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Household Energy Poverty Assessment In Central And Eastern Indonesia

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Abstract

The phenomenon of energy poverty has been of particular concern around the world. This study was conducted to look at the determinants in the social and economic perspective of households that can affect energy poverty in the Central and Eastern Regions of Indonesia. This study uses panel data with a total of 80 data in the period 2018-2022. The variables used are per capita expenditure, education, working household head, house size, and number of household members as independent variables and energy poverty as the dependent variable. The results of the study show that per capita expenditure and house size have a significant effect of energy poverty. Meanwhile, education, working household head, and number of household members have no significant effect on energy poverty in Central and Eastern Indonesia.

Keywords: energy poverty, per capita expenditure, education, household, energy.

INTRODUCTION

The phenomenon of energy poverty has occurred in almost all developing countries and is one of the main drivers of the world's development problems. The International Energy Agency (IEA) uses the concept of energy poverty as a state of lack of access to electricity and dependence on traditional biomass fuels for cooking (IEA (International Energy Agency), 2023).

Based on data from the national socio-economic survey (Susenas), there are still 11.76 percent of households in Indonesia that still use unsafe cooking fuels such as firewood in 2022 and there are still households without access to electricity in 2022,

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Papua Province has the most households with non-electric lighting sources at 20.04 percent (Badan Pusat Statistik Indonesia, 2023).

Indonesian people, especially those in rural areas, still depend on traditional materials such as firewood for cooking. This dependence is very dangerous because the smoke from burning firewood that is not equipped with a good ventilation system will cause ARI (Acute Respiratory Infection) (Institute for Essential Services Reform, 2011). The problem must be solved immediately, because economic progress requires more efficient use of energy, excessive consumption of fossil fuels will have a negative impact on the environment (Gunarto et al., 2024).

According to Indonesia's Central Bureau of Statistics (BPS), the average energy poverty rate in Western Indonesia is 6.05%, the average energy poverty rate in Central Indonesia is 13.81% and the average energy poverty rate in Eastern Indonesia reaches 52.96%. The data above shows that there is a gap between the western region and the central and eastern regions. To overcome this gap can be done by developing central areas, regional development in growth centers will stimulate economic growth which will be followed by the development of the surrounding areas (Emalia & Farida, 2018).

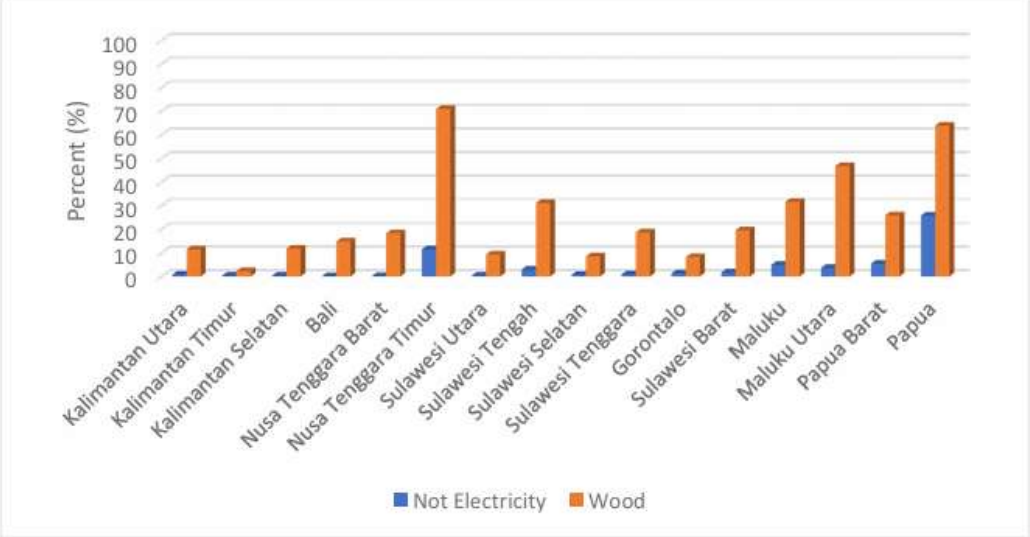


Figure 1: Average Percentage Distribution of Households by Province, Main Fuel for Cooking (Wood) and Lighting Source (Non-Electricity) 2018 - 2022

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Figure 1 shows that provinces in Central and Eastern Indonesia still have households that cook using wood with an average percentage of 24.56% in 2018 2022. East Nusa Tenggara (NTT) Province and Papua Province are the 2 highest provinces that use firewood for cooking. The average number of households that do not use electricity in Central and Eastern Indonesia is 3.81% in 2018-2022. Papua Province has the highest percentage compared to other provinces in Central and Eastern Indonesia.

In the various studies that have been conducted on energy poverty, energy poverty is often influenced by socioeconomic variables. The social household approach is very relevant in seeing and overcoming energy poverty. Research conducted by (Ramadanti & Sofa, 2023) used socio-economic variables to see its effect on energy poverty. Research (Abbas et al., 2020) also uses socio-economic variables to see its effect on energy poverty.

This study aims to look at the influence of socioeconomic variables consisting of per capita expenditure, education, working household head, house size, and number of household members on energy poverty in Central and Eastern Indonesia.

METHODOLOGY

This research uses descriptive research with a quantitative approach. This study uses secondary data in the form of a panel which is a combination of time series data and cross section data. Time Series data used for 5 years, namely from 2018 to 2022. While the Cross Section data used includes 16 Provinces in Central and Eastern Indonesia. The variables used include per capita expenditure (X1), education (X2), working household head (X3), house size (X4), and number of household members (X5) as independent variables and energy poverty (Y) as the dependent variable.

The data in this study was converted into natual logarithm form (Ln). The research data is converted into natural logarithm form, so that the parameters can be interpreted as elasticity. The research equation model is as follows:

$$\ln KE_{it} = \beta_0 + \beta_1 \ln PK_{it} + \beta_2 \ln PD_{it} + \beta_3 \ln KRT_{it} + \beta_4 \ln UR_{it} + \beta_5 \ln ART_{it} + \varepsilon t$$

Description:

KE	: Energy Poverty (percent)
β_0	: Constant
$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$	: Coefficients
PK	: Per Capita Expenditure (IDR)
PD	: Education (percent)
KRT	: Working Head of Household (percent)

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UR	: House Size (percent)
ART	: Number of Household Members (percent)
i	: Province
t	: Year
εt	: Disturbance Variable
ln	: Natural Logarithm Transformation

RESULT AND DISCUSSION

Model Specifications Test

1). Chow Test

This test is used to determine which method is better to use between the common effect and fixed effect models. The following is the hypothesis in the chow test:

H_0 : CEM (Common Effect Model)

H_a : FEM (Fixed Effect Model)

The following are the results of the Chow Test:

Table 1. The Chow Test's Summary

Effects Test	Statistic	d.f.	Prob.
Cross-section F	36.886442	(15,59)	0.0000

The results show that the Cross-Section F probability value is 0.0000 smaller than the alpha value (0.05). This means that H0 is rejected and Ha is accepted, so that the fixed effect model is more appropriate to use compared to the common effect model.

2). Hausman Test

The Hausman test is used in determining between the random effect model and the fixed effect model that should be used in panel data modeling. The hypothesis in this test is as follows:

H_0 : REM (Random Effect Model)

H_a : FEM (Fixed Effect Model)

The following are the results of the Hausman Test:

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Table 2. Hausman Test's Summary

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	20.987487	5	0.0008

The results show that the cross-section random probability value is 0.0008 which is smaller than the alpha value (0.05). It means that H0 is rejected and Ha is accepted, so the fixed effect model is more appropriate to use than the random effect model.

Classical Assumption Test

1). Normality Test

The decision-making criteria for the normality test, if the probability value of the Jarque-Bera statistic is greater than 0.05, then do not reject the hypothesis, meaning that the residuals are normally distributed. If the probability value of the Jarque-Bera statistic is smaller than 0.05, then rejecting the hypothesis means that the residuals are not normally distributed.

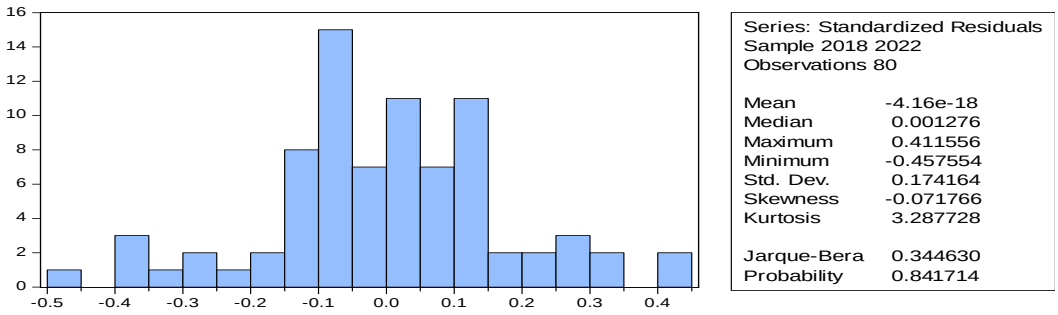


Figure 2: The Normality Test's Summary

The results show that the Jarque-Bera (JB) result is 0.344630 with a probability value of 0.841714. These results mean that the data is normally distributed, because it is greater than the probability value of 0.05 (0.841714> 0.05).

2). Multicollinearity Test

Multicollinearity test by looking at the correlation matrix between independent variables, if the correlation coefficient shows a number above 0.80 then there is multicollinearity. The results are as follows:

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Table 3. Multicollinearity Test's Summary

	LNPK	LNPD	LNKRT	LNUR	LNART
LNPK	1.000000	0.598714	0.020531	0.076700	0.292436
LNPD	0.598714	1.000000	-0.363748	-0.129350	-0.111662
LNKRT	0.020531	-0.363748	1.000000	0.435365	-0.154073
LNUR	0.076700	-0.129350	0.435365	1.000000	-0.317814
LNART	0.292436	-0.111662	-0.154073	-0.317814	1.000000

The multicollinearity test results show that the coefficient value of each independent variable.

3). Heteroscedasticity Test

The glejser test is one way to determine the presence or absence of heteroscedasticity problems in a regression model. The trick is to regress the absolute value of the residual against the independent variable.

Table 4. Heteroscedasticity Test's Summary

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.291923	7.661801	0.951724	0.3451
LNPK	-0.170495	0.293971	-0.579971	0.5641
LNPD	0.202348	0.329812	0.613525	0.5419
LNKRT	-1.141724	1.447390	-0.788816	0.4334
LNUR	-0.066737	0.063790	-1.046195	0.2997
LNART	-0.070124	0.298505	-0.234919	0.8151

The results show that the probability value of the independent variables is greater than α = 0.05. This means that the regression model in this study does not have heteroscedasticity problems.

Hasil Estimasi Regresi Data Panel

The choice of the fixed effect model as a panel data regression model results in a more detailed multiple linear regression estimation as follows:

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Table 5. Panel Data Regression Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	56.51720	14.88291	3.797457	0.0003
PK	-2.068633	0.571033	-3.622616	0.0006
PD	-0.693496	0.640653	-1.082483	0.2834
KRT	-5.333412	2.811528	-1.896980	0.0627
UR	0.325686	0.123912	2.628369	0.0109
ART	0.143065	0.579840	0.246731	0.8060
R-squared	0.966064			
Adjusted squared	0.954561			
S.E. of regression	0.201533			
Sum squared resid	2.396310			
Log likelihood	26.80879			
F-statistic	83.97929			
Prob(F-statistic)	0.000000			

The following is the output interpretation based on the panel data estimation results above:

1. The constant 56.51720 is the LNKE value when the independent variable is zero, anti-ln becomes 3.508E+24.
2. The LNPK coefficient is -2.068633, meaning that if per capita expenditure increases by 1 percent and other variables are constant or ceteris paribus, it will reduce energy poverty by -2.068633 percent.
3. The coefficient of LNUR is 0.325686, meaning that if house size increases by 1 percent and other variables are constant or ceteris paribus, it will increase energy poverty by 0.325686 percent.

Hypothesis Testing

t-Statistic Test

The test is used to see the regression relationship partially, the t-statistic test basically shows how far the influence of an independent variable individually in explaining the variation in the dependent variables. The t-statistic test decision making is by looking at the probability of the variable, if the probability value.

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Table 6. t-test results

Variable	t-Statistic	Prob.	Conclusion
LNPK	-3.622616	0.0006	Significant
LNPD	-1.082483	0.2834	Not Significant
LNKRT	-1.896980	0.0627	Not Significant
LNUR	2.628369	0.0109	Significant
LNART	0.246731	0.8060	Not Significant

F-Statistic Test

This test aims to find out whether all the independent variables used in the model have an influence simultaneously on the dependent variable.

F-statistik	F-tabel	Probabilitas	Conclusion
83.97929	2,4937	0.000000	Significant

Based on the results of the F-Statistic test, the F-Statistic result is 83.97929> F Table 2.4937, with a significance level of 5%, a probability value of 0.0000 < α 0.05. So it can be concluded that the independent variables, namely per capita expenditure, education, working household head, house size, and the number of household members together have an influence on energy poverty.

Testing the Coefficient of Determination (R^2)

R-squared	0.966064
Adjusted R-squared	0.954561

Based on the results of the fixed effect model regression calculation, it is found that the coefficient of determination or R2 value is 0.966064 while the adjusted R2 value is 0.954561. This means that the variables of per capita expenditure, education, working household head, house size, and number of household members can explain 96.61% of the energy poverty variable.

The Effect of Per Capita Expenditure on Energy Poverty

The results show that per capita expenditure has a negative and significant effect on energy poverty, with a coefficient value of -2.068633, which means that every 1%

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increase in per capita expenditure will reduce energy poverty by - 2.068633%, assuming other variables remain constant (ceteris paribus). According to the Consumption Theory proposed by JM. Keynes said that the size of consumption expenditure is only based on the size of the community's income level (Mankiw, 2006). Therefore, households with high income will allocate their income to buy or use energy more efficiently.

These findings are in line with research conducted by (Ramadanti, S.A & Sofa, 2023), which shows that the per capita expenditure variable has a significant and negative effect on energy poor households. Research conducted by (Bekele et al., 2015) is also in line with the findings of this study, using the variable household expenditure as a proxy for income, showing that households with greater income have a smaller weight of energy deficiency.

The Effect of Education on Energy Poverty

The regression results show that education has no significant effect on energy poverty. However, the results show that education has a negative influence on energy poverty. Research conducted by (Abbas et al., 2020) shows that education is one of the socio-economic determinants that has a negative influence on household multidimensional energy poverty.

The Effect of Working Household Heads on Energy Poverty

The regression results show that working household heads do not have a significant effect on energy poverty. However, the results show that working household heads have a negative influence on energy poverty. Research conducted by (Ramadanti, S.A & Sofa, 2023) found that the percentage of working household heads has a significant influence on the percentage of multidimensional energy poor households in 4 regions.

The Effect of House Size on Energy Poverty

The results show that house size has a positive and significant effect on energy poverty, with a coefficient value of house size of 0.325686 which means that every 1% increase in house size will increase energy poverty by 0.325686%, assuming other variables remain constant (ceteris paribus). Larger house sizes require more energy for lighting, air conditioning, heating, and other household appliances.

These findings are in line with research conducted by (Sharma et al., 2019) showing that increasing the dwelling size of households from low-income groups also increases their expenditure on electricity and, thus, their energy poverty.

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The Effect of Household Size on Energy Poverty

The regression results show that the number of household members has no significant effect on energy poverty. However, the results show that the number of household members has a positive influence on energy poverty. Research conducted by (Bekele et al., 2015) found that the coefficient of family size is positive, indicating that households with a large number of family members have a higher weight of energy poverty. Research conducted by (Abbas et al., 2020) found that family size plays a significant positive role in the level of multidimensional energy poverty.

CONCLUSION

Based on the results of the data analysis, it has been found that per capita expenditure has a negative and significant effect on energy poverty, education has no significant effect, but has a negative effect on energy poverty, working household heads have no significant effect, but have a negative effect on energy poverty, house size has a positive and significant effect on energy poverty, and the number of household members has no significant effect, but has a positive effect on energy poverty in Central and Eastern Indonesia.

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