.295)	(0.323)	(0.754)
Observations	1,881	1,879	1,642	237
R-squared	0.010	0.221	0.236	0.107

Standard errors in parentheses
*** p<0.01, **p<0.05, *p<0.1

The emerging trend nowadays in Indonesia is the existence of community-based waste management, such as waste banks or garbage activities through NGOs or communities [29]. Even though the Indonesian people have increased understanding regarding waste management (as pro-environment behavior), efforts to reduce electricity consumption are considered difficult or even not an important part of pro-environment behavior. As the results of research by Imelia and Ruswanti [30] show that high levels of self-control ability, subjective norms, and consumer attitudes will increase purchase intention of electronic houseware. It was even stated that there were no differences in behavior between respondents with different levels of education. The differences in purchase intention of electronic houseware are only differentiated by age and income level.

Previous studies suggest that at pro-environment behavior could lead to better subjective well-being [31] but not many studies discussed on how the behavior leads to actual energy consumption.

Positive results were shown by rural communities, where waste management activities carried out were followed by electricity spending. Village communities have a character that easily accepts programs that are socialized communally. Several rural household waste processing activities are widely developed in Indonesia, such as waste banks, TPS3R, biomass, and source-based waste sorting [32-34].

Regarding several control variables used, such as households using own plumbing, it does have a significant impact on electricity spending. Where households with own plumbing tend to have higher electricity spending because they need electricity to suck up and distribute groundwater [35, 36].

Education can also be related to electricity spending, where people with higher education tend to have higher electricity spending. As the results of previous research stated that the education level has a positive and significant association with per capita energy consumption in Indonesia as a whole and in regions outside Java. More advanced and modern societies are synonymous with efforts to reduce energy consumption and the development of better and environmentally friendly production practices [37]. Modern and advanced communities can adapt to technology more quickly, influencing energy consumption.

Meanwhile, if we look at people's income, we can see that the relationship is not in harmony. This is natural in accordance with the Keynesian Consumption Model that if disposable income increases, then consumption will also increase. It's just that the increase in consumption is not as big as the increase in disposable income.

The results of the regression analysis show that activities related to waste management carried out by people in urban areas do not reduce energy consumption (electricity spending). The research results of Saragih et al. [38] shows that Indonesian people generally have knowledge about waste management, but have not applied it well. This is proven by people who have not segregated waste even though they have knowledge about sorting household waste. Research findings from Suasih et al. [39] further emphasizes this, where people in Bali, Indonesia tend not to sort waste at the household level and rely more on sorting waste at the Integrated Waste Processing Site or 3R Waste Management (a.k.a. TPS3R). People in Indonesia tend not to be ready to process or sort waste at the household level, so they expect these activities to be carried out by groups or institutions collectively, especially in urban areas where people are busy [40].

As previously explained in the introduction, to respond to the high demand for electrical energy, the energy transition needs to be accelerated. The energy transition era is a process of changing the use of fossil-based and non-environmentally friendly energy sources into clean and environmentally friendly energy, for example solar panels, wind, water and geothermal energy. This aims to be an effort to save the earth

in the future and maintain the continuity of the ecosystem of living things.

The practical implication of these findings is that the government together with academics need to consider policies and alternative sources of electricity, considering that pro-environment behavior has an insignificant impact on household expenditure on electricity. Electricity has become an important need and is difficult to reduce, considering that most household appliances are electronic equipment. The results of this research enrich the literature, especially regarding energy-related behavior.

Indeed, there has been previous research related to electricity or energy consumption in Indonesia that used IFLS data, namely research by Rasyid and Kristina [41], but only used data from 13 provinces, and focused on household demand for energy consumption, including analyzing the influence of prices. However, there has been no specific research regarding energy (electricity) consumption-related behavior (pro environment). This research fills this gap and the implication is to become evidence/data-based policy reference.

5. CONCLUSION

This study sheds light on the nuanced relationship between pro-environmental behavior and electricity saving. While pro-environmental behavior is essential for fostering sustainable practices, the statistical findings suggest that they may not directly translate into significant electricity-saving behaviors. Other factors, such as infrastructure, access to energy-efficient technologies, and economic incentives, play crucial roles in driving actual electricity conservation. Therefore, a comprehensive approach that combines education, policy interventions, and technological advancements is necessary to effectively promote electricity-saving behaviors and achieve substantial environmental impact. The results of this study are expected to provide an overview of the indicators that lead to pro-environmental behavior in efforts to formulate policies to achieve a green economy starting from the individual and family sphere.

Previous studies use self-reported green behavior or green self-image as a proxy for pro-environment behavior. We concluded that this interesting result might due to our limitation by using household community participation as the proxy for pro-environment behavior. Also, we haven't included the idea of household moral hazard in using electricity, which costs relatively cheap. The IFLS dataset didn't include energy consumption in kWh, meaning the electricity expenditure we used in the analysis is not controlling subsidized group. Furthermore, the IFLS latest data is in 2014 which might be a little bit too obsolete, but it's the only largest household longitudinal dataset to date. In addition, research related to energy consumption behavior needs to be carried out in a time series analysis to explain the effects of regulatory interventions and the trends that occur.

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