

# The Determinants of Household Willingness to Use Biodiesel

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## ABSTRACT

*The subsidy policy of diesel in Indonesia is considered inefficient since it results an increase in the burden on the Government Budget (APBN), distribution process is not well targeted and encourages wastage of consumption. Then, in 2014 the Indonesia government decided to cut diesel subsidies and began marketing alternative solar products, namely biodiesel, as an effort to ensure energy sustainability. Therefore, this study aims to analyze the determinant that influences household's willingness to use biodiesel using quantitative methods. The results show that there are three variables having a significant effect on the willingness to use biodiesel, namely age, occupation, and knowledge.*

**Keywords:** Diesel, Biodiesel, Subsidy, Binary Logistics Regression, Willingness to Use.

**JEL classification:** A1, Q10, Q40

## INTRODUCTION

Indonesia is a country with abundant natural wealth. Unfortunately, Indonesia's natural wealth resources have not been used optimally and it could be disastrous if not managed properly. In resource course theory it is stated that many countries with abundant natural wealth have favorable economic conditions stagnant and even categorized as non-developing countries, for example, countries in Africa, this happens because the country is faced with various problems, such as corruption and the quality of human resources (Rahma et al., 2021). Indonesia should make comprehensive regulations to regulate management owned natural wealth.

The government as the largest organizational unit at the national level has three roles which are stabilization, allocation, and distribution, by carrying out policies such as infrastructure development, social safety nets, protection of educational costs to fuel subsidy policies. Pradana (2015) stated that fuel subsidy policy is a controversial policy that triggers complications

from the impact of this policy based on the results from his research.

History records several large demonstrations based on resistance to increase fuel prices, including the Tritura demonstration in 1966 regarding the rejection on the increase of the price of basic commodities due to increase in fuel prices (Aisyah, 2016). Demonstration in 1998 was motivated by political issues and fuel subsidies (Santi, 2020) and in 2015 demonstration was motivated by resistance to Presidential Regulation Number 191 of 2014 regarding the release of the intended fuel price including diesel in accordance with market mechanisms resulting in price conflicts (Aisyah, 2016). Moreover, in the liberalization era expansionary fiscal policy on the real sector, such as in energy sector, has influenced the national economy (Feriansyah et al., 2021)

An increase in the price of diesel fuel in the short term that occurs continuously every year will influence higher operational costs and an increase in the price of goods or services (Benes et al. 2015). The price increase has a major

impact on the community, especially fishermen who use diesel fuel as the main source of energy for their ships. (Benes et al. 2015).

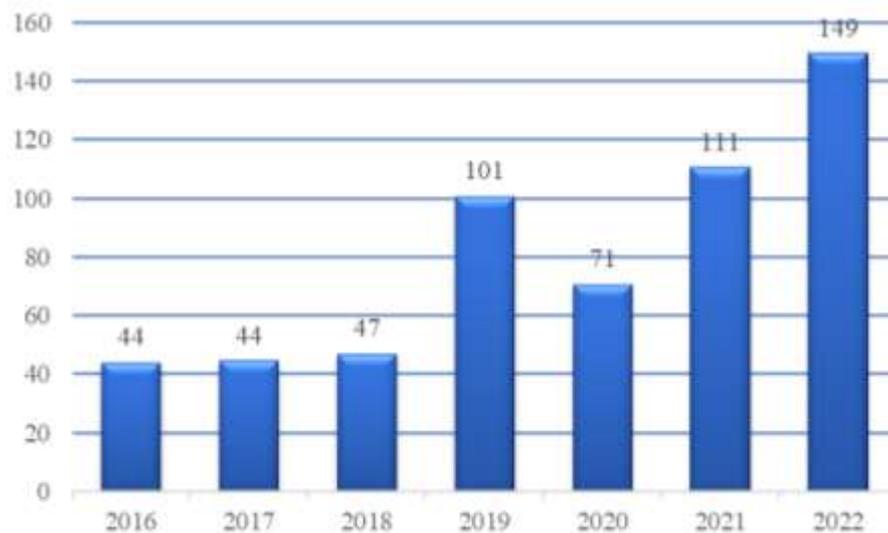
Based on the publication of the Ministry of Marine Affairs and Fisheries (KKP) (2019), there are 2.7 million people who worked as fishermen which is the poorest profession in Indonesia. The research indicates the fishermen should be eligible to receive diesel subsidies because they meet the requirements as recipients. In accordance with Law No. 30 Article 7 of 2007 regarding energy prices, the government and regional governments should provide subsidy funds for disadvantaged groups of people.

In Indonesia, regulations related to the management of natural resources are indicated in the 1945 Constitution Article 33 paragraphs 2 and 3 which said that production sectors that are important for the state and affected the livelihood of the people at large are controlled by the

government, including the management of oil and natural gas.

The main purposed of those regulations are for Indonesia's natural resources will be properly managed solely for the benefit of the community. However, the application of the policy has not been perfect, especially in the diesel subsidy policy. The diesel subsidy policy, which should aim to provide guarantees to low-income people so that they can meet their needs, has been called as mistargeted (Hidayatullah, 2020).

Hidayatullah (2020) stated that diesel subsidies provided by the government in large amounts only become a burden on the state budget and encourage higher public consumption as evidenced by the graph in Figure 1. It shows that government spending on fuel subsidies continued to increase since 2016. This means that between 2016 and 2022 there was a surge in spending of 105 trillion rupiah.



Source: Kementerian Keuangan (2023)

**Figure 1.** Fuel Subsidy Expenditure for 2016 – 2022 (Trillion Rupiah)

The high consumption of diesel fuel was driven by the increasing public need for diesel fuel and the occurrence of wasted diesel fuel consumption driven by subsidies, while the increase in spending on subsidies was driven by the ineffective process of distributing subsidized diesel. In fact, the high consumption of diesel fuel is not only driven by subsidies, the needs of the community are also increasing, so that the consumption and environmental damage from the

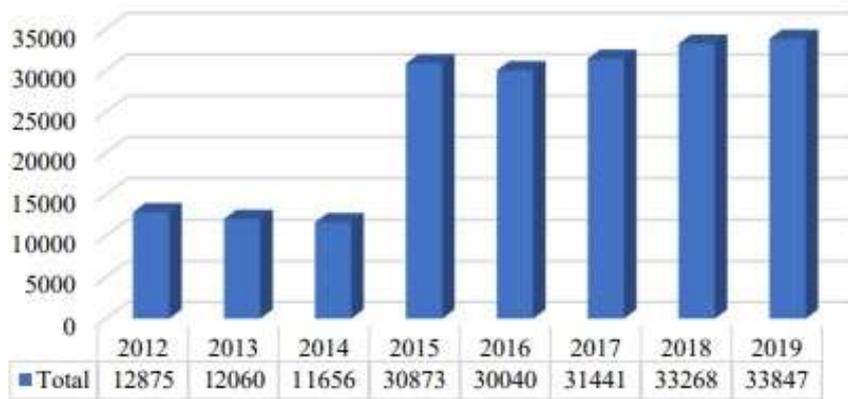
use of diesel is getting higher (Hidayatullah, 2020).

Based on data from the World Bank in 2010, there were 25% of households with high incomes enjoying 77% subsidies, while 25% of people with low incomes only enjoyed 15% subsidies (Pusat Kebijakan Anggaran Pendapatan dan Belanja Negara, 2015), this was confirmed by the Minister's statement of the Ministry of Marine Affairs and Fisheries, that many fishermen have not received subsidized diesel fuel. There are two

possibilities why this happened, firstly because there was an incorrect prediction of the diesel quota, and secondly, the distribution scheme was not correct.

On the other hand, the public does not know that Indonesia's current oil reserves have decreased, referring to data for 2020, the Minister of Energy and Mineral Resources (Kementerian

ESDM, 2021a) stated that Indonesia's oil reserves can only last up to 9.5 more years, assuming no discovery of new oil reserves. Panigoro (2015a) argues that Indonesia is currently facing an energy crisis. The irony is that Indonesia has not been able to break away from dependence on conventional energy (Noviana et al., 2016).



Source: Kementerian ESDM (2021a)

**Figure 2.** Indonesia's Solar Import Data (Thousand Kiloliters) for 2015 - 2019

Even though Indonesia is a country with great potential to develop alternative energy, namely palm oil. Thanks to the abundance of oil palm plants, in 2020 Indonesia will be able to dominate 55% of the world palm market share (Kementerian Koordinator Bidang Perekonomian, 2021). Furthermore, Indonesia also still has a myriad of potentials for alternative energy development, such as micro hydro energy, biomass, wind energy, and geothermal. It is unfortunate if this potential is not utilized optimally.

Indonesia has chosen to continue importing to meet domestic solar needs, rather than developing available alternative energy. Figure 2 shows that from 2012 to 2019 Indonesia still imports a total of 33 million kiloliters. Figure 2 also proves that the amount of imported diesel continues to increase. This condition is exacerbated by the provision of diesel fuel subsidies and the people feel comfortable with policies that seem to be in their favor.

Most people will refuse if the government decides to increase the price of diesel fuel. To overcome the problems previously described, in 2014 the government decided to reform diesel subsidies policy as an effort to increase the

effectiveness of diesel subsidies and implemented effectively in 2015.

As an effort to ensure energy sustainability and overcome environmental damage, the government has started converting diesel to biodiesel marked by the marketing of B30 products since January 1, 2020. The B30 itself is a type of biodiesel with a mixture of 30% biofuel for energy sustainability (Oktaviani et al. 2021). Biodiesel is believed having a better efficiency than gasoline and also environmental friendly (Demirbas, 2007) and mostly Indonesian biodiesel is trading abroad (export) (Pambudi et al. 2019).

To reduce the use of diesel, the government is currently continuing the development of biodiesel with a higher content of Biofuels (BBN) (Kementerian ESDM, 2020). Therefore, it is important to analyse factors that influence people's willingness to use biodiesel.

Biofuels produced from renewable sources, provide added value through down-streaming the domestic agricultural industry, stabilize prices, improve the welfare of small farmers, produce less greenhouse gas emissions compared to fossil fuels, reduce imported fuels, save the country's foreign exchange and trade balance, provide

employment opportunities, and to maintain energy security (Kementerian ESDM, 2020).

From the previous description it can be stated that there are four main reasons the government is taking steps to cut diesel fuel subsidies. The first is because the portion of the diesel subsidy has long been a burden on the state budget (Panigoro, 2015a). The second is because the environmental damage is increasing. The third is inappropriate subsidy schemes and the fourth is the energy crisis that Indonesia is currently facing (Panigoro, 2015b).

The projection results of the Indonesian Institute for Energy Economics (2015) stated that based on data on proven oil reserves in 2013, Indonesia could only survive for the next 12 years. Followed by a statement from Kementerian ESDM (2021b) which states that based on data for 2020, Indonesia can only survive for the next 9.5 years. Even though the diesel subsidy reform policy has been implemented since 2015.

Indonesia's National Energy Policy sets out the ambition to change the energy mix by prioritizing new and renewable energy sources. The policy targets new and renewable energy sources to contribute around 23% of the total primary energy mix in 2025. By 2021, the share of Renewable Energy has reached 11.7% of the total energy mix and biodiesel contributes around 35% (Kementerian ESDM (2021b)).

This policy still reaps pros and cons from various groups and on people who usually use solar for the daily activity. So it becomes important to analyze what factors influence people's willingness to using biodiesel.

## METHOD

### Government Functions

Government in a broad sense is all the activities of public bodies which include legislative, executive and judicial activities in an effort to achieve state goals. Government in a narrow sense is all the activities of public bodies that include only executive power. (C.F. Strong, 2004)

Referring to the public economy, the government has three main functions, namely distribution allocation and stabilization, these

three roles have an important role in fulfilling public goods (Khusaini, 2019). Public goods are goods that have two main criteria, which are non-rivalry and non-excludable (Buchanan, 1967). Non-rivalry means that an item can be used or consumed simultaneously by several parties without eliminating the opportunity for other parties to use or consume it (Cowen, 1991). Non-Excludable means that there are no restrictions for individuals in using or consuming public goods even though the individual does not pay (Wicaksono, 2012).

Public goods can be divided into 2, namely pure public goods and mixed public goods. Pure public goods are goods that meet the criteria of non-rivalry and non-excludable, while mixed public goods only meet one of these criteria (Dwiputrianti, 2012). In this case diesel is included in the category of mixed public goods because diesel is guaranteed by the government, but users must pay a certain amount of money to be able to use it.

Therefore, to ensure the availability of diesel fuel at prices that can be reached by the public, the government has assigned a task to *State-Owned Enterprises* (BUMN), to be precise, Pertamina. The government provides written guarantees in paragraphs 2 and 3 of the 1945 Constitution which states that "productive branches which are important to the state and which affect the livelihood of the public are controlled by the state". This means that the government has the authority to manage certain resources, with the hope that the government will manage and use them wisely.

### Solar or Diesel Fuel

In Indonesia, fuel is classified into several types, including premium, diesel, kerosene, and avtur, each type of fuel has its own uses. Diesel fuel is a type of fuel that has a clear yellow-brown color, boils at a temperature of 173-370 degrees Celsius and is generally used for diesel-type engines, such as rice field ploughing machines, compressors, and rice milling machines (Pertamina, 2023). High quality diesel fuel can be measured by its cetane content, the higher the cetane level, the better the combustion quality.

Biofuel would be the main substitute for petroleum fuel, especially in the transportation sector. The potential future of energy demand made from biofuel is highly uncertain due to the rapid development of alternative technologies, and business (IESR, 2021). Plantation productivity has only increased by 0.34%. The increasing demand of biofuels is expected by the government as a result of an additional four to six million hectares of plantation in 2024, which exceeds the available and suitable land estimated by some studies (IESR, 2021).

There are various types of diesel fuel in Indonesia including diesel (gas oil), biosolar, pertaminadex and dextrite. Of the four types of diesel fuel provided by the government through Pertamina, there is one that is subsidized by the government, namely diesel (gas oil) priced at IDR 5,150 per liter. Based on the Regulation of the President of the Republic of Indonesia No. 191 of 2014, there are 3 types of fuel in Indonesia, namely certain fuel, special fuel for assignments and general fuel with other.

### **Subsidy**

Subsidies are one of the realizations of budget allocations in the form of money channeled by the government through certain commodity producers or direct financial assistance through the community with the aim that the community can meet their needs (Munawar, 2013). Minister Sri Mulyani in 2021 said that one of the commodities subsidized by the government is diesel fuel. Until 2021 the government will still use commodity-based subsidies instead of beneficiary-based subsidies.

Commodity subsidies are subsidies that are distributed by paying a portion of the price of diesel fuel in accordance with predetermined conditions. Diesel subsidies are channeled by the government through state-owned enterprises, to be precise, PT. Pertamina. With this scheme, the price of diesel fuel seems to be cheaper, even though in essence the price of diesel fuel has not changed at all, it's just that part of the price is paid by the government.

An economic expert as well as a senior economist at the Indonesia Economic Intelligence (Sunarsip, 2021) argues that commodity-based subsidies tend not to be on target, the majority of

recipients actually come from economically affluent circles, this condition drives a gap between people with low economic backgrounds and people with low-income backgrounds. Established economy. From the statement (Sunarsip, 2021) there are indications of market failure in diesel subsidies.

Market failure is the inability of the economy, in this case the government, to function efficiently in economic growth. Market failure in this case occurs due to inefficient allocation, meaning that there is management and/or distribution that is not optimal in these market activities (Reza, 2021). Therefore it is important to analyze the determinants of household willingness to use biodiesel to improve economic conditions in Indonesia and the people that depend on their livelihoods with solar or diesel fuel.

### **Well-being**

Providing solar subsidies is one of the government's efforts to carry out the stabilization, allocation and distribution functions that aim to improve the welfare of the community. Welfare can be defined as a concept that shows conditions in which individuals or communities can meet their needs easily (Medaline, 2017). The theory of neoclassical welfare is one theory that discusses welfare. This theory is known as its pareto *optimal theory*.

Optimal Pareto can be achieved when increasing the welfare of one party does not make the other party experience a decrease in welfare (Reza, 2021). However, the optimal *pareto theory* also states that at a certain point welfare conditions cannot be improved without reducing the welfare of other individuals (Gunawan, 2015). so that with this theory it will be able to see how the accuracy of the subsidy program organized by the government can work well.

### **Alternative Energy**

Alternative energy is an energy source that comes from nature with the ability to regenerate faster than conventional energy (Aksara, 2007). With the ability to regenerate quickly, alternative energy is attractive, especially for countries that are facing limited supply of conventional energy, such as Indonesia, alternative energy can be a

solution to ensure energy sustainability in the future.

Indonesia as a country with abundant natural wealth certainly has a lot of potential for the development of alternative energy, one of which is the development of biodiesel. According to the Balai Teknologi Bahan Bakar dan Rekayasa Disain (2014) biodiesel is an alternative fuel consisting of vegetable and animal fuels and is produced from an esterification process to produce methyl-ester compounds. According to Ministry of Agriculture (2019) Indonesia has many plants that can be used as biodiesel materials including coconut, candlenut, jatropha, nyamplung, kapok, peanuts, oil palm and others.

Indonesia started developing biodiesel since 1994 after going through a long journey, finally Indonesia's struggles began to bear fruit, as evidenced by the presence of B30 products which began to be marketed since January 1 2020 (Oktaviani et al., 2021). Indonesia can produce alternative energy if managed properly and correctly for a better fuel future.

### **Research Design**

The main object of this research is people who live in three provinces with the largest population and poor population in Indonesia, namely East Java, West Java, and Central Java. In the process of taking samples, researchers used a purposive sampling technique. Purposive sampling with special criteria for the sample in this study are households that use diesel fuel in predetermined areas.

The sample is part of the population that is used as the object of research (Respatiningsih & Sudirjo, 2015). In the process of taking samples, researchers used a purposive sampling technique. Purposive sampling is a sampling technique in which the researcher determines specific criteria that are in accordance with the research objectives and are expected to be able to answer the formulation of the research problem (Sitoresmi, 2021).

Specific criteria for the sample in this study are households that use diesel fuel in predetermined areas. The total samples taken from the three regions amounted to 100. According to Kerlinger and Lee (2000) the minimum number of samples used in quantitative

research was 30. In line with Kerlinger and Lee (2000) and Sugiyono (2011) stated that the number of eligible samples in a study was 30 to with 500, if the sample is divided by category, the number of samples for each category is at least 30.

Secondary data collection taken from the official website of the BPS and related ministries while the primary data collection technique carried out with survey method by directly interviewed people in targeted areas and according to predetermined criteria.

### **Analysis Method**

This study uses quantitative methods. Quantitative analysis methods are used to analyse primary data from survey results in three provinces, namely West Java, East Java, and Central Java. Quantitative analysis in this study used econometric methodology, namely a binary logistic regression analysis.

Logistic regression is a non-linear regression used for classification data analysis where the dependent variable is categorical data. Specifically, quantitative analysis was carried out using the binary logistic regression estimation method where the dependent variable in the study was zero and one. Interpretation is carried out using the marginal effect method to determine the change in the probability of the value of the independent variable on the willingness to use biodiesel.

### **Research Model**

This study focuses on the variables of age, knowledge of alternative energy, income, education, and employment. Researchers included work variables by fishermen because to fishermen and non-fishermen because fishermen are one of the professions that use diesel fuel intensely in their operational activities.

The education data is classified into two, namely respondents with less than 12 years of education and respondents with more than 12 years of education, this refers to the Ministry of Education's regulations regarding the minimum standard of national education, which is 12 years. From these variables, the econometric model is formed as follows:

$$\text{Will}_i = \beta_0 + \beta_1 \text{Educ} + \beta_2 \text{Age}_i + \beta_3 \text{Occ}_i + \beta_4 \text{Know}_i + \beta_5 \text{Inc}_i + \mu_i$$

Description:

Dependent Variable

- Will = Willingness to use biodiesel 0 (no) or 1 (yes) Independent Variable
- Educ = Education 0 (less than 12 years of education) and 1 (more than 12 years of education)
- Age = Age
- Occ = Profession 0 (other) and 1 (Fisherman)
- Know = Knowledge related to alternative energy 0 (does not know alternative energy exists) and 1 (Knows alternative energy exists)
- Inc = Income (Rp 0 – 3 million) or 1 (> Rp 3 million)

### Stages of Analysis

There are two stages in this study, the first is the questionnaire testing stage and the second is the testing stage for analysing the factors that influence people's willingness to use biodiesel using binary logistic regression.

First, the validity test is carried out, which is the ability of a measuring instrument to measure an object. A test carried out to find out how far the function of the measuring tool can measure the object under study is called a validity test (Darma, 2021). Validity test can be done with the Pearson correlation method. The questionnaire is declared valid if the value of *r* count is greater than *r* table (Garson, 2013).

Then a Reliability Test was carried out to test what was done on the questionnaire to find out the consistency of the questionnaire (Darma, 2021). The test is applied to analyze the measurement scale for every variable (Puspitawati et al. 2011). The reliability test can be done by comparing the value of Cronbach's alpha with the significance level used in related studies. A questionnaire is said to be reliable if the Cronbach's alpha value is greater than the significance level used (Garson, 2013).

The next stage is the analysis needed to obtain estimation results regarding the factors that influence people's willingness to use biodiesel. The analysis stage includes the stages of the

multicollinearity test which is one of the tests conducted to determine the relationship or correlation between independent variables (Hasan, 2020), with indications of variables indicating that they are free from multicollinearity problems if the correlation value between variables is less than 0.8.

Furthermore, Binary Logistic Regression was carried out which is a data analysis method that is able to describe the relationship between the dependent variable and independent variables that are qualitative in nature, both categorical data or interval data with more than one category (Hendayana, 2013). This study uses the binary logistic regression method because the dependent variable used consists of 2 categories.

In determining the estimation results, logistic regression uses the Maximum Likelihood Estimation (MLE) method. According to Myung (2003) MLE is a method used to obtain the greatest probability estimation results from the data being analyzed, bearing in mind that binary logistic regression is limited to data consisting of zeros and ones. After the logit regression estimation results are obtained, the next stage is to interpret using the marginal effect method to determine changes in the probability of the independent variable to the dependent variable (Norton & Dowd, 2018).

Then a goodness of fit test is carried out which is basically used to determine the accuracy of the econometric model from the data being analyzed (May & Hosmer, 2003). This study uses the Hosmer Lemeshow test to test the accuracy of the model used. A model is said to be correct if the Chi-Square probability is greater than the alpha value. And finally, the Z-statistical test conducted on the econometric model to find out whether all the independent variables used in the study have a significant effect on the dependent variable. The Z test is carried out if the number of samples is more than 30.

## RESULT AND DISCUSSION

### Determinants influencing people's willingness to use biodiesel.

The data analyse consisted of willingness to use biodiesel as the dependent variable, while the independent variables used were occupation, age,

knowledge of alternative energy, income, and education. Before carrying out the test to the next stage, table 1 shows the distribution of data from each variable to find out the average or percentage for each variable which result for the test questionnaire this research is as follow:

**Table 1.** Data Distribution

Variable		Average/ Percentage
Will	0: No	77%
	1: Yes	23%
Educ	0: less than 12 years of education	62%
	1: education more than equal to 12 years	38%
Age		43 Years
Occ	0: Other	39%
	1: Fisherman	61%
Know	0: Did not know there is alternative energy	45%
	1: Knowing there is alternative energy	55%
Inc	0: Rp 0 – 3 million	24%
	1: > Rp 3 million	76%

100

The results of the questionnaire test on all samples used showed that the questionnaire in the study was declared valid. It is indicated by the r-count value (item correlation) of each variable which is greater than the r table value which is 0.1161.

The result showed that for variable Will respondent answered more not as much on 77%. For education as much as 62% answered less than 12 years of education with age average respondent in 43 years and worked as a fisherman in 61%. Respondent as much 55%

answer knowing there is alternative energy with income as much 76% in >Rp 3 milion.

#### Classic assumption test

The multicollinearity test shows that the greatest correlation value is found in the age and occupation variables which have a value of 0.3757 so that no indication of multicollinearity problems is found in all the variables used ( $\geq 0.8$ ) which that shown in Table 2, with the result for multicollinearity this research, with the largest correlation explain more answer the indicator variable correlation.

**Table 2.** Multicollinearity Test

	Will	Age	Occ	Know	Inc	Educ
Will	1					
Age	0.1209	1				
Occ	-0.3425	0.3757	1			
Know	0.1600	-0.0925	-0.1051	1		
Inc	-0.0267	0.1183	0.0787	0.0565	1	
Educ	0.0127	-0.1056	-0.2610	0.0456	0.0540	1

Based on the results of the multicollinearity test in Table 2 The largest correlation value is found in the age and occupation variables which have a value of 0.3757. No indications of multicollinearity problems were found in all the variables used. A variable is indicated to be free from multicollinearity problems if the correlation

value between variables is less than 0.8 ( $\geq 0.8$ ). The result has meant the testing can proceed to the next stage, with correlation between variables which is being analyzed in this research.

#### Goodness of Fit test

The goodness of fit test is used to test whether the model used in the research is appropriate or

fit (May & Hosmer, 2003). The results of the Goodness Of fit test using the Hosmer Lemeshow test show that the model used is appropriate or fit because the probability of chi-square is 0.9835 greater than the alpha value. The result shows how the Goodness Of fit test that data has good model accuracy then can continue next step.

Result from Goodness of fit hoshmer Lemeshow Test:

Number of Observation = 100  
 Number of groups = 4  
 Hosmer- Lemeshow Chi2(2) = 2.20  
 Prob > Chi2 = 0.3325

**Z test**

The z test aims to determine whether the independent variables used in the study have a significant effect. In this case the value of the Z test can be known from the logistic regression estimation. The independent variable is declared to have a significant effect if the z test value is smaller than the alpha used. The estimation results show that the independent variables in the study have a significant effect on the dependent variable ( $P > z$ ). The complete Z test results can be seen in Table 3.

**Table 3.** Logistic regression and statistical Z test

Variabel	Coef.	Std. Error	P>z
Age	0.1037	.0358	0.004
Occ	-2.8012	0.7266	0.000
Know	1.2618	0.6500	0.052
Inc	-0.0695	0.6685	0.917
Educ	-0.6446	0.6254	0.303
Cons	-4.8309	1.6448	0.003

The results show independent variables in this research is significant with the dependent variable with result  $P > z$ , then the test can continue to next stage for calculation and analysis result that will answer the hipotesis.

**Estimation Results**

The results of further analysis of this study used the method of marginal effects and binary logistic regression. From the estimation results it

is known that the pseudo R2 value is 22.77%. This means that the independent variables used in this study have an effect of 22.77% on the willingness to use biodiesel while the rest are influenced by other variables. The estimation results using the marginal effect are listed in Table 4.

**Table 4.** Results

Variables	Marginal Effect	P-value > z
Occ	-0.3731	0.000***
Age	0.0138	0.001***
Know	0.1681	0.041**
Inc	-0.0093	0.918
Educ	-0.0826	0.276

Notes:

- \*\*\* : Significant in  $\alpha = 1 \%$
- \*\* : Significant in  $\alpha = 5 \%$
- \* : Significant in  $\alpha = 10 \%$

Based on the hypothesis in this study, occupation as a fisherman is predicted to have a negative effect on people's willingness to use biodiesel. The research predictions are in line with the results of the analysis in Table 4 which

shows that individuals with a profession as fishermen have a 21 percent lower probability of using biodiesel compared to individuals with other professions. Similar research results were found in Ireland which showed that 40 percent of

fishermen on the island of Ireland agreed to the development of alternative energy, 15 percent were neutral, and 45 percent of fishermen did not agree with the development of alternative energy (Reilly et al. 2015).

It turns out that the case for these fishermen follows the U curve stated by Wolsink (2007). At first, fishermen enthusiastically responded to the alternative energy development plan, increasing over time. From the Wolsink (2007), it can be indicated that in this case, fishermen are in the second stage, considering that biodiesel has only been marketed since 2020. This stage is referred to as the stage of forming perceptions of alternative energy (Reilly et al. 2015).

Table 4 shows that the age variable has a positive and significant effect on the willingness to use biodiesel. As one year of age increases, the probability of people's willingness to use biodiesel will increase by 0.98 percent assuming *ceteris paribus*. These results are in line with research conducted by Sardianou & Genoudi (2013) which states that age has a positive and significant correlation with willingness to use alternative energy. This is due to the increasing age of the individual, the desire will arise to prepare long-term planning in this case, namely a better quality of life in the future or in old age (Steinberg et al. 2009).

Quality of life can be associated with health conditions and a comfortable environment (Phillips, 2006). Where the use of biodiesel can be one of the tools in encouraging better environmental quality in the future. Age can also be associated with the integrity phase, which is the phase in which individuals can accept, adapt, or even equate to all social changes and/or environmental conditions (Crain et al. 2007).

The knowledge variable is predicted to have a positive effect on the willingness to use biodiesel. This is in line with the results of the study showing that the knowledge variable has a significant effect and has a positive relationship to the willingness to use biodiesel. This means that individuals who have knowledge regarding alternative energy have a 16.81 percent higher probability of being willing to use biodiesel compared to individuals who do not have knowledge regarding alternative energy, assuming *ceteris paribus*.

In line with the results of Ayodele et al. (2021) research which stated that knowledge of alternative energy influences the willingness to use alternative energy. This is because households who have knowledge of alternative energy know that there are other alternative energy sources that can be used to meet their needs, meaning that increased knowledge regarding the benefits of using alternative energy can be a motivation for households to use other energy sources (Adjakloe et al. 2021). In this case biodiesel.

Based on the research hypothesis, willingness to use biodiesel will be higher for people with an income of more than Rp 3 million. This hypothesis is inconsistent with research results which show that households with an income of more than Rp 3 million have a lower probability of being willing to use biodiesel compared to individuals with an income of less than Rp 3 million, assuming *ceteris paribus*.

This is an interesting finding from this study, if we refer to the research of Wang and Matsumoto (2021) and the research of Adjakloe et al. (2021), the income variable is a variable that has a positive and significant effect on the possibility of using alternative energy. The results of this study are indeed different from the results of research in general. This is because households with an income of more than 3 million per month have farther access to gas stations compared to buying at retail, while retail does not sell biodiesel.

There are 19 households with an income of more than 3 million buying diesel from retail, there are even households with an income of more than 3 million who must travel 17 KM to get access to buy biodiesel fuel. This is in line with the statement which states that high-income households do not use alternative energy due to difficult accessibility and/or access to using other types of fuel which is easier (Shen et al. 2015). Referring to the survey results, it was identified that there were no significant differences in the portion of spending on energy among individuals with various income levels. For the income group of 1-3 million, the share of spending on energy is 45% of the total expenditure. Furthermore, for the income group of 3-5 million and more than 5

million, the share of spending on energy is 44% and 45% respectively.

In a study by Kapsalyamova et al. (2021) also stated that the more expensive price of alternative energy could be the reason why households with higher incomes do not use alternative energy. Considering that the price of biodiesel reaches IDR 13,746 (ESDM, 2021). More expensive than the price of dextrite which reaches Rp. 9,500 while pertaminadex is sold for Rp. 13,200.

Education is predicted to have a positive effect on the willingness to use biodiesel. This hypothesis is inconsistent with the estimation results which show that individuals with more than 12 years of education have a lower probability than individuals with less than 12 years of education to be willing to use biodiesel with the assumption *ceteris paribus*.

According to Savvanidou et al. (2010) this is because people who have a higher education have the possibility of being educated regarding the disadvantages or deficiencies of alternative energy products, in this case biodiesel. In addition, Savvanidou et al (2010) stated that individuals with higher education have knowledge of other alternative energy sources which they believe are better than biodiesel. and this is where the importance of the government's role in managing new renewable energy for better future. for some aspects of biodiesel as a reliable alternative to fossil fuels will become a strategic role in the future because it has a positive impact on sustainability.

## CONCLUSION

The diesel subsidy policy is a policy that has so far burdened the state budget and limited fiscal space in determining policy. The government has been planning to reform solar subsidies since the reign of President Soeharto, but various obstacles have always been the reason why the policy was not passed. Until finally the Minister of Energy and Mineral Resources Regulation No. 34 of 2014 was ratified and enforced as of January 1, 2015. This policy reaped positive and negative responses from various groups.

Besides being driven by diesel subsidies, the increase in diesel consumption was also triggered by the increasing demand for diesel fuel. On the

other hand, Indonesia is facing an energy crisis, as evidenced by the Ministry of Energy and Mineral Resources' projection which states that Indonesia's oil reserves can only last for another 9.5 years assuming no new oil discoveries. As an effort to guarantee the availability of energy for current and future generations.

In 2020 the government officially markets B30 type biodiesel products and by 2021 the government is in the development stage of B40, the hope is that it can reach B100. Even though it has been marketed since 2020, there are still many people who are reluctant to switch consumption patterns from diesel to biodiesel. Therefore, this study tries to analyze what factors influence an individual's willingness to use biodiesel. The estimation results show that the factors that have a significant influence on people's willingness to use biodiesel are the variables of work, knowledge, and age.

The government is expected to implement a beneficiary card-based diesel subsidy policy such as the fertilizer subsidy program. Simultaneously the government must also provide education to beneficiaries regarding how to use the card. As for efforts to increase public willingness to use biodiesel. The government can conduct outreach to the community regarding the excess use of biodiesel and the importance of switching consumption, besides that it is necessary to include alternative energy subjects into the school curriculum with material that leads to the importance of using alternative energy, considering that the education variable has no significant effect.

This research has limitations so that for subsequent research it is suggested that the analysis of the effectiveness of the diesel subsidy reform policy be analyzed in more depth and specifically, especially to measure the effectiveness of solar distribution using 6 indicators, namely the right price, the right amount, the right place, the right quality, the right type, and the right time. As for the analysis of the determinants that influence the willingness to use biodiesel, it is hoped that the next research will be carried out on a larger scale and use a more diverse range of variables. To find out more about what factors influence people's willingness to use biodiesel.

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