Impact of Hydro Electricity Power Investment on Indonesia Economic Growth

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Abstract: The development of Renewable Energy (EBT) is Indonesia's main focus in efforts to reduce dependence on limited energy sources and at the same time has the potential to damage the environment. The Indonesian government targets the portion of EBT to increase to 23% by 2025. One type of EBT used by the electricity sector is Hydroelectric Power Plants (PLTA). The aim of this research is to analyze and examine: (i). Development of New Renewable Energy (EBT) in Indonesia; (ii). Impact of Hydropower Investment on Backward Linkage and Forward Linkage; (iii). Impact of hydropower investment on leading sectors; (iv). To Analyze and Assess the Impact of Hydropower Investment on Economic Growth; and (v). EBT policy to achieve SDGs goals.

The research method used is a Mix Method approach, namely a combination of a quantitative approach (using Input-Output (I-O), Computable General Equilibrium (CGE), with 2016 SNSE data) and a qualitative approach (using Systematic Literature Review/SLR). Based on the research results obtained: (i). Currently, renewable energy utilization in Indonesia reaches around 2.5% of the total potential of 417.8 GW. Based on the 2017 National Energy General Plan, hydropower potential reaches 94,476 MW. With the current capacity, the utilized potential of hydropower is only 6.99%; (ii). The electricity sector, including hydropower, is ranked second with a Backward Linkage value of 3.159. Meanwhile, for Forward Linkage, this sector is ranked 7th with a value of 3,372; (iii). The determination of leading sectors is based on sectors with high Backward and Forward Linkage, so the three main leading sectors are the oil and gas refining sector, the food and beverage sector, and the paper goods sector, printing and recording media reproduction; (iv). The impact of hydropower investment on economic growth (through CGE model simulations) shows that there is a linear relationship between investments made in the hydropower industry and Indonesia's economic growth; (v). The implementation of the EBT policy has achieved the SDGs goals, where the Government is currently preparing a Grand National Energy Strategy to ensure the availability of sufficient, good, affordable, and environmentally friendly energy in the 2020-2040 period.

In order for the target of using EBT to be achieved, energy development with technological support is needed, as well as policies providing incentives from the government in the form of fiscal policies, subsidies, and investment policies. Apart from that, there needs to be land planning and ease of licensing for the development of generating, transmission, and distribution land in accordance with the spatial plan. The involvement of the community, private sector, and universities is necessary to accelerate the achievement of EBT development targets and their sustainability.

Keywords: EBT, Hydropower, Economic Growth, C G E

Introduction

Renewable Energy (EBT) has become a major topic of discussion in various countries in recent years, and this is also the case in Indonesia. The development of EBT is Indonesia's main focus in efforts to reduce dependence on energy sources that are limited and have the potential to damage the environment. The Ministry of Energy and Mineral Resources (ESDM) has published the 2022 Handbook of Energy & Economic Statistics of Indonesia (HEESI), explaining that Indonesia's energy supply in 2022 has experienced a significant increase from the previous year, namely 19% or the highest since 2012. Meanwhile, the primary energy mix is still dominated by coal at 42.38%, followed by petroleum at 31.40%, gas at 13.92%, and EBT at 12.30%. Indonesia through Presidential Decree No. 22 of 2017 concerning the General National Energy Plan (RUEN) states that the NRE mix target within the scope of national primary energy in 2025 is 23% and in 2050 it will be 31%.

So far the role of EBT is still small, even though there have been many policies issued by the government. However, the policies issued have not been able to encourage the development of renewable energy significantly. The Indonesian government is also still unable to provide equal access to energy for the Indonesian people. This is due to limited funds for developing EBT in Indonesia. So, this makes other countries and international organizations take a role in developing EBT, especially in providing energy access for the Indonesian people. Based on data obtained from The International Renewable Energy Agency (IRENA), the most important factors are the very small return on investment and the fairly long infrastructure development period. The risk of unattractive returns on EBT projects is also supported by the low Return on Investment (ROI) of EBT, especially when compared to investments in the coal sector. As already mentioned, the costs of establishing EBT-generating infrastructure are quite high, although operational costs when the infrastructure is ready for use tend to be lower. However, the time period required for infrastructure development is quite long. Therefore, even though it is actually more promising, investors tend to choose to invest in the coal sector because the results can be obtained in a relatively short time.

The development of EBT in accordance with the assistance of these respective programs have been implemented in several countries and the countries that have succeeded in developing EBT according to data from the Institute for Essential Service Reform (IESR) are India, Vietnam, and Thailand. India is one of the leading players in solar energy in the world. Since the 2000s, the Indian government has been working seriously on solar energy. The National Solar Mission was declared by India in 2010, with a target of “only” 20 GW by 2022. In addition to strong political commitment, clear targets, and supportive policy and regulatory derivatives, the opening of a global solar energy market contributed to the decline in solar module prices, then prompted India to revise the target to 100 GW and increase it again to 200 GW by the same deadline. India's success is due to: (i). Consistent political and policy commitment with clear and targeted long-term targets; (ii). Implementation of policies in more concrete programs and projects; (iii). Availability of financing support through the National Clean Energy and Environmental Fund (NCEEF); (iv). Financial assistance to project developers and optimization of public funding; (v). Effective procurement process; and (vi). There is high competitiveness. With good design, carried out transparently, made on a large scale, and the reverse auction principle adopted by the Indian government, it is able to produce generation prices that are much cheaper than the price of fossil energy.

In Southeast Asia, Thailand and Vietnam have also successfully implemented this program. Both countries share similar strategies with India to encourage innovative solar energy, tailored to the country's context. The Vietnamese government is responding to the threat of a future electricity crisis by ensuring the security of energy supplies from renewable energy sources. Solar energy is Vietnam's choice because it is faster to build, involves many parties in the investment so it does not burden the state budget in the long term, and the price of solar technology, which is getting lower and lower, will contribute to reducing overall energy prices.

Indonesia has a quite large potential for new renewable energy to achieve the primary energy mix target, as shown in Table 1. below:

Table 1. The Potential of Renewable Energy

Kinds of Energy	The Potential (in Gigawaat/GW)
Hydropower	95 GW
Geothermal 1	23 GW
Bio Energy	57 GW
Sun	3.294 GW
Wind	155 GW
Ocean Energy	63 GW
Total Potential	3687 GW

Source: Ditjen EBTKE (2023)

The total EBT potential of 3,687 GW will later be used for electricity generation, while Fuel Oil (BBM) and Biogas amounting to 200 thousand Bph will be used for fuel purposes in the transportation, household, commercial, and industrial sectors. The description above shows that several countries require very large costs, international aid funding processes, private funding, philanthropic funding, and consistency of government or country policies in EBT funding. Even though EBT investment is a very large investment and requires a large amount of capital, the impact of this investment economically, socially, and environmentally is also very large, so the author is interested in raising the topic of EBT research, especially Hydroelectric Power Plants (PLTA) with the title "Impact of Investment Hydroelectric Power Plants (PLTA) on Indonesia's Economic Growth".

Theoretical Background

Study Background

The magnitude of the influence of EBT is also a concern for researchers. Several research results discussing EBT have found that EBT has various challenges in its development, namely: (i). The average cost of electricity is still very high compared to electricity produced from fossil fuels; (ii). Readiness of Human Resources (HR) in terms of workforce skills in operating and maintaining technology; (iii). Ecological and social environmental problems; (iv). Inconsistent regulations; and (v). Problems with financing schemes and funding that suit needs. Some of these studies were conducted by: Zhang (2021); Krömer & Gatzert (2018); He (2019); Taghizadeh-Hesary (2020); Sendstad (2022); and Shimbar (2020). Specifically for Indonesia, several studies include: Oktaviani & Sahara (2005); Ortiz, et al., (2022); and Narsiyah & Aji (2022).

In detail, some of them can be explained as follows. Zhang (2021) in his research explains that green credit policies can promote investment in EBT. However, the research results also show that the success of this investment still depends and is closely related to the characteristics of high costs and high risks, as well as the need for a gradual disbursement scheme to ease financial constraints in realizing EBT development goals. Meanwhile, Krömer & Gatzert (2018) show that investment in EBT projects operated together with energy storage systems is constrained by return risk characteristics from the perspective of private and institutional investors, resource risk, energy price risk, inflation risk, and policy risk.

On the other hand, Taghizadeh-Hesary (2020) found that the lack of long-term funding, low rates of return, the existence of various risks, and the lack of capacity of market players are the main challenges to the development of green energy projects. It also found that sudden and unexpected policy changes could deter further investment activity in affected countries. This suggests that a stable policy environment is essential to incentivize investment by private companies, and political risks (Shimbar (2020). Overall this research also highlights the challenges of green financing and investment in EBT projects and provides practical solutions to fill the green financing gap. Practical solutions include: (i). Increasing the role of public financial institutions and non-bank financial institutions (pension funds and insurance companies) in long-term environmentally friendly investments; (ii). Leverage spillover taxes to increase the rate of return on green projects; (iii). Developing an environmentally friendly credit guarantee scheme to reduce credit risk; (iv). Establishing community-based trust funds; and (v). Addressing environmentally friendly investment risks through reducing financial and policy risks.

The energy sector also plays an important role in the economic aspect. The level of energy prices is able to influence aspects of consumption which requires the government to ensure that energy adequacy is met for all regions, especially electricity and this will then have an impact on economic growth and reduced carbon emissions (see among others: Oktaviani & Sahara, 2005; Rahayu & Windarta, 2022; Shahbaz et al., 2020; Zafar et al., 2019; and Bhattacharya et al., 2016). More specifically, NRE investment, especially Hydroelectric Power Plants (PLTA), is also considered to have an impact on economic growth (Narsiyah & Aji, 2022; Ueda et al., 2019). Studies conducted by Narsiyah & Aji (2022) in Indonesia and Ueda et al (2019) in Japan, using Input-Output analysis techniques, show that investment in hydropower development has the potential to encourage an increase in economic output. Furthermore, the study maps several problems related to the development of EBT itself, such as: (i). Regulatory uncertainty contributed 83%; (ii). Coordination problems assessed as lacking between existing Ministries and Institutions – 73%; (iii). Financial Obtaining – 67%; (iv). Timeliness of PPI and Permints – 63%; and (v). The EBT rate is 50%.

In Indonesia, the funding scheme for EBT, citing the Ministry of Finance's official PPP website, is implemented using Blended Finance. This is defined as a transaction structure in optimizing the use of development financing instruments (philanthropy) and mobilizing commercial (private) financing. How to utilize funding (not only domestically, not only based on commercial banking), but also from a philanthropic perspective, which intends to support the development of EBT in Indonesia. The Blended Finance funding model is an Indonesian climate change trust fund. This model will facilitate obtaining funds from donors, such as the Asian Development Bank, European Investment Bank (grants/loans), and the World Bank.

Input-Output Model and General Equilibrium Model

The Input-Output (I-O) Table was originally developed by Professor Wassily Leontief at the end of 1930. During its development, the methods used in the I-O Table were increasingly applied as practical and quantitative analysis and planning tools. The I-O model is often used in regional analysis which is generally used to analyze macroplanning problems in the field of development economics; both at the national and regional levels. It is common to look at the interrelationships between economic sectors in development, including integrating biological, physical, and other social models into an I-O framework, developing dynamic models, and incorporating uncertainty to analyze complex real-world problems (Thomassin, 2018 and Sener (2013).

I-O analysis shows that the economy as a whole contains interconnectedness and interdependence between industries. The input of one industry is the output of another industry and vice versa, so that ultimately they are interconnected, and lead to equilibrium between supply and demand in the economy as a whole (Jhingan, 1975; Midmore, et.al., 2006; Miller, 1966; Miller, 1986; Rueda-Cantuche, et.al., 2012; Sonis, et.al., 2000; and Timmer, et.al., 2015). In general, the characteristics of the model I-O are: (i). It is static depending on the availability of the I-O table; (ii). More detailed economic sectors (Disaggregate); (iii). The model is not influenced by prices; (iv). There are no supply constraints (Demand Driven Model); (v). Intermediate and primary input demand using the Leontief function; (vi). Fixed Input Coefficients, this means there is no technological change in the production process; (vii). This is a descriptive statistic, and (viii). Used for impact analysis (see among others: West, 1995; West & Jackson, 1998; and Rey, 2002).

The I-O analysis model can show which sectors should be prioritized so that this sector can influence other sectors to improve the economy. In addition, the use of I-O tables has the advantage of simultaneous analysis in development planning and really highlights the relationships and linkages between sectors in the economy (BPS, 1995a). The I-O table can be used to analyze the influence of the growth of a sector on regional and sectoral economic growth, for example, analysis of linkages between sectors (Backward and Forward Linkage), multiplier impact analysis (Multiplier Effect Analysis) which is very important in sectoral planning.

Meanwhile, the general balance model is an initial model of the Input-Output Model. This model is assumed to be a bridge between macro and microeconomic models. This general equilibrium idea departs from the belief first put forward by Walras (1951) which stated that at some point there will be a vector of prices that can balance the level of demand and supply in each commodity market. Walras believes that this equilibrium price level can be achieved through the Tatonnement process. This process works like an Auctioneer who will reduce prices in markets experiencing Excess Supply and increase prices in markets experiencing Excess Demand, until an equilibrium price occurs. Robinson (1989) suggests that the general equilibrium model is the most relevant economic model in analyzing the impact of government economic policies. If a country's economic performance tends to adhere to a free market system or the role of market mechanisms in the economy, then the state tends to become increasingly dominant. Correspondingly, in the 1930-1950s period, the development of applied general balance models developed rapidly, such as: the I-O Leontief model, the socio-economic balance model / Social Accounting Matrix, and the Computing General Equilibrium (CGE) model.

Research Methodology

This research aims to analyze the impact of investment in Hydroelectric Power Plants (PLTA) on Indonesia's macroeconomic indicators. This research method uses the Input-Output model approach and the Computable General Equilibrium model. The data used to answer the various objectives of this research is the Input-Output (secondary) table. The I-O table can be used to answer research objectives related to Backward and Forward Linkage. Apart from that, to construct the Computable General Equilibrium model database, we also use the I-O Output table and the Social Accounting Matrix (SAM) table, which in Indonesia is commonly called the Socio-Economic Balance System (SNSE).

To obtain a more in-depth analysis of the CGE modeling results, a review method of previous studies (Systematic Literature Review) will be used. Systematic Literature Review is a research method for identifying, evaluating, and interpreting all relevant research results related to certain research questions, certain topics, or phenomena of concern. The Systematic Literature Review data analysis technique is to carry out synthesis (using PRISMA) and deepening the relevant research results using NVivo Analysis.

Result Analysis and Discussion

Energy and Electricity Conditions in Indonesia in General

The government, through the Ministry of Energy and Mineral Resources, is targeting all regions in Indonesia to be fully electrified this year or have an electrification ratio (RE) of 100%. The electrification ratio achieved by 2022 is 99.63%, up from 99.45% in 2021. There are three strategies prepared by the government to expand access to electricity throughout Indonesia, especially in the frontier, outermost, and underdeveloped (3T) areas. The first strategy is to boost grid expansion. Network expansion program connecting villages and/or households close to the PLN network (Grid) through the Grid Extension program. The second step, is the development of Miningrid through the construction of a generator that utilizes local new renewable energy (EBT) potential for areas that are difficult to reach through the expansion of the PLN electricity network and the community living communally. The third strategy is the 450 VA New Electricity Installation Assistance (BPBL) program for Households (RT) that cannot afford/don't have electricity that is registered in the Integrated Social Welfare Data (DTKS). This program aims to electrify around 83,000 RT by 2023.

From 2015 to 2019, Indonesia's installed power generation capacity increased by almost 15 GW or the same as 15,000 MW over five years. In 2020, the installed capacity of national power plants will reach 69.6 GW. Five years ago, electricity generation capacity was around 54.7 GW. Of the total national electricity generation capacity of 69.6 GW, Steam Power Plants (PLTU) still dominate the national capacity, namely 34.7 GW or 49.9%, followed by Gas Power Plants (PLTG/GU/MG) amounting to 19.9 GW or around 28.6%. The electricity generating capacity of New Renewable Energy (EBT) is currently around 10.3 GW or around 14.8%, and PLTD is 4.6 GW or around 6.7%. In the next five years (2020 – 2024), the electricity generation infrastructure plan to be built will reach a total capacity of 27.28 GW, consisting of 18.28 GW (67.0%) of fossil generators and 9 GW of renewable energy plants. .05 GW (33.0%). Of the total planned capacity of 27.28 GW, there is an installed capacity of 35,000 MW Program generating capacity of 20.62 GW which is planned to be completed by 2024.

The energy regulatory framework includes regulations and policies made by the government or regulatory agencies to regulate the energy sector. The energy regulatory framework provides the legal and regulatory basis that regulates production, distribution, consumption, and investment activities in the energy sector. The aim is to achieve national energy policy goals, such as energy security, sustainability, efficiency, and equitable energy access. The taxonomy and energy regulatory framework describes the Demand Side and Supply Side flow, which then classifies data between New and Renewable Primary Energy (EBT and Geothermal Energy), Non-Renewable Energy (Petroleum, Natural Gas, Coal, and Peat), and secondary energy.

The energy taxonomy and energy regulatory framework work together to achieve national energy policy objectives. Energy taxonomy helps in identifying the potential for renewable energy development, classifying energy sources based on their level of sustainability, and guiding decision-making regarding investment and development of energy infrastructure. Meanwhile, the energy regulatory framework provides the legal and regulatory basis needed to regulate and direct activities in the energy sector in accordance with established policies and objectives.

Analysis of Results and Discussion

Input-Output Analysis

Economic driving sector analysis was carried out to identify leading sectors using three indicators, namely; Backward Linkage, Forward Linkage, and a combination of the two previous indicators.

a. Backward Linkage (BL)

This analysis is carried out to determine the leading sectors based on which sector uses the most output from other sectors as input in its production process. Sectors that have high BL figures can be called leading sectors driving the economy because they have strong backward linkages to attract other economic sectors. The processing results for Backward Linkage show that the electricity sector, including hydropower, is in second place with a BL value of 3.159, which shows that every 1 unit increase in electricity sector output will cause an increase in the output of other sectors, including the electricity sector itself, by 3.159. The 5 highest rankings for Backward Linkage are: (i). Machinery and Equipment; (ii). Electricity; (iii). Metal Goods; Computers, Electronic Goods, Optics; and Electrical Equipment; (iv). Base Metal; and (v). Paper and Paper Products; Printing and Reproduction of Recorded Media.

b. Forward Linkage

Forward Linkage (FL) provides an overview of future linkages, meaning it describes the impact caused by an increase in the output of a particular sector to other sectors or in other words to explain which sector whose output is most often used as input by other sectors. Sectors with high FL are said to be the leading sectors driving the economy, considering that there are strong future linkages to encourage the use of their output in other economic sectors. The processing results for FL show that the electricity sector is ranked 7th with a FL value of 3,372, which means that every time there is an increase in 1 unit of output in the electricity sector, it will cause an increase in the output of other sectors in front of it, including the electricity sector itself, by 3,372. The 5 highest rankings for FL are: (i). Chemistry, pharmacy, and traditional medicine; (ii). Oil and Gas Refinery Results; (iii). Machinery and Equipment; (iv). Oil, Gas, and Geothermal Mining; and (v). Food and Drink.

c. Leading Sector

Determination of leading sectors is based on sectors that have high Backward and Forward Linkage. There are 9 sectors that have the potential to be developed into leading sectors because they have high Backward and Forward Linkage (above the average value), namely: (i). Oil and gas refining products sector; (ii). Food and beverage sector; (iii). Paper, paper goods, printing and reproduction of recorded media sectors; (iv). Basic metals sector; (v). Metal goods sector: computers, electronics, optics and electrical equipment; (vi). Transportation equipment sector; (vii). Electricity sector; (viii). Construction Sector; and (ix). Air transport sector.

The development of the 9 sectors above will have a high multiplier effect on the Output Multiplier, namely increasing economic growth because this sector's output is widely used as input by other sectors and conversely, this sector uses a lot of input from other sectors in its production process. If you look at the Backward and Forward Linkage analysis above, the Electricity sector including PLTA (sector 29) plays an important role because it has the highest combination of Forward Linkage and Backward Linkage compared to the average.

Analysis of CGE Results

In general, the simulation results of the IO model and CGE model provide relatively similar information. The difference is more in the approach, if the IO model uses a multiplier index that describes economic benefits in certain units and is the same in reading them. Meanwhile, the CGE model uses a growth or percentage basis in reading the simulation results.

Table 2. Simulation results of the benefits of investment in the hydropower industry using the CGE model

Hydroelectric Investment	Economic Growth
Increase 2%	0.00007%
Increase 5%	0.00017%
Increase 10%	0.00035%
Increase 15%	0.00052%
Increase 20%	0.00069%
Increase 30%	0.00104%

Source: Simulation of CGE Model, processed (2023)

The CGE model simulation results also found that the relationship between investments made in the hydropower industry and Indonesia's economic growth is linear or directly proportional. Increasing investment in the hydropower industry will have a positive impact on Indonesia's economic growth. When compared with the benefits of investment in the energy sector, the impact of hydropower investment on economic growth is smaller than the impact of investment in the oil and gas sector. This is partly because the portion of hydropower which is new and renewable energy (EBT) is relatively smaller compared to oil and gas, namely fossil energy, the development of which is relatively more established. Data shows that the portion of fossil energy in Indonesia's energy mix in 2022 will be 86%.

Analysis of Systematic Literature Review Results

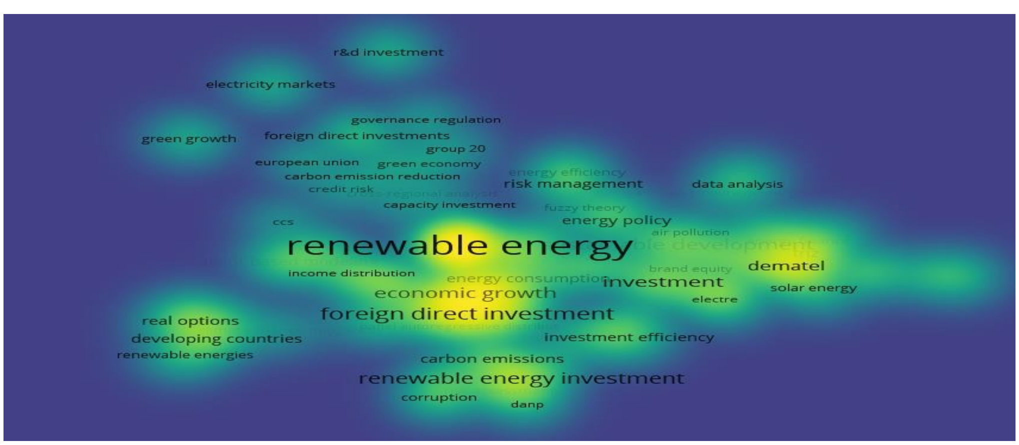
To search for articles and data sources used in this research, use the Publish or Perish (PoP) software with the publication time criteria between 2019-2023. The keywords used are: (i). Renewable Energy Investment; (ii). Renewable Energy Investment vs Economic Growth; and (iii). Sustainable Energy Investment. The reason underlying the use of these keywords is to refer to the big theme in this research which identifies the influence of hydropower investment, which is part of NRE, on economic growth. Based on the search for the keywords used, 304 data were generated (n = 304), where each keyword produced as much data as: (i). Renewable Energy Investment – 200 data; (ii). Renewable Energy Investment vs Economic Growth - 23; and (iii). Sustainable Energy Investment – 81 data. Furthermore, of the 304 available data, the first exclusion criterion was used, namely that the data to be used as input must be published in article form and not in other forms (Chapter in Book, Review, Book, Note, and so on).

In the first criterion, 129 data were found in forms other than articles, so in this case the remaining data was (n = 175). The next criterion used is that the selected articles must have keywords. In this case, 6 articles were filtered out that did not have keywords in the data in the form of articles, so that the remaining (n = 169) articles would be processed for further data processing. Based on these stages (using 2 criteria) it can be concluded that there are 169 eligible articles for further analysis. Next, in the second stage, partial network mapping will be carried out for each keyword used. First, the mapping results will be shown on keywords that refer to the big research theme related to hydropower investment, namely Renewable Energy Investment (n = 122) to map what keywords appear.

The study conducted by Grabara et al. (2021) found different results in the relationship between economic growth and output from New Renewable Energy (EBT) in Kazakhstan and Uzbekistan. The results of this study show that economic growth has a positive and significant effect on the growth of NRE output in Uzbekistan, and vice versa for Kazakhstan. Furthermore, the finding is that incoming foreign investment has a negative effect on EBT output growth. This is because the use of fossil energy is still widespread in developing countries, such as Uzbekistan and Kazakhstan. Therefore, the study recommends that the government stimulate investment in technology and infrastructure to encourage the EBT sector. Furthermore, another study, namely Sulieaman & Saradat (2021), which identified the influence of NRE investment on economic growth in the GCC (Gulf Cooperation Council) countries in 2010-2019 found that there was a positive and significant influence of investment variables on economic growth, especially in the UAE. , KSA, and Qatar. These two study results support the findings of the CGE simulation where the NRE investment aspect has a significant relationship with economic growth in Indonesia.

Results from the study of Lyeonov et al. (2019) in countries in the European Union in the 2008-2016 period found that green investments made were proven to be able to increase per capita income by 6.4%. The results of this mapping also support the results of the CGE simulation carried out previously where the hydropower investment carried out was able to have a positive impact on economic growth in Indonesia. These results also conclude that the EBT investments made are also part of efforts to achieve sustainable development. Furthermore, it will also show a mapping of the development of studies regarding (a combination of 3 keywords) to see how far these studies have developed from 2019-2023 through the density analysis below:

Figure 1. Composite Keyword Density Analysis



Source: Data processed (2023)

Based on the image above, it can be seen that studies using the keyword Renewable Energy Investment tend to be widely used, especially in relation to economic growth. However, keywords related to Hydroelectric were not found. This can be seen from the keywords Renewable Energy Investment and Economic Growth which are brighter and more contrasting compared to other keywords. These results conclude that, many studies have been carried out regarding EBT investment, however, specifically referring to the hydropower sector, there is still little to be found, especially in the 169 input data used.

Conclusions and Policy Recommendations

Conclusion

Based on the analysis and discussion carried out in the previous chapter, this research concludes:

1. Based on developments, EBT in Indonesia currently reaches 10.4 GW or around 2.5% of the total potential of 417.8 GW and biofuel is 10 million KL of the total potential of 12 million KL. Although the challenge to achieve the target of 23% by 2025 is quite large, the Government believes that this target can be achieved by implementing a comprehensive acceleration program and support from all stakeholders. The level of new and renewable energy mix (Energy Mix) until the end of 2021 reached 13.5 percent. In the national energy plan, the government wants to achieve an energy mix level of 23 percent by 2025. Based on the 2021-2030 National Electric Power Supply Business Plan (RUPTL), to reach this level, additional NRE generating capacity is needed of 10,640 MW. Hydroelectric power plants are the biggest supporter of NRE plants. In 2021, combined hydroelectric power generation reached 6,601.9 MW. Based on the 2017 National Energy General Plan, hydropower potential reaches 94,476 MW. With the current capacity, the potential for hydropower utilization is only 6.99 percent.
2. The electricity sector, including hydropower, is ranked second with a Backward Linkage value of 3.159 related to the 3 main sectors of Metal Goods Electrical Machinery and Equipment; Computers, Electronic Goods, Optics; and Electrical Equipment. Meanwhile, Forward Linkage shows that the electricity sector, including hydropower, is ranked 7th with a value of 3,372. FL results can later be used as a basis for developing leading sectors, namely chemistry, pharmacy and traditional medicine, oil and gas refining results and machinery and equipment. The results of the Systematic Literature Review (SLR) approach also prove that there is a link between hydropower investment and economic growth.
3. Determination of leading sectors is based on sectors that have high Backward and Forward Linkage, indicating that there are 9 sectors that have the potential to be developed into leading sectors because they have high Backward and Forward Linkage, namely above the average value. The three main leading sectors are the oil and gas refining sector, the food and beverage sector, and the paper goods, printing and recording media reproduction sector.
4. The CGE model simulation results also found that the relationship between investments made in the hydropower industry and Indonesia's economic growth is linear or directly proportional. The simulation results found that increasing investment in hydropower by 2%, 5%, 10%, 15%, 20%, and 30% respectively would increase Indonesia's economic growth by 0.00007%, 0.00017%, 0.00035% , 0.00052%, 0.00069%, and 0.00104%. The results of the density analysis show that the Hydroelectric (PLTA) study was not found.
5. The government is currently preparing a Grand National Energy Strategy to ensure the availability of sufficient energy, good quality, affordable prices, and environmental friendliness in the 2020-2040 period. The strategies developed include increasing oil lifting, encouraging the development of electric vehicles, developing and building refineries, as well as developing NRE to reduce oil imports, strategies for using electric stoves, building city gas networks, and using Dimethyl Either (DME), namely alternative energy to replace Liquified Petroleum (LPG gas). The keyword mapping results support the results of the CGE analysis carried out previously. First, general mapping through the keyword Renewable Energy Investment shows that there is a connection with economic, electricity, and sustainability aspects. However, the electricity aspect in this case does not focus on the energy source used, especially water (Hydroelectric). Further analysis was carried out by inputting the keywords Renewable Energy Investment vs Economic Growth. The results of mapping these keywords support previous findings in CGE analysis, where one study showed a positive and significant influence of the EBT investment variable on economic growth in several Gulf Cooperation Council (GCC) countries.

Policy Recommendations

Increasing and accelerating the development of clean energy towards the energy transition with technological support and financial support from various entities including government, international organizations, financial institutions, businesses, and philanthropy. Regarding access, the use and use of technology must be made more inclusive. Maximizing the application of Bioenergy also requires synergy in the development of EBT with the development of economic clusters such as Special Economic Zones, Industrial Zones, and Leading Tourism Areas.

In order to increase the target for renewable energy use, the government provides incentives in the form of fiscal policies and subsidies in an investment policy. Apart from that, there needs to be land planning and ease of licensing for the development of generating, transmission, and distribution of land in accordance with the spatial plan. Continuous development of renewable energy from the fields of micro-hydro, biomass, and hybrid systems, and involvement of the community, private sector, and universities are very necessary to accelerate the achievement of renewable energy development targets.

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