The Impact of Using Induction Stoves on Household Energy Expenditure in Denpasar City

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Abstract : In achieving the Sustainable Development Goals, goal number 7, namely Clean and Affordable Energy, can be implemented through several efforts, one of which is the transformation of household energy from using LPG to an induction stove. Even though every household has the choice to choose an energy source to be used in its household activities, in making this choice, a household will find out which energy source is safer, cleaner and more economical to support its household activities. Household energy expenditure is an aspect that is no less important in this consideration. In addition to the use of induction stove, there are several other factors that affect household energy expenditure, including the number of household members, the number of electronic goods used, installed electrical power and the area of the residential building. This research was conducted in Denpasar City with sample selection using propensity score matching with the nearest neighbor matching approach in 3 sub-districts/villages, namely Penatih Sub-District, Kesiman Petilan Village, and Tonja Sub-District.

Keywords : Induction stove, Household energy expenditure, Energy conversion

INTRODUCTION

In achieving the target of Sustainable Development Goals point 7 which reads Clean and Affordable Energy, it is necessary to increase the use of Clean and Renewable Energy (EBT). Clean and renewable energy is an energy source available by nature and can be utilized continuously (Janitra, 2022). Clean and renewable energy is an energy source available by nature and can be utilized continuously (Janitra, 2022)**.** In Indonesia, new energy and renewable energy policies are contained in Government Regulation No. 79 of 2014 concerning National Energy Policy (KEN) (Pemerintah Republik Indonesia, 2014). In the document, new energy and renewable energy are targeted to reach 23% by 2025, and by 2050 at least reach 31%. To achieve this target, various efforts and programs are needed whose elaboration and implementation are outlined in the National Energy General Plan (RUEN) and the Regional Energy General Plan at the Provincial level (RUED-P) (Setyono et al., 2019).

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Almost all provinces in Indonesia show that the ratio of household gas use or the ratio between the number of households using gas (be it LPG gas or gas network) to the total household tends to increase every year. However, to meet the needs of LPG gas, unfortunately Indonesia still needs imports from abroad to meet the needs of its people. This can be seen through the comparison of production volume and LPG gas import volume in Indonesia.

Figure 1. Production Volume and LPG Gas Import Volume in Indonesia
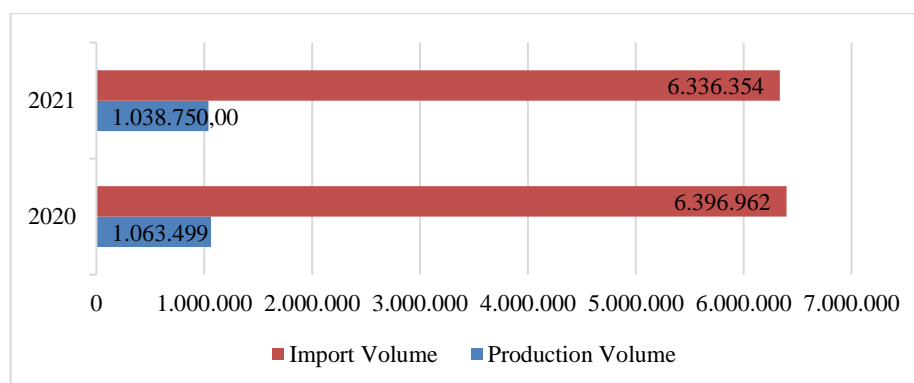
Based on Figure 1, the comparison between production volume and import volume shows that every year between LPG production and imports is very unequal, it can be seen that in 2020 the ratio between LPG gas production was 1.063 million tons or 14.25% compared to LPG gas imports which totaled 6.396 million tons or 85.74%. Meanwhile, in 2021, the production volume of 1.038 million tons or 14.08% is far compared to the import volume of 6.336 million tons or 85.91% of the total LPG supply to meet the needs of the community. Thus, it can be seen that Indonesian people have a dependence on the use of fuel in the form of LPG, making LPG gas as the main fuel for cooking. The large use of LPG gas has an impact on the State Budget and the State Energy Subsidy Budget every year. Based on public information from the Ministry of Finance of the Republic of Indonesia (2022), the comparison of energy subsidy and compensation budgets has increased from 2019 to IDR 144.4 trillion, to IDR 199.9 trillion in 2020, IDR 188.3 trillion in 2021, and soared by IDR 502.4 trillion in 2022. This energy subsidy budget is divided into 3 sectors, namely electricity subsidies of IDR 100.6 trillion, LPG subsidies of IDR 134.8 trillion, and fuel subsidies and compensation of IDR 267 trillion in 2022.

So, with this Indonesia needs to make changes by converting stove ingredients for cooking, from LPG gas fuel to induction stoves. PLN has a Pilot Project program for the Transfer of Import-Based Energy to Domestic through the Conversion of LPG Stoves to Induction Stoves in 2 cities in Indonesia, namely Solo City and Denpasar City which is carried out from June 2022 until this research is made. This program encourages the community to

convert tools for cooking to achieve cleaner energy use and also has an impact on the distribution of energy subsidies that are right on target through electricity. This program targets subsidized electricity users with a power amount of 450 VA and 900 VA for households. Subsidy electricity users are given encouragement in the form of induction stoves for free to realize the conversion of LPG stoves to induction stoves so that later they can intervene in other communities so that later they will participate in the government's efforts to convert cleaner energy. This effort is called nudge.

In addition to providing free stoves, people also consider the amount of money spent in the use of induction stoves that affect their household energy expenditure. Household energy expenditure includes LPG gas for cooking fuel and electricity used for lighting and operation of electronic goods supporting household activities. One of the most widely used energy sources is electrical energy. Demand or use of household electricity is also influenced by variables, such as: price (tariff), income, price of other goods, the number of electrical equipment used, the price of electrical equipment used, peak load time, level of economic activity, building area of houses, climate and other social factors (Kadir, 2000).

This study compares between areas that receive assistance in the form of induction stoves with areas that do not receive induction stoves that are close to each other and aims to see whether there is a significant difference in household energy expenditure between induction stove recipients and non-induction stove recipients matched through the propensity score matching method by control variables, namely the number of family members, electronic items used, installed electrical power, and residential building area. Thus, this study aims to determine and analyze the effect of the use of induction stoves, the number of family members, the number of electronic items used, installed electrical power and the area of residential buildings on household energy expenditure in Denpasar City.

RESEARCH METHOD

This study uses multiple linear regression analysis to determine the relationship between the independent variables of induction stove use, number of family members, electronic goods used, installed electrical power, and residential building area to the dependent variable, namely household energy expenditure in Denpasar City. This research was conducted in areas that were given induction stove assistance and areas that did not get induction stove assistance that bordered each other and were in Denpasar City. The bordering area is the border between Penatih Village and Kesiman Petilan Village as an area that receives induction stove assistance

and Tonja Village as an area that does not receive induction stove assistance. In this study, the dependent variable is household energy expenditure (Y), the independent variable studied from this study was the use of an induction stove (X_1) and the control variables were the number of family members (X_2), the number of electronics used (X_3), installed electrical power (X_4), and the area of the residential building (X_5).

The population in this study was households in Penatih Village and in Tonja Village with a total of 9,350 families. By using a critical value of 10%, the number of samples used uses the Slovin formula, the number of samples taken was 99 people (rounded) households in Penatih Village, Kesiman Petilan Village, and Tonja Village. In this study, the sampling technique used is probability sampling, namely cluster random sampling or random sampling based on area or region with the aim of determining the influence of the same characteristics but getting different treatment from other regions. This study also used propensity score matching (PSM) technique with nearest neighbor matching approach. The research instrument used in this study was a questionnaire guideline.

RESULT AND DISCUSSION

The use of induction stoves for households can affect household energy expenditure, especially in electricity expenditure, and if this energy transformation is carried out fully by households, this can also affect fossil energy expenditure in the form of LPG. In this study, the distribution area of the use of induction stoves in Denpasar City is South Denpasar District or more precisely in Penatih Village and Kesiman Petilan Village. The surveyed area is a road or area bordering Tonja Village which is a village that feels in West Denpasar District.

Table 1. Distribution of Respondents According to The Use of Induction Cookers

Use of Induction Stove	Total (Family Card)	Percentage (%)
Using an induction cooker	33	33,33
Not using an Induction cooker	63	63,63
Total	99	100

In this study, the number of family members is the total of all family members who live in 1 building with 1 meter and who are more than 5 years old. The number of family members affects the fulfillment of daily needs, both from the use of fuel for cooking and the use of electronic goods in a family. In this study, the number of family members became one of the control variables over the use of the propensity score matching method matched by researchers in the field when carrying out surveys.

Table 2. Distribution of respondents according to the number of family members.

Number of Family Members (People)	Total	Percentage (%)
1	5	5,05
2	6	6,06
3	30	30,30
4	41	41,41
5	7	7,07
6	7	7,07
7	3	3,03
Total	99	100

Each respondent's family has different needs for electronic goods. Based on the number of electronic items used, the author can see patterns of energy consumption by respondents. In this study, the number of electronic items used became one of the control variables for the use of the propensity score matching method matched by researchers in the field when carrying out surveys.

Table 3. Distribution of Respondents According to the Number of Electronic Goods Used

Number of Electronic Items Used (Units)	Total	Percentage (%)
1-10	1	1,01
11-20	34	34,34
21-30	59	59,59
> 30	5	4,04
Total	99	100

Every house or building that uses an electric lighting source by PLN has several classifications of electrical power which will later adjust the installed electric voltage and electricity tariffs that will be charged by an electricity user. In this study, the installed electrical power became one of the control variables over the use of the propensity score matching method matched by researchers in the field when carrying out surveys.

Table 4. Distribution of Respondents According to Installed Electrical Power

Installed Electric Power (VA)	Total	Percentage (%)
450	2	2,02
900	71	71,72
1.300	23	24,24
> 1.300	2	2,02
Total	99	100

Based on the type of settlement or residence in Penatih Village, Kesiman Petilan Village and Tonja Village have similar or the same characteristics. Residential buildings are measured per 1 nuclear family living together. If in 1 yard there are 2 families, 2 respondents will be counted.

Table 5. Distribution of Respondents According to Residential Building Area

Residential Building Area (m^2)	Total	Percentage (%)
50-150	67	67,67
151-250	26	26,26
251-350	6	6,06
>350	0	0
Total	**99**	**100**

The analysis model used in this study was multiple linear regression using the STATA 14.2 tool.

Table 6. Multiple Linear Regression Analysis Test Results

Variabel	Coef.	Std. Error	t	Prob.
Use of induction cookers (X_1)	-0,1658975	0,0576168	-2,88	0,005
Number of family members (X_2)	0,0587313	0,0256362	2,29	0,024
Number of electronics used (X_3)	0,0355402	0,0074015	4,80	0,000
Built-in electrical power (X_4)	0,3844396	0,0576492	6,67	0,000
Area of residential buildings (lnX_5)	-0,1382616	0,078777	-1,76	0,083
cons/Household energy expenditure (lnY)	11,15708	0,3196287	34,91	0,000

The Effect of the Use of Induction Stoves, Number of Family Members, Number of Electronic Items Used, Installed Electrical Power, and Area of Residential Buildings on Household Energy Expenditure in Denpasar City. Based on the results of STATA 14.2 data processing, it was obtained that the use of induction stoves, the number of family members, the number of electronic items used, installed electrical power, and the area of residential buildings against household energy expenditure had a Calculate value of 43.63 greater than Ftable, which was 1.91 and had a value (Prob.) 0.0000 is less than the significance level of 10%. This shows that household energy expenditure in Denpasar City is influenced simultaneously or jointly by the use of induction stoves, the number of family members, the number of electronic items used, installed electrical power, and the area of residential buildings.

The Effect of the Use of Induction Stoves on Household Energy Expenditure in Denpasar City. This study states that the use of induction stoves has a negative and significant effect on household energy expenditure in Denpasar City. This statement is supported by the guidelines for the implementation of the pilot project for converting gas stoves to induction stoves in 2022 which say that the use of induction stoves can save or reduce family expenses to pay for electricity, and the use of induction stoves has a negative and significant influence on household energy expenditure. This can be seen through the results of STATA 14.2 data processing which is shown by the results of the t test obtained a calculated value of -2.91 < table 1.29 and with a significance value of 0.004 < 0.10. So, it shows a negative and significant relationship. Based on the results of data processing, it can be concluded that if someone uses

an induction stove, a household can save or reduce household expenses by 16.45%. The use of induction stoves has a negative and significant effect on household energy expenditure in Denpasar City. This is because the recipients of the induction stoves studied in this study are participants in the pilot project of the gas stove to induction stove conversion program by PLN in 2022 which targets 450 VA and 900 VA subsidized electricity users. The amount of energy consumption from an electric stove of 7.19 kWh is equivalent to 1 kg of LPG. So, if someone has changed the LPG stove to an induction stove, based on calculations, a household will save at least Rp 6,953 if it uses 900 VA (R1) electric power when compared to using 1 3 kg LPG cylinder at a price of Rp 20,000. So, with this, the use of induction stoves has a negative influence on household energy expenditure, where if someone uses an induction stove, it will be able to save or reduce household energy expenditure, especially if the household has stopped using LPG gas as fuel.

The Effect of the Number of Household Members on Household Energy Expenditure in Denpasar City. This study states that the number of household members has a positive and significant influence on household energy expenditure in Denpasar City. This statement is supported by a similar study by Purnomo (2020) which states that the number of household members has a positive effect on household electricity expenditure. This study also showed that the results of STATA 14.2 data processing obtained a calculated value of 2.39 > from a table value of 1.29 with a significance value of 0.019 < 0.10. Thus, it can be concluded that every increase of 1 family member, household energy expenditure increases by 6.05%. Household energy expenditure can also be affected by the number of households, electronics used and electrical power installed in a family's residence or home. This is because every member of the household needs energy to operate an electronic device both as a function and for entertainment. In this study, household members counted were household members who were more than 5 years old. It is assumed that household members under the age of 5 years cannot operate electronic goods smoothly, while household members over the age of 5 years are assumed to be able to use simple electronic items. In addition, the use of electronic goods does not escape the use of energy, in this case electrical energy. In addition to the use of electronic goods, household energy expenditure can be affected by several things such as installed electrical power, the type and size of the electronic goods themselves. If the installed electronic goods have a large number, high amount of power, and frequent use, then the electricity bill will be even greater.

The Effect of the Number of Electronic Goods Used on Household Energy Expenditure in Denpasar City. This study states that the number of electronic items used has a positive and significant influence on household energy expenditure in Denpasar City. This statement is supported by a similar study by Purnomo (2020) which states that the number of electronic items used has a positive effect on household electricity expenditure. This study also showed that the results of STATA 14.2 data processing obtained a calculated value of 4.89 > from a table value of 1.29 with a significance value of 0.000 < 0.10. Thus, it can be concluded that every increase in 1 electronic item used, household energy expenditure increases by 3.56%. Installed electrical power also has a positive influence on household energy expenditure. This is mentioned because the higher the electricity voltage, the electricity tariff used as a reference for electricity payments becomes more expensive so that household energy expenditures increase. Installed electrical power also affects the electrical capacity available for use. Therefore, the greater the level of installed electrical power, the greater the household energy expenditure charged to a household.

The Effect of Installed Electric Power on Household Energy Expenditure in Denpasar City. This study states that installed electrical power has a positive and significant influence on household energy expenditure in Denpasar City. This statement is supported by a similar study by Purnomo (2020) which states that installed electrical power has a positive effect on household electricity expenditure. This study also showed that the results of STATA 14.2 data processing obtained a calculated value of 6.81 > from a table value of 1.29 with a significance value of 0.000 < 0.10. Thus, it can be concluded that every increase in the level of installed electrical power, household energy expenditure increases by 38.31%. The area of residential buildings has no influence on household energy expenditure. This is due to the previous research by Purnomo (2020) having a research location in Sekaran Village, Gunungpati District, Semarang City, while this research was carried out in 3 villages/ward in Denpasar City. The difference in the location of this study is the reason that the results of this study. Residents living in Penatih Village, Kesiman Petilan Village, and Tonja Village have similar residential characteristics, and have similar characteristics, namely the main building that is separate from the kitchen, bathroom, and place of worship (sanggah/merajan). So, thus the calculation of the building area becomes different and looks very wide. In fact, only the main building contains a large number of electronic goods, meanwhile, other buildings only contain electronic goods in the form of lighting and electronic goods with small input sizes.

The Widespread Influence of Residential Buildings on Household Energy Expenditure in Denpasar City. This study states that the area of residential buildings has no influence on household energy expenditure in Denpasar City. This statement is not in accordance with the initial hypothesis which reads "The area of residential buildings has a positive and significant effect on household energy expenditure in Denpasar City" which refers to previous research by Purnomo (2020) which stated that residential building area had a positive effect of 39.02% on household electricity expenditure. The characteristics of the households studied were 1.96% or 2 respondents were 450 VA (R1) electricity users, then 72.54% or as many as 74 respondents were 900 VA electricity users (R1 and R1M) and from a total of 102 respondents were subsidized and non-subsidized electricity users who had electricity tariffs of Rp 415 to Rp 1,352 per kWh. While the remaining 27.45% or as many as 28 respondents are non-subsidized electricity users or who have electricity tariffs of Rp 1,444 to Rp 1,699.1 per kWh. Thus, the area of residential buildings must also be influenced by installed electrical power and the number of electronic items used to be able to affect household energy expenditure. However, this study has a focus on the object of research of households receiving electricity subsidies or having electrical power groups of 450 VA to 900 VA, so, the area of residential buildings cannot affect household energy expenditure in Denpasar City.

CONCLUSION

Based on the results of the research that has been done, the following conclusions can be obtained: 1) Household energy expenditure in Denpasar City is simultaneously influenced by the use of induction stoves, the number of household members, the number of electronic items used, installed electrical power, and the area of residential buildings. 2) The use of induction stoves partially negatively affects household energy expenditure in Denpasar City. 3) The number of family members partially has a positive effect on household energy expenditure in Denpasar City. 4) The number of electronic items used partially has a positive effect on household energy expenditure in Denpasar City. 5) Electrical power partially has a positive effect on household energy expenditure in Denpasar City. 6) The area of residential buildings has no influence on household energy expenditure in Denpasar City.

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