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Implementation of Green Industry Policy on Sustainable Development with Green Innovation as a Mediating Variable at PT Samator Gas Industri Tebing Tinggi

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ABSTRACT

This research is about the Implementation of Green Industrial Policy on Sustainable Development with Green Innovation as a Mediating Variable at PT Samator Gas Industri Tebing Tinggi. In this research, the approach used by researchers is a quantitative approach. Quantitative research is systematic scientific research into parts and phenomena as well as the relationships between parts of phenomena. Data analysis techniques are used to answer problems or test hypotheses that have been formulated. Data management in this research will use smartPLS software. The first hypothesis is accepted that Green Industry (X) influences Green Innovation (Z). The second hypothesis is accepted that Green Innovation (Z) influences Sustainable Development (Y). The third hypothesis is accepted that Green Industry (X) has a significant effect on Sustainable Development (Y) through Green Innovation (Z) as an intervening variable.

Keywords: Green Industry, Sustainable Development and Green Innovation.

INTRODUCTION

Environmental sustainability is an important issue in development. Development in its process cannot be separated from the use of natural resources, both renewable and non-renewable natural resources. Often in the utilization of natural resources do not pay attention to their sustainability, even tend to use as much as possible. This is what will cause negative impacts on the environment, because basically natural resources and the environment have limited capacity or carrying capacity. Development that does not pay attention to the capacity of natural resources and the environment will cause development problems in the future because the flow of goods and services produced from natural resources will not always be able to be carried out continuously (on a sustainable basis)(Pasaribu, 2018). Therefore, in a development it is necessary to pay attention to environmental sustainability so that development can be carried out continuously so that sustainable development is realized.

The concept of sustainable development has developed in many sectors, especially those directly related to the environment, such as the industrial sector. Industry is a leading sector in development because the development of the industrial sector can spur and lift the development of other sectors such as the trade sector, agriculture, or the service sector.(Arsyad, 2020). As an important sector in development, industry has a greater responsibility in implementing the concept of sustainable development. Sustainable development is considered important to be implemented in the industrial sector because of the many negative impacts resulting from industrial activities. Industry is

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a sector that causes a decline in environmental quality because industry in its production process always produces waste or environmental damage due to the exploitation of natural resources that can disrupt human life in it. In general, the implementation of Green Industry can be implemented through reduce, recycle, reuse and recovery in the production process; use of low energy intensity; use of low water intensity; use of competent human resources; minimizing waste; and use of low carbon technology.

Meanwhile, the Green Industry standards set by the Indonesian government through Law No. 3 of 2014 are through (1) the use of raw materials, auxiliary materials, and energy; (2) production process; (3) products produced; (4) business management; (5) waste management. The five standards that have been set are used as government assessment materials for industry and are proven through the granting of green industry certificates carried out by green industry certification institutions appointed by the Ministry. Although legally the Green Industry concept was only legalized in 2014, the Green Industry assessment has been implemented by the Indonesian government since 2011 with reference to the green industry standardization in the Regulation of the Ministry of Industry NUMBER: 05/M-IND/PER/1/2011 concerning the Green Industry Award Program, which is realized through the granting of awards to companies that are able to apply the green concept in their production process. According to data from the Ministry of Industry in 2020, there were 69 companies that successfully won the Green Industry award and one of them was PT Samator Gas Industri Tebing Tinggi Tbk, which is basically the company that is the largest contributor of CO2 gas compared to other industries.

PT Samator Gas Industri Tebing Tinggi Tbk is a company engaged in the manufacturing sectorproducing various gases for industry and related products, such as specialty gases, rare gases, both in the form of liquid and solid gases.In its production process, this company uses raw materials that come from nature and are a type of non-renewable resource. The raw materials for making gas consist of many compounds of silica, alumina, or iron. In the process of making gas, a chemical reaction occurs in the clinker, resulting in CO2 gas (www.digilib.its.ac.id). As a company that contributes CO2 that can disrupt human life and damage the environment, PT Samator Gas Industri Tebing Tinggi Tbk has social and environmental responsibilities as a form of reciprocity for the losses caused. The form of responsibility carried out is through a program to create an efficient, environmentally friendly, and sustainable gas industry according to the Green Industry concept. One form of success of this activity is through the awarding of a green industry certification award by the Ministry of Industry. This can prove that PT Samator Gas Industri Tebing Tinggi Tbk has implemented the Green Industry policy well and is able to meet all the specified standards.

The process of implementing the Green Industry policy, PT Samator Gas Industri Tebing Tinggi Tbk as a gas producing company that in its production process does not produce hazardous waste, however, these activities can still affect environmental quality because the main materials used come from nature, so the choice of programs used by the company will be different from other companies engaged in different fields in running the Green Industry according to the mandate of the constitution. Therefore, the author feels the need to conduct an in-depth study to find out how the implementation of the Green Industry policy is carried out by PT Samator Gas Industri Tebing Tinggi Tbk in an effort to implement a production process based on sustainable development.Industrial players must also have commitment and awareness to implement Green industry. in its operations. This can be done by transforming and adapting digital technology that integrates with the application of green industry technology through the development of new platforms and business models that prioritize environmental sustainability. In addition, industry players must also conduct regular assessments and evaluations of their environmental performance and make continuous improvements.

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Barriers to implementing clean industry come from internal and external factors. Internal factors are those related to humans, for example lack of communication, leadership, resistance to change, unfavorable or non-existent reward systems, lack of flexibility in organizational structures, and concerns about data confidentiality. External factors, namely the lack of concern for pollution prevention and the environment by the community, are factors that ultimately disrupt the perception of the need for the business world to adopt clean industry practices.(Vieira, RP, 2018). Cleaner production affects the performance of an industry, with the application of comparing clean production activity schemes with high costs and low costs. Most companies carry out low-cost schemes because they provide a greater contribution to a company's financial performance and usually will run for a long time, but when carrying out clean production, the company's reputation in the eyes of the public will increase.(Zheng Q et al, 2020). It is also stated that clean production is the overall environmental efficiency of a company through a comprehensive pollution prevention approach.(Geng, Chang-An, 2019).

LITERATURE REVIEW

Green Industry

*Green industry*or Green Industry, is a concept that focuses on efforts to address environmental challenges. Green industry is basically an approach that promotes sustainable practices in all aspects of industry, from production to distribution. Green industry principles include resource efficiency, waste reduction, use of renewable energy, and development of environmentally friendly technologies.(Calza, F., Parmentola, A., 2017). Green industry is the use of renewable energy such as solar panels, the use of environmentally friendly raw materials, waste reduction, and the use of environmentally friendly technology.(Ramdhani, Abdullah, ; Muhammad, 2017).

Sustainable Development

According to(Luthfi, & Ahmad, 2020)states that sustainability means being able to meet current developments without sacrificing future rights. Sustainability has three pillars, namely economic, social and environmental or commonly known as 3P (Profit, Planet, People). Sustainability is a development process that optimizes the benefits of natural resources and human resources with development(Gischa, 2020)so that it can improve the welfare of society in fulfilling its interests without sacrificing the abilities of future generations.

Green Innovation

According to(Damas, D., Maghviroh, R. El, Indreswari, M., Accounting, M., 2021), Green Innovation is a change in the production process or new technology to minimize environmental pollution leading to energy efficiency, pollution minimization, waste recycling, and environmentally friendly design. Green Innovation or Green Innovation is developing new products or significantly improving products.(Alfian, RN, 2021). Green Innovation is a way for a business to eliminate or minimize the negative environmental impacts of its operations.(Dewi, PP, 2022).

METHOD

In this study, the approach used by the researcher is a quantitative approach. Quantitative research is a systematic scientific study of parts and phenomena and the relationships between parts of the phenomenon,(Abdullah, 2018)The steps in quantitative research are formulating problems, seeking theoretical basis, formulating hypotheses, formulating hypotheses, developing instruments and testing instruments on the population and then samples, then collecting data, analyzing data, then concluding and providing suggestions.

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Data analysis is breaking down the whole into smaller components to find out which components are dominant, comparing one component with another, and comparing one or more components with the whole.(Misbahuddin, 2022). Data analysis techniques are used to answer the problem formulation or test the hypothesis that has been formulated,(Sugiyono, 2017). Data management in this study will use smartPLS software.

In hypothesis testing, it can be seen from the t-statistic value and probability value. For hypothesis testing, namely by using statistical values, then for alpha 5% the t-statistic value used is 1.96. So the criteria for accepting/rejecting the hypothesis are Ha is accepted and H0 is rejected when the t-statistic> 1.96. To reject/accept the hypothesis using probability, Ha is accepted if the p value <0.05.

RESULTS AND DISCUSSION

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Evaluation of Measurement Model (Outer Model)

The measurement model (outer model) is confirmatory factor analysis (CFA) by testing the validity and reliability of latent constructs. The following are the results of the outer model evaluation in this study.

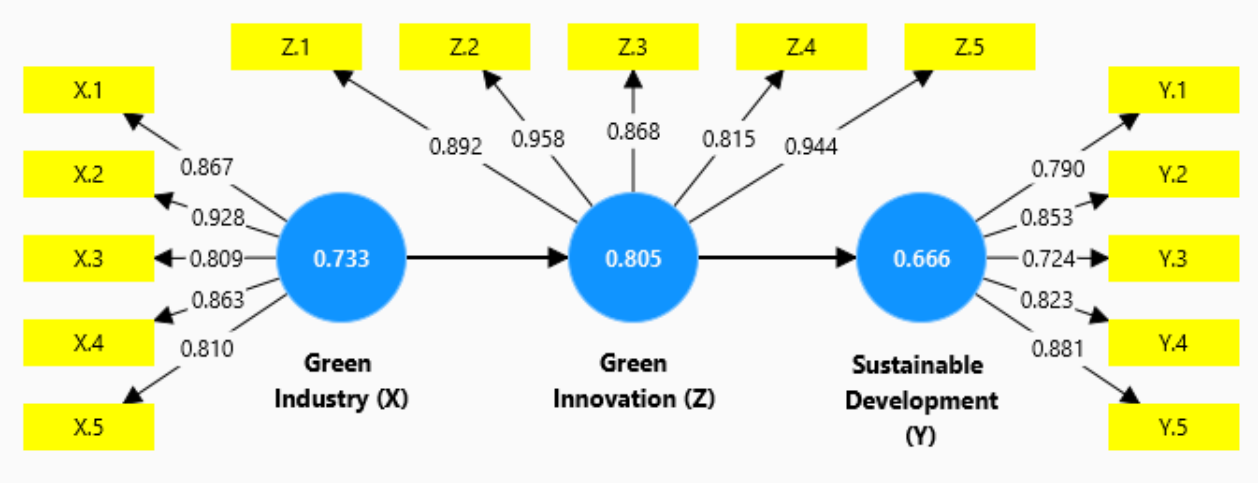

Figure 1. Outer Model

Convergent Validity

The convergent validity of the measurement model with the reflective indicator model is assessed based on the correlation between the item score/component score and the construct score calculated using PLS. The following are the results of the convergent validity measurement model test using loading factors:

Table 1
Results of Instrument Validity Test Using Loading Factor

Variables	*Green Industry*(X)	*Green Innovation*(Z)	*Sustainable Development*(Y)
X.1	0.867		
X.2	0.928		
X.3	0.809		
X.4	0.863		
X.5	0.810		
Y.1			0.790

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Y.2			0.853
Y.3			0.724
Y.4			0.823
Y.5			0.881
Z.1		0.892	
Z.2		0.958	
Z.3		0.868	
Z.4		0.815	
Z.5		0.944	

Source: Primary data processed (2024)

Based on Table 4.1 above, it can be seen that all loading factor values have passed the limit of 0.7 so that it can be concluded that each indicator in this study is valid. Therefore, these indicators can be used to measure research variables.

Reliability Test

An instrument can be said to be reliable by looking at the value of Average Variance Extracted more than 0.5, Cronbach Alpha more than 0.6 and Composite Reliability more than 0.7. The following are the results of the calculation of reliability through Average Variance Extracted (AVE), Cronbach Alpha and Composite Reliability can be seen in the following table:

Table 2
Calculation of AVE, Cronbach Alpha, and Composite Reliability

	Cronbach's alpha	Keandalan komposit (rho_a)	Keandalan komposit (rho_c)	Rata-rata varians diekstraksi (AVE)
Green _Industry (X)	0.908	0.914	0.932	0.733
Green_Innovation (Z)	0.938	0.945	0.954	0.805
Sustainable _Development_(Y)	0.874	0.882	0.908	0.666

Source:Primary data processed (2024)

Based on Table 4.2 above, it can be seen that the Cronbach Alpha value of the Green Industry variable (X) is 0.908, the Green Innovation variable (Z) is 0.938, and the Sustainable Development variable (Y) is 0.874. From the calculation results above, it can be seen that all indicators are reliable in measuring their latent variables.

Structural Model Evaluation (Inner Model)

Evaluation of the inner model can be seen from several indicators including the coefficient of determination (R2), Predictive Relevance (Q2) and Goodness of Fit Index (GoF) (Hussein, 2015). The results of the structural model displayed by Smart PLS 3.0 in this study are as follows:

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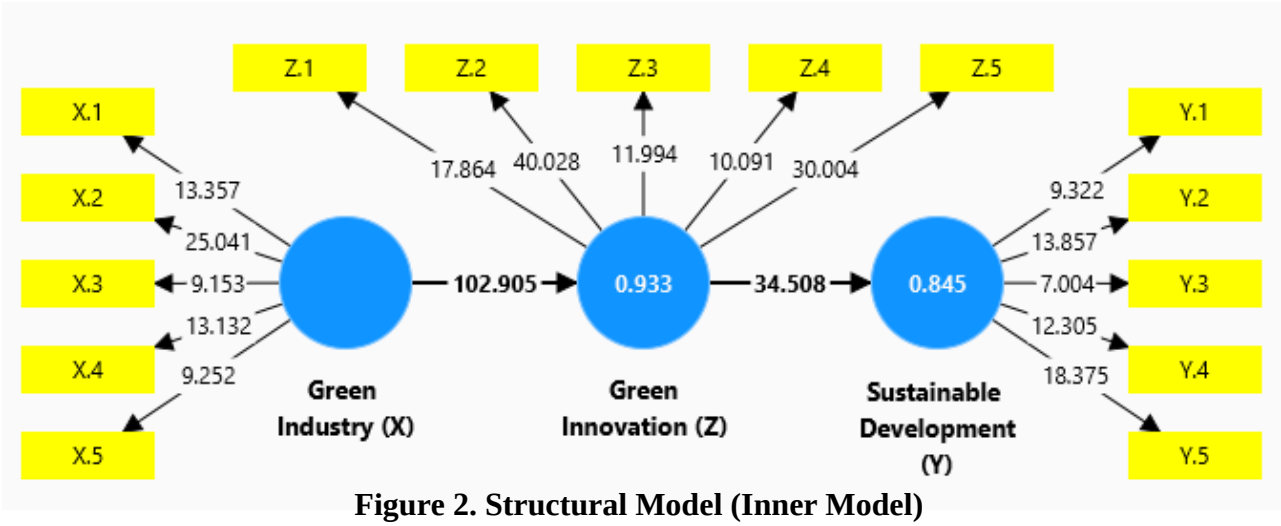

Figure 2. Structural Model (Inner Model)

R2 (R-square) results

In assessing the model with PLS, it begins by looking at the R-square for each dependent latent variable. The results of the r2 calculation in this study are as follows:

Table 3
Correlation Value (r2)

	R-square	Adjusted R-square
Green_Innovation (Z)	0.935	0.933
Sustainable _Development_(Y)	0.849	0.845

Source :Primary data processed (2024)

Based on the calculation results using bootstapping in Table 4.14 above, it is known that the r2 value of the Green Innovation (Z) variable is 0.933, which means that the Green Innovation (Z) variable is influenced by the Green Industry (X) variable by 93.3% or in other words, the contribution of the Green Industry (X) variable is 93.3% while the remaining 6.7% is the contribution of other variables that are not discussed in this study.

The r2 result of the Sustainable Development (Y) variable is 0.845, which means that the Sustainable Development (Y) variable is influenced by Green Industry (X) by 84.5% or in other words, the contribution of the Green Industry (X) variable is 84.5% while the remaining 15.5% is the contribution of other variables.

Goodness of Fit Model

The calculation of goodness of fit can be used to determine the magnitude of the contribution given by exogenous variables to endogenous variables. The GoF value in PLS analysis can be calculated using Q-square predictive relevance (Q2). The following are the results of the calculation of the Goodness of Fit Model in this study:

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$Q^2 = 1 – (1 – r12) (1 – r22)$
$Q2 = 1 – (1 – 0.933) (1 – 0.845)$
$Q2 = 0.9896$

Based on the calculation above, the Q-square predictive relevance (Q2) value is 0.9896 or 98.96%. This is able to show that the diversity of the Sustainable Development (Y) variable can be explained by the model as a whole by 0.9896 or it can also be interpreted that the contribution of the Green Industry (X) variable to the Sustainable Development (Y) variable as a whole is 98.96%, while the remaining 1.04% is the contribution of variables not discussed in this study.

Hypothesis Testing

Based on the results of the outer model conducted, all hypotheses tested have met the requirements, so they can be used as analysis models in this study. Hypothesis testing in this study uses alpha 5% which means if the t-statistic value ≥ 2.048 or the probability value ≤ level of significance (α = 5%).

Table 4
Path Coefficients

	Original Sample (O)	*Sample Mean (M)*	*Standard Deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P Values*
Green Industry(X) -> *Green Innovation*(Z)	0.967	0.969	0.009	102,905	0,000
Green Innovation(Z) ->*Sustainable Development*(Y)	0.922	0.925	0.027	34,508	0,000

Source :Primary data processed (2024)

Based on Table 4.4, the test results for each hypothesis are as follows:

a. *Green Industry*(X)has an effect on Green Innovation (Z). Based on the test results in Table 4.4, it can be seen that the t-statistic value of the relationship between the Green Industry (X) variable and the Green Innovation (Z) variable is 102.905 with a sig. of 0.000. The test results show that the t-statistic ≤ 1.96 and the sig. value ≥ level of significance (α = 5%). Thus, the first hypothesis is accepted that Green Industry (X) has an effect on Green Innovation (Z).
b. *Green Innovation*(Z)has an effect on Sustainable Development (Y). Based on the test results in Table 4.4, it can be seen that the t-statistic value of the relationship between the Green Innovation (Z) variable and the Sustainable Development (Y) variable is 34.508 with a sig. of 0.000. The test results show that the t-statistic ≤ 1.96 and the sig. value ≥ level of significance (α = 5%). Thus, the second hypothesis is accepted that Green Innovation (Z) has an effect on Sustainable Development (Y).

Indirect Effect Testing

The indirect effect test is conducted by testing the strength of the indirect effect of the independent variable (variable X) to the dependent variable (variable Y) through the intervening variable (variable Z) with the condition that the t-statistic value is > 1.96. The indirect effect can be stated as significant

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if both direct effects that form it are significant. The results of this test can be seen in the following table:

Table 5
Indirect Effect

	Original Sample (O)	*Sample Mean (M)*	*Standard Deviation (STDEV)*	*T statistics (|O/STDEV|)*	*P Values*
Green Industry(X) -> *Green Innovation*(Z) ->*Sustainable Development*(Y)	0.891	0.897	0.031	28,431	0,000

Source :Primary data processed (2024)

Green Industry(X)has a significant effect on Sustainable Development (Y) through Green Innovation (Z). Based on the test results in Table 4.5, it can be seen that the t-statistic value of the relationship between the Green Industry (X) variable and the Sustainable Development (Y) variable through the Green Innovation (Z) variable is 28.431 with a sig. of 0.000. The test results show that the t-statistic> 1.96 and the sig. value <0.000 level of significance (α = 5%). Thus, the third hypothesis is accepted that Green Industry (X) has a significant effect on Sustainable Development (Y) through Green Innovation (Z) as an intervening variable.

CONCLUSION

Based on the research results and discussion in the previous chapter, the following conclusions can be drawn:

a. The Green Innovation (Z) variable is 0.933, which means that the Green Innovation (Z) variable is influenced by the Green Industry (X) variable by 93.3% or in other words, the contribution of the Green Industry (X) variable is 93.3% while the remaining 6.7% is the contribution of other variables that are not discussed in this study.
b. The Sustainable Development (Y) variable is 0.845, which means that the Sustainable Development (Y) variable is influenced by Green Industry (X) by 84.5% or in other words, the contribution of the Green Industry (X) variable is 84.5% while the remaining 15.5% is the contribution of other variables.
c. The first hypothesis is accepted that Green Industry (X) has an influence on Green Innovation (Z).
d. The second hypothesis is accepted that Green Innovation (Z) has an influence on Sustainable Development (Y).
e. The third hypothesis is accepted that Green Industry (X) has a significant influence on Sustainable Development (Y) through Green Innovation (Z) as an intervening variable.

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