Analysis of the Linkages and Impact of Electricity Industry Investments on Leading Industries in East Nusa Tenggara Province

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ABSTRACT: This study aims to identify key industries in East Nusa Tenggara (NTT) in 2023, examine linkages among these industries, and analyze the impact of investment shocks in the electricity sectors. Using the updated 2023 input-output tables, the analysis includes interrelationships, multiplier effects, and impact simulations. The study reveals that investment in the electricity sector is crucial for enhancing production and distribution capacity in NTT. Eight key industries in NTT demonstrated strong forward and backward linkages in 2023. Investments in the electricity sector are projected to increase total economic output. This investment not only directly benefits the electricity industry but also positively impacts other industries, particularly wholesale and retail trade. In the future, an exploration of renewable energy potential should be conducted.

Keywords: *Electricity, I - O Table, Simulations, Investments, NTT*

ABSTRAK: *Studi ini bertujuan untuk mengidentifikasi industri utama di Nusa Tenggara Timur (NTT) pada tahun 2023, mengkaji keterkaitan antar industri, dan menganalisis dampak guncangan investasi di sektor ketenagalistrikan. Dengan menggunakan tabel input-output tahun 2023 yang diperbarui, analisis ini mencakup keterkaitan antarindustri, efek pengganda, dan simulasi dampak. Studi ini menemukan bahwa investasi di sektor ketenagalistrikan sangat penting untuk meningkatkan kapasitas produksi dan distribusi di NTT. Delapan industri unggulan di NTT menunjukkan keterkaitan ke depan dan ke belakang yang kuat pada tahun 2023. Investasi di sektor ketenagalistrikan diproyeksikan meningkatkan total output ekonomi. Investasi ini tidak hanya secara langsung menguntungkan sektor ketenagalistrikan tetapi juga berdampak positif pada industri lain, terutama perdagangan besar dan eceran. Ke depannya, perlu dilakukan eksplorasi lebih lanjut terkait potensi energi terbarukan.*

Kata Kunci: *Ketenagalistrikan, Tabel I-O, Simulasi, Investasi, NTT*

INTRODUCTION

Electricity and the economy are two inseparable things. Dependency on electrical energy and its impact on economic growth is a major concern for the general public (Duarte et al., 2017). Furthermore, regarded as a primary determinant of growth for several developing economies, productivity in this sector is directly linked to global economic welfare (Dang et al., 2024). Electricity, as a form of energy, has great potential in advancing an area. Utilization of energy is not only a consumer good, but also a crucial input in developing technology and the economy (Kartiasih et al., 2012). Apart from that, the use of electricity cannot be separated from daily needs, such as communication and changes in human lifestyle (IEA, 2019). In Indonesia, electrical energy is the energy most consumed by households. According to data from the Ministry of Energy and Mineral Resources (KESDM), total household energy consumption in Indonesia in 2021 will reach 148.97 million Barrel Oil Equivalent (BOE). The Central Statistics Agency noted that per capita electricity consumption in Indonesia also increased by 73.75% from 2013 to 2023. The increase in electricity demand is predicted to continue to grow every year in line with the use of electronic equipment in households, government, and industry. (Anrokhi et al., 2019). Therefore, economic growth and progress in the economic sector, especially the industrial sector, is very dependent on the sustainability and availability of sufficient electrical energy (IEA, 2020). However, distribution, electricity availability, and electricity infrastructure are still problems in several areas, including in East Nusa Tenggara (NTT) Province.

NTT Province is the province with the PLN Main Unit of Distribution (UID) which has the lowest electrification ratio, namely 69.06% (PLN, 2022). The electrification ratio is the comparison between the number of households that have access to electricity and the total number of households (Ministry of Energy and Mineral Resources, Directorate General of Electricity , 2021). NTT's electrification ratio is still very low compared to Indonesia's target in the Bright Indonesia Program of 97% in 2019. Based on the level of reliability of the electricity distribution system System Average Interruption Frequency Index (SAIFI), NTT Province is still a province with a high average blackout frequency of 6.86 times per customer per year. Meanwhile, the average for SAIFI Indonesia is 5.62 times per customer per year. The high SAIFI of an area is related to the reliability of electricity producers in meeting the community's electricity needs. NTT Province is in 8th place as the province with the smallest electricity distribution in 2022, namely 1,206.91 GWh (BPS, 2022). Therefore, NTT Province is still facing major problems in the production and distribution efficiency of the electricity industry which leads to economic sub-optimality.

The economy of NTT Province always grows from year to year. According to the Central Statistics Agency (BPS), the 2010 ADHK GRDP or Gross Regional Domestic Product at Constant Prices 2010 in NTT Province rose 72% from 2010 to 2023. This GRDP is supported by industrial contributions - industry in NTT Province. The GRDP contribution of each industry shows its respective role industry in the regional economy (Suryani, 2023). Apart from that, industries that stand out or are called leading industries are the key to an economy that can be maximized. Optimizing the potential of leading industries can be utilized to encourage economic growth and expand employment opportunities. The GRDP contribution of industries to the GRDP of NTT Province is shown in Figure 1.
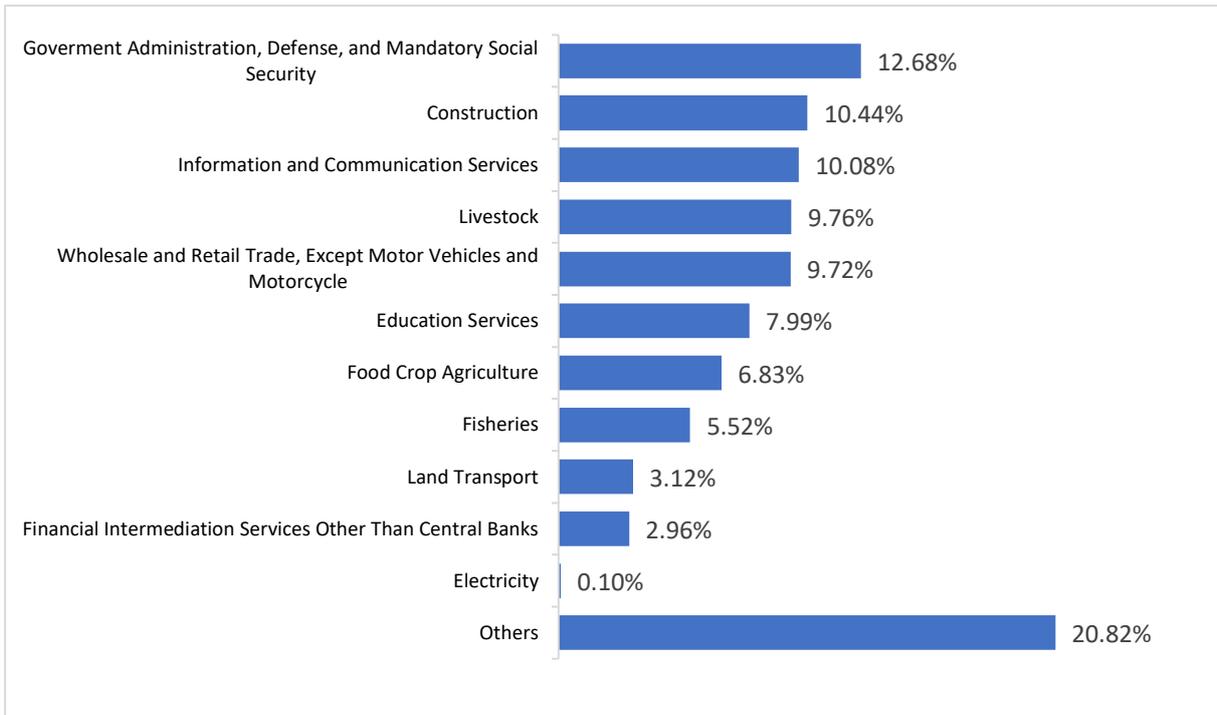
Figure 1. Contribution of Industrial GRDP to NTT GRDP in 2023
Source: BPS-Statistics of NTT (2023b), processed

Based on Figure 1, the industry that dominates the NTT economy is the Government Administration, Defense, and Mandatory Social Security industry with a share of 12.67 percent. The electricity industry is contributing the NTT GDRP with a share of 0.10 percent. Even though the electricity industry does not have a dominating share, this industry continues to experience growth. Industrial GDP growth electricity 2017-2023 is shown in Figure 2.
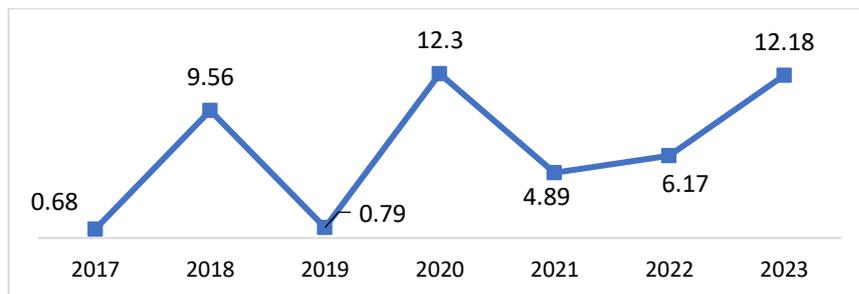

Figure 2. GRDP Growth of the Electricity Industry in NTT 2017-2023 (%)
Source: BPS NTT Province (2023)

Figure 2 shows the growth of industrial GDP NTT Province's electricity supply is fluctuating, but shows an upward trend from 2017 to 2023. The increasing GRDP growth of the electricity industry shows that the electricity industry continues to develop in NTT Province. Based on GRDP value by industry, industrial GRDP NTT Province's electricity power will reach 73 trillion rupiah in 2023. The energy industry is classified as a capital-intensive sector (Raikar & Adamson, 2020), utilizing funds to build infrastructure such as power plants, transmission networks, and other infrastructure necessary for producing and delivering energy to consumers. The availability of funds and investment is a crucial need in supporting the growth and development of the electricity industry. Investment has an important role in encouraging increased output by increasing production capacity through capital accumulation. However, more than just encouraging the growth of one industry, investment also has a

widespread impact on other industries, especially leading industries. The increase in investment in one particular industry creates a close connection with other industries, leading to growth and development in those related sectors as well. The estimated investment needs for Indonesia's electricity projects come from IPP (Independent Power Producer) generation projects, PLN plants, transmission and GI (substation), distribution, and others (PLN, 2021). The projected proxy for investment needs for electricity projects in NTT Province is shown in Figure 3.
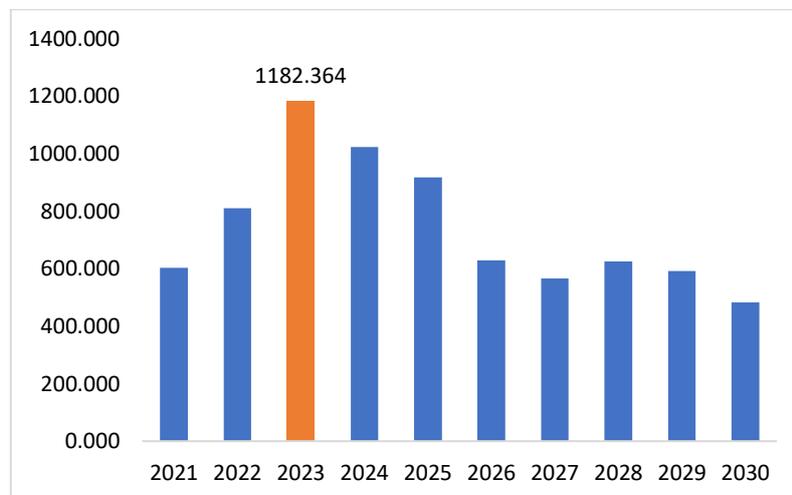

Figure 3. Estimated Investment Needs for NTT Province Electricity Projects for 2021-2030 (Billions of Rupiah)
Source: PLN (2021)

Figure 3 shows the projected investment needs for electricity projects in NTT Province for 2021-2030. This estimated investment need is proxied by the ratio of electricity sales between NTT Province and Indonesia to the projected investment need for Indonesia's electricity projects. Based on Figure 3, 2023 is the year with the highest estimated investment needs for electricity projects in the projection for the 2021-2030 period, amounting to 1182.364 Billion Rupiah. This investment will be distributed to regions in NTT Province.

Previous research states that investment is very important to invest in leading industries. A study by Adam (2016) analyzed the dynamics of the electricity industry in Indonesia using data from PT PLN, World Bank, and BPS. Adam highlighted that the level of electricity supply is still insufficient compared to demand, so high investment is needed to increase the availability of electricity. The research conducted by Palmer (2017) indicates that the electricity generation industry in Australia was energetically economic in 2013-2014 based on Energy-Return-On-Investment (EROI). Palmer performed the analysis using Environmentally Extended Input-Output Analysis (EEIOA).

The use of Input-Output analysis in examining electricity has also been conducted by Yan (2018). This research shows that an increase in electricity prices will affect the prices of other sectors, the Consumer Price Index (CPI), and the GDP deflator, indicating that the electricity sector holds an important position in Guangxi's economy. Something similar was also shown in the study of Erkok & Kutuk (2023) that all industry in Turkey is highly dependent on Electricity, Gas, Steam, and Air (EGSA), and recommends support in financing to encourage massive investment in renewable energy and technology development. The study by Henriques & Sousa (2023), using Economic Input-Output Life Cycle Assessment (EIO-LCA), recommends that more studies are needed at the sub-national level to support local energy policies.

Based on the background above, Input-Output analysis can be an important tool in reviewing electrical energy consumption, economic growth, and environmental impacts in various research contexts, both at the national and regional levels. The urgency of conducting this research is because

the electricity industry, which is crucial for the economy and people's lives, is still a big problem in NTT Province, and the estimated high investment need for Indonesia's electricity projects in 2023.

This study involves novel research and provides four contributions to Indonesian literature related to Input-Output Analysis. First, this research identifies the leading industries in NTT Province in 2023. Previous research, from Utomo (2021) shows that the Electricity, Gas, and Water industries are key industries that provide a positive stimulus to the economy in NTT Province. However, this study has not implemented updating so the new thing this research is doing is updating the NTT Province Input-Output Table until 2023 to obtain an analysis of the latest leading industry. Second, this study analyzes the linkage of leading industries in NTT Province. Analysis of industry linkage analysis - leading industries can show the interaction and influence between industries on the economy of NTT Province. Third, researchers analyzed the impact of the output multiplier on leading industries in NTT Province to determine their contribution to driving economic growth. Fourth, this research analyzes the effect of shock electricity industry investment in leading industries in NTT Province. Simulations of the effects of investment changes in the electricity industry are used to estimate long-term benefits for the NTT Province economy, including increased efficiency and reduced costs. In addition, analysis can show the impact of shock industrial investment electricity to industries superior in NTT Province. Thus, industry Electricity in NTT Province can be further optimized through the investment shock.

METHODS
Data

This study uses data from the Input-Output Table for East Nusa Tenggara (NTT) Province Domestic Transactions Based on Producer Prices (52 Industries) in 2016 in millions of rupiah and Gross Regional Domestic Product (GRDP) data based on Constant Prices from 2016 to 2023 (BPS Provinsi NTT, 2021). The second data was obtained from the Central Statistics Agency (BPS). Data on projected investment needs for Indonesian electricity projects and projected electricity sales were taken from PT PLN (Persero)'s 2021 Electricity Supply Business Plan (RUPTL) as a proxy for investment shock in the electricity industry in NTT Province

Basic Input-Output (IO) Model

The Input-Output (IO) model is a tool commonly used in analyzing industrial systems or economic systems at a macro level to explore the relationship between interrelated sectors (Lamonica et al., 2020). Through this IO model, it can be illustrated the extent of the current linkages between sectors in an economy (Miernyk, 2020). The theoretical basis for the IO model is the connection between the input used and the distribution of output (Prihawantoro et al., 2019). Based on this assumption, the IO table is a quantitative model own weakness, that is input coefficient or coefficient technical considered constant during period analysis or projection (Kristiana et al., 2020). As a result, producers cannot adapt to input changes. With coefficient constant technical or fixed, the technology used by the sector's economy in the production process is also considered No change. Therefore that's change in the quantity and price of inputs will be always in line with a change in the quantity and price of output. Despite its limitations, the IO model remains become tool analysis of comprehensive and in-depth economics (Diego et al., 2017). The IO analysis that will be used in this research consists of two aspects, namely multiplier analysis which includes output multipliers and structure analysis. This structural analysis consists of forward linkage and backward linkage (Sukma et al., 2018).

Updating Input-Output Table

The RAS method is a semi-survey technique used to evaluate coefficients in Input-Output tables, developed by Professor Richard Stone from the University of Cambridge, England (Honarvar et al., 2014) . This method is used to estimate the input coefficient matrix in years, $A(t)$, which is located in Quadrant I by considering the input coefficient matrix in the base year, $A(0)$, total input between years t, and total demand between years t. Thus, the RAS method can be expressed in Equation (1) (Miller & Blair, 2009) .

$$A(t) = R\,A(0)\,S \tag{1}$$

Information :

A(t)	:	year input coefficient matrix
A(0)	:	base year input coefficient matrix
R	:	diagonal matrix of simultaneous influences (by row)
S	:	diagonal matrix of fabrication influences (by column)

Multiplier Matrix (Multiplier)

In Table IO, the multiplier matrix shows changes in endogenous variables as a result of changes in exogenous variables (BPS, 2008) . The multiplier matrix is used to carry out impact analysis, such as analysis of the impact of output, employment, and income, as well as analysis of forward and backward linkages. The multiplier impact can be direct or indirect due to changes in exogenous variables in economic activity (Ojede, Atems, & Yamarik, 2018). To obtain the multiplier matrix, the initial step required is to calculate the input coefficients formulated in equation (2).

$$a_{ij} = \frac{x_{ij}}{X_j} \tag{2}$$

Information:

a_{ij}	:	coefficient of input of the I th industry by the I th industry j
x_{ij}	:	use of inputs from the I th industry by the I th industry j
X_j	:	industrial output to -j

The collection of input coefficients for all industries in the Input-Output table is called the input coefficient matrix or matrix A^d (Lamonica et al., 2020). Then, the next stage is to carry out matrix calculations $(I - A^d)$, namely the results of subtracting the identity matrix (I) from the input coefficient matrix (A^d). The results can be written as follows.

$$I - A^d = \begin{bmatrix} 1 & 0 & \cdots & 0 \\ 0 & 1 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & 1 \end{bmatrix} - \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1j} \\ a_{21} & a_{22} & \cdots & a_{2j} \\ \vdots & \vdots & \ddots & \vdots \\ a_{i1} & a_{i2} & \cdots & a_{ij} \end{bmatrix} = \begin{bmatrix} 1 - a_{11} & -a_{12} & \cdots & -a_{1j} \\ -a_{21} & 1 - a_{22} & \cdots & -a_{2j} \\ \vdots & \vdots & \ddots & \vdots \\ -a_{i1} & -a_{i2} & \cdots & 1 - a_{ij} \end{bmatrix}$$

Lastly, namely looking for the inverse matrix of the matrix $(I - A^d)$. Thus, we obtain a multiplier matrix which can be written in equation (3).

$$B = (I - A^d)^{-1} = \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1j} \\ b_{21} & b_{22} & \cdots & b_{2j} \\ \vdots & \vdots & \ddots & \vdots \\ b_{i1} & b_{i2} & \cdots & b_{ij} \end{bmatrix} \tag{3}$$

Information:

B	:	matrix multiplier
I	:	matrix identity
A^d	:	matrix input coefficient

Analysis of Inter-Industry Linkages and Leading Industries

The analysis in Table IO is a method used to identify industries that have the potential to become leading sectors in a region's economy. There are two crucial types of relationships, namely backward

linkage and forward linkage (Ojaleye & Narayanan, 2018). Backward linkage also known as spreading power is when the output of one industry drives changes in other industries that use the output as input. The formula for the amount of spreading power is stated in equation (4) (BPS, 2008).

$$r_j = b_{1j} + b_{2j} + \cdots + b_{nj} = \sum_i b_{ij} \tag{4}$$

Information:

r_j : The total impact due to changes in industry's final demand on the output of all economic industries independently

b_{ij} : The impact of changes in final demand for industry j on industry i

The number of impacts in equation (4) is also called the amount of spreading power or total backward linkage. In comparing dispersion power between industries, normalization is needed in equation (4). Equality That called as Spread Power Index (IDP) or Index of the Power of Dispersion, whose formula served in equation (5) (Miller & Blair, 2009) .

$$IDP_j = \frac{\sum_i b_{ij}}{\left(\frac{1}{n}\right) \sum_j \sum_i b_{ij}} \tag{5}$$

Information:

IDP_j : J th Industry Dispersion Power Index

Forward linkage or degree of sensitivity is a change that occurs when the output of an industry drives changes in industries that use that industry's output as input in their production process. The formula can be seen in equation (6) (Suputra, 2021) .

$$s_i = b_{i1} + b_{i2} + \cdots + b_{in} = \sum_j b_{ij} \tag{6}$$

Information:

s_i : Number of impacts on industry i as a result of changes in all industries in columns

The number of impacts in equation (6) is also called the number of degrees of sensitivity or total forward linkage. In comparing dispersion power between industries, normalization is needed in equation (6). Equality That called as Spread Power Index (IDP) or Index of the Sensitivity of Dispersion, the formula for which is as in equation (7) (Miller & Blair, 2009).

$$IDK_i = \frac{\sum_j b_{ij}}{\left(\frac{1}{n}\right) \sum_j \sum_i b_{ij}} \tag{7}$$

Information:

IDK_i : Industrial Sensitivity Degree Index i

Industries with IDP and IDK values greater than one are categorized as leading industries or leading sectors (Yasa & Monika, 2021) . A leading industrial strategy can be an effective approach to accelerate economic growth by focusing resources on industries that have great potential to increase demand and overall output (Surya et al., 2021). Next, class typology analysis uses IDP and IDK values. This analysis will look at which industries have high linkages, both forward and backward linkages so that these industries can become superior industries or leading sectors (Sofilda & Hamzah, 2016) . Economic industries will be grouped into four quadrants in the Classen typology, namely:

a. Quadrant 1 contains industries with IDP > 1and IDK > 1 which can drive the economy in terms of input and output and are the leading industries or leading sectors of the region.

b. Quadrant II contains industries with value $IDP < 1$ and $IDK > 1$ which have a strong ability to drive the economy in terms of output.
c. Quadrant III contains industries with value $IDP < 1$ and $IDK < 1$ which are less able to move the economy in terms of the output produced and in terms of the input required.
d. Quadrant IV contains industries with $IDP > 1$ and $IDK < 1$ which have a strong ability to drive the economy from the input side.

RESULTS AND DISCUSSION
Analysis of Leading Industries in NTT Province
The analysis was carried out using the Input-Output table for 52 NTT Province Industries in 2023 which is the result of updating the Input-Output table 52 Industries of NTT Province in 2016. Updating was carried out using the RAS method and with the help of R software. The results show that there were 16 iterations in the implementation of updating the Input-Output table for 52 Industries of NTT Province. The distribution of industries both in 2016 and after updating 2023 based on IDK and IDP values is depicted in Figure 2.
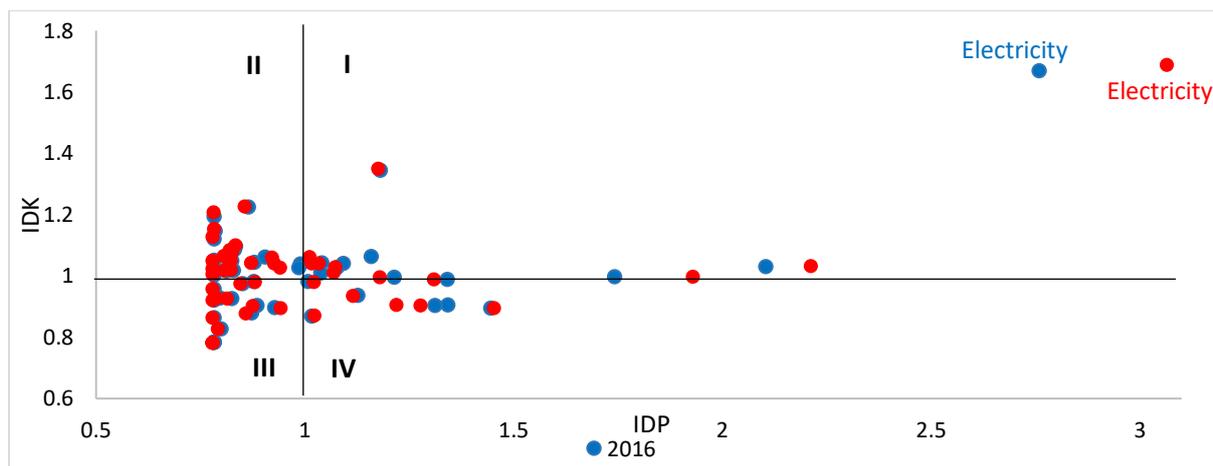

Figure 2. *Scatter Plot* of Spread Power Index (IDP) and Degree of Sensitivity Index (IDK) for 52 Industries in 2016 and *Updated* in 2023 in NTT Province
Source: Data Processing Results

Based on Figure 2, there are 8 industries in quadrant I both in 2016 and 2023 (updated results). This shows that these 8 industries are responsive to changes in demand, including final demand and strongly encourage the growth of other economic industries. Industries included in quadrant I are referred to as superior industries or leaders in economic growth. Apart from that, the electricity industry was the most prominent in both years.

Figure 2 also shows that there are 19 industries in quadrant II in 2016 and 2023. This indicates that these industries are responsive or sensitive to change, but are lacking in encouraging other industrial sectors of the economy. In other words, the industry's dependence on other industries is high, but its driving force on other industries is small. There were 16 industries in quadrant III in both years. Industries in Quadrant III need support and encouragement from other industrial sectors because of weak capabilities. Finally, there are 9 industries in quadrant IV in both years. These nine industries are less responsive to changes in demand but are strong in encouraging other industrial sectors of the economy. Even though the number of industries per quadrant is the same both in 2016 and after updating 2023, the industries contained in each quadrant have changed.

Table 1. Leading Industries in 2016 and 2023 in NTT Province

	Leading Industry 2016				Leading Industry 2023		
Code	Industry	IDP	IDK	Code	Industry	IDP	IDK
I-04	Farm	1.08	1.03	I-04	Farm	1.07	1.03
I-13	Food and Beverage Industry	1.18	1.34	I-13	Food and Beverage Industry	1.18	1.35
I-28	Electricity	2.76	1.67	I-17	Wood industry, goods made from wood and cork and woven goods made from bamboo, rattan, and the like	1.02	1.04
I-31	Construction	1.04	1.04	I-28	Electricity	3.07	1.69
I-33	Wholesale and Retail Trade, Not Cars and Motorbikes	2.10	1.03	I-31	Construction	1.03	1.04
I-38	Air Freight	1.16	1.06	I-33	Wholesale and Retail Trade, Not Cars and Motorbikes	2.21	1.03
I-39	Warehousing and Transport, Postal and Courier Support Services	1.04	1.01	I-38	Air Freight	1.01	1.06
I-48	Company Services	1.09	1.04	I-39	Warehousing and Transport, Postal and Courier Support Services	1.07	1.01

Source: Author's Calculation based on Updated NTT Province Input-Output Table, 2023

Table 1 shows the leading industries in NTT Province in 2016 and 2023. These leading industries are the main focus of regional economic development planning. Based on Table 1, there are several shifts in industrial sectors that were initially considered as leading sectors in 2016, but after updating in 2023, these sectors are no longer classified as leading industries. In 2016, there were 8 industrial sectors included in the leading category, namely Livestock; Food and Beverage Industry; Electricity; Construction; Wholesale and Retail Trade, Not Cars and Motorbikes; Air Freight; Warehousing and Transport, Postal and Courier Support Services; as well as Company Services. However, after updating in 2023, the industrial sectors included in the leading category include Livestock; Food and Beverage Industry; Wood Industry: Wood and Cork Products and Woven Products from Bamboo, Rattan, and the Like; Electricity; Construction; Wholesale and Retail Trade, Not Cars and Motorbikes; Air Freight; as well as Warehousing and Transport, Postal and Courier Support Services.

The Corporate Services Industry, which was previously classified as a leading industry in 2016 with an IDP of 1.09 and an IDK of 1.04, has shifted to non-leading after the update in 2023 with an IDP of 0.93 and an IDK of 1.04. This shift was triggered by a drastic decline in the economic growth of this industry by 40.65 percent from 2016 to 2023. Meanwhile, in the wood industry, goods made from wood and cork, as well as woven goods made from bamboo, rattan, and the like, were previously not included in the industry. superior in 2016 with an IDP of 0.99 and an IDK of 1.04, has changed to a superior industry after updating in 2023 with an IDP of 1.02 and an IDK of 1.04. NTT's great potential in developing this industry has been proven. As explained by Fauziyah et al. (2021) , interest in using bamboo, both for construction purposes and as a material for various products, is increasing because it is part of an environmentally friendly lifestyle. Therefore, the NTT government has developed Tourism and the Creative Economy through the construction of the Agroforestry Bamboo Village Campus. As a

result, the economic growth of this industry from 2016 to 2023 experienced a drastic increase of 46.62 percent.

From Table 1, it can also be seen that one industry that has not experienced a shift from a leading industry to a non-leading industry is the Electricity Industry. This industry remains the leading industry both in 2016 and after updating in 2023, with the highest IDP and IDK values. In other words, the Electricity Industry is the main industry whose final demand can stimulate production on a much larger scale than the average of other industries and has the most dominant role in stimulating growth in other industries in NTT Province. This finding is in line with the results of research conducted by Darlen et al. (2015) which shows that the Electricity and Clean Water industry is one of the leading industries in NTT.

Analysis of Leading Industry Linkages in NTT Province

Table 2 presents the direct and indirect linkage values of leading industries in NTT. In this table, direct linkages are explained through Direct Forward Linkage (DFL) and Direct Backward Linkage (DBL), while indirect linkages are represented by Indirect Forward Linkage (IFL) and Indirect Backward Linkage (IBL). Apart from that, Table 2 also displays the total values of forward and backward linkages, namely Total Forward Linkage (TFL) and Total Backward linkage (TBL).

Table 2. Value of Direct and Indirect Linkages of Leading Industries in NTT

Industry Code	Future Linkages			Backward Linkages		
	DFL	IFL	TFL	DBL	IFL	TBL
I-04	0.286	1.089	1.376	0.228	1.089	1.316
I-13	0.423	1.086	1.508	0.594	1.134	1.728
I-17	0.275	1.028	1.303	0.247	1.084	1.330
I-28	1,333	2.597	3.930	0.568	1.594	2.161
I-31	0.250	1.076	1.326	0.255	1.077	1.332
I-33	1,509	1.328	2.837	0.241	1.079	1.320
I-38	0.247	1.050	1.298	0.262	1.096	1.357
I-39	0.290	1.081	1.371	0.211	1.084	1.295

Source: Author's Calculation based on Updated NTT Province Input-Output Table, 2023

Based on Table 2, the calculation results show that the direct backward linkage (DBL) coefficient for all industries in East Nusa Tenggara Province is less than 1 (DBL < 1). This indicates that each industry in the economy has not been able to generate significant derived demand for other industries. The Food and Beverage Industry (I-13) has the highest DBL with a value of 0.594, which indicates that in its production process, this industry uses intermediate inputs of 0.853 units for every one-unit increase in final demand.

Table 2 also outlines the direct forward linkage (DFL) of each industry in the economy. Only two industries have a DFL coefficient greater than one (DFL > 1), namely the Electricity Industry (I-28) with a value of 1.332 and the Wholesale and Retail Trade Industry, Not Cars and Motorcycles (I-33) with a value of 1.508. This means that the output of these two industries is relatively more widely used by other industries as input or that these two industries are strong input suppliers for all industries in the economy. The DFL coefficient for the Wholesale and Retail Trade Industry, Not Cars and Motorbikes, is ranked highest among other industries, namely 1.508, which shows that every one unit increase in final demand for this industry can increase the output of 1.508 units in all industries that use its output.

Based on the two DBL and DFL coefficients in Table 2, it can be seen that five industries have DBL < DFL values. A higher degree of forward linkage than backward linkage indicates that the industry is more actively involved in upstream production activities in the economy (Wang et al., 2017)

. In other words, the industry has succeeded in diversifying its products and can sell large output, so that it can create sufficient added value.

Based on Table 2, it can be seen that all sectors in the economy have an indirect backward linkage coefficient that exceeds one. This indicates that this sector is highly dependent on goods and services supplied by other industries (Pratt, 2015) . The Electricity Industry (I-28) stands out with the highest backward linkage coefficient, namely 1.593. This illustrates that if the final demand from the Electricity Industry increases by one unit, the output of all industries in the NTT regional economy will increase by 1.593 units.

On the other hand, indirect forward linkages describe how much an industry can meet the final demand of all industries in the economy. Table 2 shows that the Electricity Industry (I-28) has the largest indirect forward linkage, namely 2.597. This means if there is an increase in final demand from all industries in NTT Province by one unit, the Electricity Industry will be able to fulfill it by 2.597 units.

Analysis of the Impact of the Output Multiplier on Leading Industries in NTT Province

The multiplier figure describes the additional output produced due to an increase in final demand by 1 unit of money. The higher the multiplier effect, the greater the industry's contribution to total economic output (GDP), far exceeding the amount of funds initially spent. The output multiplier values for leading industries in NTT are listed in Table 3.

Table 3. Output Multiplier Value of Leading Industries in NTT

Industry Code	Output Multiplier	Industry Code	Output Multiplier
I-04	1.311896	I-31	1.330567
I-13	1.718075	I-33	1.315828
I-17	1.327142	I-38	1.356718
I-28	2.132948	I-39	1.289969

Source: Author's Calculation based on Updated NTT Province Input-Output Table, 2023

In Table 3, all leading industries recorded output multipliers greater than 1. This shows the ability of leading industries to increase total economic output significantly as a result of increasing final demand. The Electricity Industry (I-28) recorded the highest output multiplier figure in 2023, namely 2.13. Thus, an increase in final demand in the Electricity Industry sector (I-28) by 1 rupiah can increase total economic output by 2.13 rupiah.

Simulation of Additional Investment in the Electricity Industry

Policy simulations were conducted by introducing a shock or injection into the Electricity Industry. The shock value was derived from the projected investment needs of the NTT Electricity Industry in 2023. These investment needs were estimated based on the proportion of electricity sales, yielding a value of 1,182.364 billion Rupiah. Table 4 presents the results of the shock and its impact on the output of leading industries.

As shown in Table 4, the Electricity Industry is the largest sector among other leading industries in absorbing this investment, accounting for 92.16 percent of the total. This indicates that investment in the NTT Electricity Industry will increase the sector's output by 2,355.079 billion Rupiah, with the total production across all industries rising to 2,555.541 billion Rupiah. The output increase in the Electricity Industry includes a direct impact of 1,182.364 billion Rupiah and an indirect impact of 1,172.715 billion Rupiah. These findings align with the study by Firmansyah et al. (2023), which suggests that investment in a specific sector tends to have the greatest impact on the output of that sector itself. This is further supported by various other studies employing input-output analysis, such as those by Amelia et al. (2022) and Haryanto & Resosudarmo (2021). These studies confirm that sectors receiving investments typically experience significant increases in output and broader economic impacts.

Table 4 also highlights that the Wholesale and Retail Trade industry, excluding Cars and Motorcycles, emerges as the second-largest contributor to output growth among the leading sectors, accounting for 1.79 percent. This indicates a strong interconnection between this industry and the Electricity Industry. The Electricity Industry also stimulates and supports the progress of the Wholesale and Retail Trade industry, excluding Cars and Motorcycles. These findings are consistent with research by Fevriera & Tjandra (2023) , which highlights how the Accommodation and Food and Beverage Provision industries can attract and drive progress in the Energy and Waste Management industries.

Table 4. The Impact of Investment in the Electricity Industry on Leading Industries in NTT Province

Code	Industry	Direct Impact (Billion Rp)	Indirect Impact (Billion Rp)	Total Impact (Billion Rp)	% to Total Impact (Billion Rp)
I-04	Farm	0	0.268	0.268	0.0105%
I-13	Food and Beverage Industry	0	1.178	1.178	0.0461%
I-17	Wood industry, goods made from wood and cork and woven goods made from bamboo, rattan, and the like	0	0.102	0.102	0.0040%
I-28	Electricity	1182.364	1172.715	2355.079	92.1558%
I-31	Construction	0	1.593	1.593	0.0623%
I-33	Wholesale and Retail Trade, Not Cars and Motorbikes	0	45.691	45.691	1.7879%
I-38	Air Freight	0	4.541	4.541	0.1777%
I-39	Warehousing and Transport, Postal and Courier Support Services	0	2.536	2.536	0.0992%
-	Other industries	0	144.552	144.552	5.6564%

Source: Author's Calculation based on Updated NTT Province Input-Output Table, 2023

The category 'other industries' in the Table 4 refers to sectors that are not classified as leading industries in NTT. While the total impact from 'other industries may appear substantial, it is an aggregate of various diverse sectors and is not the second-highest in terms of individual impact. The inclusion of this category is intended to provide a comprehensive view of the total impact of investment in the electricity sector, ensuring that the total percentage reaches 100%. Therefore, the primary focus of the study remains on the leading industries, while 'other industries' offer additional context on the overall investment impact.

While the direct impact of investment in the electricity sector on other sectors may seem insignificant due to its small size, as illustrated in Table 4, it is essential to understand that this reflects only the impact for the year 2023, which represents short-term effects. The potential long-term effects, however, are substantial. Initial investments in the electricity sector are expected to enhance the capacity and efficiency of electricity supply, thereby supporting other sectors such as manufacturing and trade. Although the benefits may not be immediately noticeable, over time these sectors will adapt, leading to increased productivity and reduced operational costs. Therefore, investment in the electricity sector not only fosters growth within that sector but also contributes to broader and more sustainable economic development. This demonstrates the principle of the 'butterfly effect,' where small changes in one sector can lead to significant impacts on other sectors within the economy over the long term.

CONCLUSIONS
This study highlights the significant role of the electricity industry in driving economic growth in NTT Province, as evidenced by the analysis of leading industries using the updated Input-Output table for

2023. The findings reveal that while the direct impact of investments in the electricity sector on other industries may appear limited in the short term, the long-term effects are substantial due to the interconnectedness of economic sectors. The electricity industry not only remains a leading sector but also exhibits the highest output multiplier, indicating its capacity to stimulate broader economic activity. The simulation of additional investments demonstrates that the electricity sector absorbs the majority of investment, leading to considerable output increases across various industries, particularly in wholesale and retail trade. Furthermore, the concept of the "butterfly effect" underscores how initial investments can trigger significant ripple effects, enhancing productivity and reducing operational costs in dependent sectors over time. Overall, this research underscores the importance of strategic investments in the electricity sector as a catalyst for sustainable economic development in NTT Province.

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