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Scenario Planning of Electricity Needs In Indonesia for The Next Ten Years

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Abstract. *Indonesia as the largest archipelago in the world, has its own challenges in energy supply infrastructure compared with continental countries. According to data from Directorate General of Electricity (2018), the electrification ratio Indonesia until the end of 2017 just around 95,37%. Even more, there are two provinces that have electrification ratio below 70% (NTT 59,85% and Papua 61,94%). Compared with other ASEAN countries, Indonesia's national electrification ratio is still low. The electrification ratio of Thailand and Singapore already 100%. Malaysia and Brunei Darussalam have 99% electrification ratio and Vietnam with electrification ratio reaching 98%. Therefore, at this time the Government seeks to achieve electrification ratio 99,90% in 2019. For that reason, the government is trying to increase electrification ratio by 35.000 MW program. But to realize this, the government must face high uncertainty of the future. So it needed scenario planning approach to prevent unwanted conditions. The purpose of this study is not only to provide an overview of the future situation in the electricity industry and all aspects that may impact on changes in the electricity sector, but also being able to transform from one scenario to another scenario with a better future. There are two main uncertainty factors with the greatest impact that is the level of economic growth and security of primary energy supply to power plant. Then these two factors of uncertainty are used as axis to create four quadrants containing four scenarios that will occur. The four scenarios are Alert Industry, Full of Light Industry, Climbdown Industry, and Blackout Industry.*

Keywords: *Scenario Planning, Electrification Ratio, 35.000 MW Program, Economic Growth, Security of Primary Energy Supply.*

Abstrak. *Indonesia sebagai negara kepulauan terbesar di dunia, memiliki tantangan tersendiri dalam infrastruktur pasokan energi dibandingkan dengan negara kontinental. Menurut data dari Direktorat Jenderal Ketenagalistrikan (2018), rasio elektrifikasi Indonesia hingga akhir 2017 hanya sekitar 95,37%. Terlebih lagi, masih ada dua provinsi dengan rasio elektrifikasi di bawah 70% (NTT 59,85% dan Papua 61,94%). Dibandingkan dengan negara-negara ASEAN lainnya, rasio elektrifikasi nasional Indonesia masih rendah. Rasio elektrifikasi Thailand dan Singapura sudah 100%. Malaysia dan Brunei Darussalam memiliki rasio elektrifikasi 99% dan Vietnam dengan rasio elektrifikasi mencapai 98%. Sehingga saat ini Pemerintah berupaya mencapai rasio elektrifikasi 99,90% pada 2019. Oleh karena itu, pemerintah berupaya meningkatkan rasio elektrifikasi melalui program 35.000 MW. Tapi untuk merealisasikan hal ini, pemerintah harus menghadapi ketidakpastian yang tinggi di masa depan. Sehingga dibutuhkan metode perencanaan skenario untuk mencegah kondisi yang tidak diinginkan. Tujuan dari penelitian ini adalah tidak hanya untuk memberikan gambaran umum situasi masa depan di industri ketenagalistrikan dan semua aspek yang berdampak pada perubahan sektor ketenagalistrikan, namun juga dapat mengubah dari satu skenario ke skenario lain dengan masa depan yang lebih baik. Ada dua faktor ketidakpastian utama dengan dampak terbesar yaitu tingkat pertumbuhan ekonomi dan keamanan pasokan energi primer terhadap pembangkit listrik. Kemudian kedua faktor ketidakpastian ini digunakan sebagai sumbu untuk membuat empat kuadran yang berisi empat skenario yang akan terjadi. Keempat skenario tersebut adalah Alert Industry, Full of Light Industry, Climbdown Industry, dan Blackout Industry.*

Kata kunci: *Perencanaan Skenario, Rasio Elektrifikasi, Program 35.000 MW, Pertumbuhan Ekonomi, Keamanan Pasokan Energi Primer.*

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Introduction

Indonesia has a dream that electricity across the island to be light up as in Java or other countries, as well as ensuring the availability of electricity in sufficient quantity, good quality and reasonable price to improve the welfare of the people is a must, as mandated by Law No. 30 Year 2009 on Electricity. Archipelagic country is difficult to provide integrated access infrastructure of the region that already has sufficient access to the remote areas, for example in the border region and left behind. Access to adequate energy concentrated in the central area of the center of government and the economy. Directorate General of Electricity (2017) defines that electrification ratio is the number of households that have been electrified divided by the total number of households in Indonesia. The electrification ratio is an indicator of the performance achievement from the Government in terms of electricity fulfillment throughout Indonesia in addition to indicators of electricity consumption per capita.

According to data from Directorate General of Electricity (2018), the electrification ratio Indonesia until the end of 2017 just around 95,37%. Even more, there are two provinces (NTT and Papua) that have electrification ratio below 70% (NTT 59,85% and Papua 61,94%). Compared with other ASEAN countries, Indonesia's national electrification ratio is still low. The electrification ratio of Thailand and Singapore already 100%. Malaysia and Brunei Darussalam have 99% electrification ratio and Vietnam with electrification ratio reaching 98%, details in figure 2. Therefore, at this time the Government seeks to achieve electrification ratio 99,90% in 2019, see figure 1. If we compare from electricity infrastructure index, the rank of Indonesia is 6th position under Singapore, Malaysia, Brunei, Thailand, and Laos (World Economic Forum, 2018).

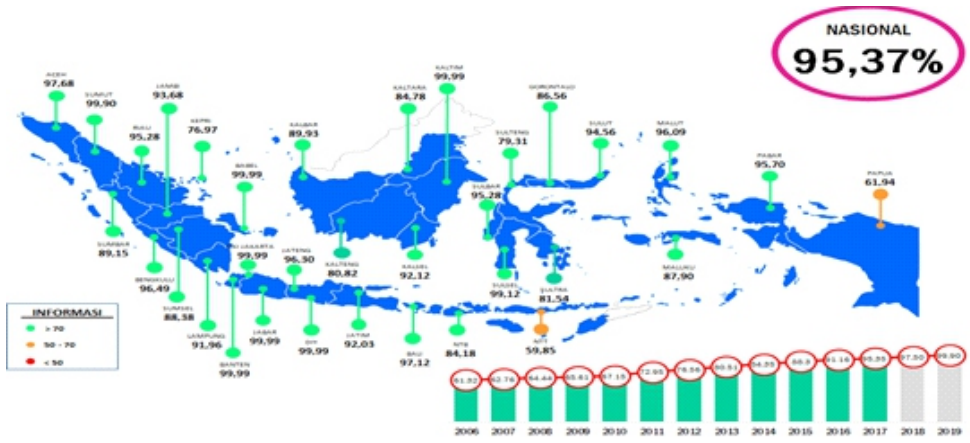

Figure 1.
Electrification Ratio in 2017 (Source: DGE, 2018)

This target requires the addition of an average electricity household of about 2,5 million per year and an average of about 1,01 million per year to reach 100 % by 2025 (DGE, 2018). The target of the electrification ratio can be achieved provided that the financing of infrastructure development of electricity supply and the constraints in the construction of electricity supply infrastructure can be overcome.

If PLN's budget is insufficient to add an electrified household, other sources of funding are needed, such as funding from the state budget. Things that need attention in increasing the ratio of electrification not only electrical connection to the house, but also need to pay attention to the reliability.

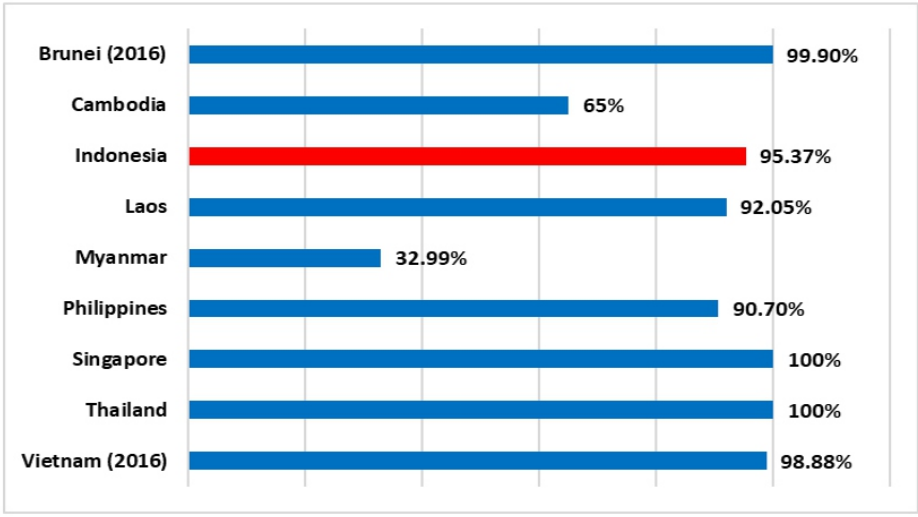

Figure 2.
Electrification Ratio in ASEAN Countries (Source: DGE, 2018)

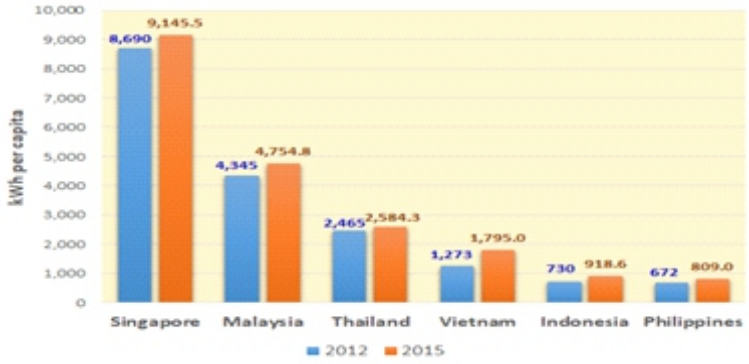

Figure 3.
Electricity consumption per capita in some ASEAN countries (Source: DGE, 2017)

Security of Primary Energy

According to data from PLN (2017), fluctuating of primary energy price from fuel, coal, gas and so will greatly affect the company, especially if the price increase is followed by supply constraints because of the influence of market demand. Primary energy has the largest contribution in the production of electricity and operational cost. Around 64% the electricity providing is come from primary energy cost, so if there is increasing in their cost it will give impact to the electricity tariff.

Electricity Consumption

Directorate General of Electricity (2017) report that Indonesia's electricity demand is increasing every year. This is seen in Indonesia's per capita electricity consumption in line with the national population growth. From 2010 that only 698 kWh/capita to 956 kWh/capita in 2016 shows that the electricity demand of Indonesia's population increased significantly. The target set will be expected in 2019 to reach 1.200 kWh/capita (RPJMN 2015-2019).

Although Indonesia's per capita consumption (kWh) increases annually but is still low at 956 kWh in 2016 (DGE, 2017). Compared to other ASEAN countries, kWh per capita of Indonesia in 2015 is still low compared to Singapore (9.145 kWh /capita), Malaysia (4.754 kWh /capita), Thailand (2.584 kWh /capita), and Vietnam (1.795 kWh /capita). Electricity consumption per capita is obtained by means of total national electrical energy consumption divided by the total population of Indonesia (DGE, 2017), see figure 3.

Several previous studies indicate that no one has specifically reviewed the need for electricity in Indonesia with scenario planning approach. Existing research has been more on the constraints of project completion, development strategy according to regional potential, and supply and demand studies (Nizam, 2008; Suharmanto, Fitria, & Ghaliyah, 2015; Hendro & Sunitiyoso, 2016; Gultom, 2017).

Furthermore research Quentara & Suryani (2017), showed that the main problem of the electrical operational systems in Indonesia is how to maintain the continuity of effective and efficient services to the customers and meet the supply and demand for electrical power, particularly a lot of islands area in Indonesia are far distant from the power generation sources. Moreover Kasperowicz (2014) in his research found that understanding the behavior of electricity consumption in relation to the economy is very important for improve a stable economic growth and development.

Based on the results of the phenomenon analysis and review of some previous studies as described above, it can be seen that although there are some similarities between this study with previous research relating to the variables studied, but no one has specifically research using scenario planning in Indonesia's electricity sector for the next ten years. While this research will focus more on fulfillment of electricity needs in Indonesia for the next ten years using scenario planning approach. Scenario planning is based on the uncertainty of the situation that will occur in the future against an organization or institution (Salomo, 2009). Fundamentals to scenario planning is how to describe future situations (Schoemaker, 1995). Kancana (2011) states that Scenario planning is one of strategic management alternatives in which considerate what will occur in the future based on past, present condition and future outlook.

Practical Gap

Directorate General of Electricity (2017) states that the 35.000 MW program is a government project to build a power plant of up to 35.000 Megawatts by 2019. The 35.000 MW program aims to meet the electricity needs of Indonesians from Sabang to Merauke. But what happens is still often the occurrence of power outages and electrification ratio gap, especially in eastern Indonesia. The emergence of the gap between the objectives of the 35.000 MW program and the realization that occurs, of course, requires a scenario planning approach to find out what scenarios will occur in the future along with the implications and options for completion.

The purpose of this research is to provide an overview of the future situation in the electricity industry and all aspects that may impact on changes in the electricity sector in Indonesia like driving forces, critical uncertainties, possible scenarios, and implication also option for each scenario. This research also being able to transform from one scenario to another scenario with a better future. So it will be able to generate a powerful strategy for dealing with the future along with the implications and options that will occur for each scenario that is generated. Through this research will generate the possibility of future opportunities and preparing for future competitive challenges.

Research Methodology

This study begins with identifying key issues in electricity development in Indonesia. After that conducted an assessment in the form of Pestle analysis and benchmarking strategic issues with India and Brazil to get an overview of electricity industry. Pestle method used to understand business environment analysis and also to get a description of the business environment in determining opportunities or threats. This is done with the aim that policymakers can anticipate any problems that will arise and find ways to solve the problem by developing early warning signals so that it can be known earlier potential problems that will occur.

The methodology used is literature review, data analysis related to electricity development policy, interview with experts, and scenario planning development. Interviews with experts are needed to get input on the main factors driving the development of electricity in Indonesia along with its uncertainty and solutions needed to address emerging problems. The respondent profiles as primary data for this research comes from internal and also external. This primary data as a basis to determine the axis of uncertainty in developing scenario planning, finding implication and option from each scenario, and also determining early warning signals, that will use to analyze and make the decision. The respondent for this research are Chrisnawan Anditya, Pramudya, Saleh Abdurrahman, Nur Pamudji, and Adi Priyanto. Chrisnawan Anditya is the Head of Planning and Reporting Division from Directorate General of Electricity. He has competence in the development of electricity development program, formulation of development policy of electricity investment, policy evaluation, plan and program, and preparation of electricity policy material.

The second informer is Pramudya, the Section Head of Evaluation for Electricity Provision Program from Directorate General of Electricity. He has competence in drafting general plan of the national electricity (RUKN), management of electric power data, and evaluation of electricity policies, plans and programs. The third respondent is Saleh Abdurrahman, the Secretary General of National Energy Council (DEN). He has competence in National Energy Policy, General Plan of National Energy, Crisis and Emergency Management of energy, and also implementation of energy sector policies that are cross-sectoral. The fourth respondent, Nur Pamudji is the President Director of PT. PLN 2011-2014 and Chairman UP3KN team 2015-2016. He has com petence in power generation and power system also become one of the drafting team Bandung Scenario. Lastly, Adi Priyanto, is the Head of Planning Division from PT. PLN. He has competence in planning electricity system.

After that develop scenario planning and the implications also options of the four scenarios based on two major uncertainties. Also developed early warning signal on the scenario and the last is to set solutions and recommendations from the results of research that has been done.

Results and Discussion

Macro *Environment- PESTLE Analysis Political Aspect*

Recognizing the importance of electricity for the development of the nation, the government through the Ministry of Energy and Mineral Resources (ESDM) continues to realize the energy fairness in the electricity sector. The hard work done by the government, among others, by increasing the ratio of electrification, equity and affordability, sustainability, and bureaucratic reform, especially in electricity licensing.

Directorate General of Electricity (2017) states that the 35.000 MW program has a crucial role to meet the electricity needs of the Indonesian people and has a significant impact on economic growth outside Java, which previously lacked power supplies. According to data from PLN (2017), the total power generating capacity built by PLN is 11.256 MW and the rest will be built by independent power producer of 24.580 MW. The objective is to provide a larger private portion that more parties are involved in the 35.000 MW project. With so many private parties involved, emerging jobs are becoming larger and local industries are also growing. So that multiplier effect will be created a lot and economic growth will also be higher. According to data from PLN (2017), the construction of 35.000 MW requires an investment of Rp 1.200 trillion, with private portion reaching Rp 615 trillion and PLN Rp 585 trillion. PLN itself must allocate Rp 200 trillion to build power plants and Rp 385 trillion to build transmission lines. From this explanation, so the electricity industry in Indonesia now is quite competitive, because a lot of private sectors are interested to join in the 35.000 MW program.

According to data from Directorate General of Electricity (2017), it can be seen that the development of power plants coming from the private sector or IPP (Independent Power Producer) continues to increase every year. From 2013 with total installed capacity of 10,6 GW to 13,9 GW in 2017. Government provides a larger portion to the private sector to contribute to the 35.000 MW program is also based on the limited funding capabilities of the Government and PLN, so it should involve the role of the private sector to participate (see figure 4).

Economical Aspect

Economic growth, electrification programs, and government programs to build economic zones and industrial estates are the main drivers of electricity demand in a region. Economic growth in the process requires electricity as one of the inputs to support it, in addition to the input of other goods and services. In addition, economic growth will increase electricity consumption in a country.

The growth of the Indonesian economy over the past 10 years expressed in gross domestic product (GDP) at constant 2000 prices an average of 5.7% per annum. Economic growth in 2009 was relatively low (4.6%) due to the effects of the global financial crisis that occurred in 2008 to 2009.

Indonesia was able to recover the economic condition in 2010 with 6.2% growth and strengthened to 6.5% in 2011. In 2012 until 2015, economic growth continues to decline to 4.79%, so that electricity sales also decreased drastically, especially in the industrial sector. In total, electricity sales are only able to grow 2% in 2015, see figure 5.

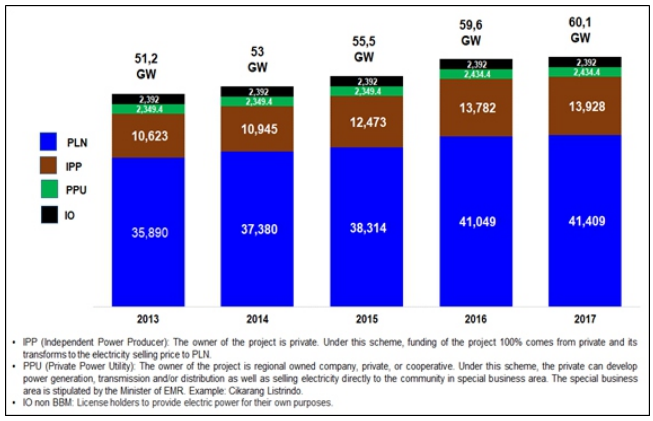

Figure 4.
Progress of Installed Capacity Based on Ownership (Source: DGE, 2017)

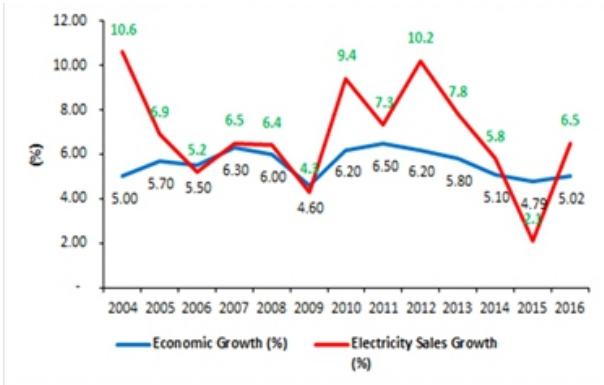

Figure 5.
Electricity Sales Growth Vs Economic Growth (Source: DGE, 2017)

Social Aspect

Development of electricity infrastructure such as power plants, transmission and distribution lines, can be hampered by problems so that realization deviates from the target, both in terms of capacity and time. The problem is in the form of social problems, namely the community's refusal of the existence of PLN installation because it is considered disturbing and dangerous for the surrounding community. The main problem in electricity development is 60% coming from land acquisition. In addition to difficulties in getting people to move from the land needed for infrastructure, land acquisition becomes complicated because PLN must buy community land, at prices that are in accordance with the provisions of the law and the appraisal team. In fact, the value determined by the law and the appraisal team is not necessarily in accordance with the market price that the landowner community desires.

In many cases, PLN actually has sufficient funds to buy land at a price to the people's wishes. However, PLN cannot do so because it would be considered to be detrimental to the state when buying land at a price above the provisions of the law and the appraisal team. The government has already issued Law Number 2 of 2012 on land acquisition to accelerate the process of land acquisition. However, with this law the land acquisition still takes up to 400 days or more than a year. If PLN has to spend more than a year just to clear the land, then the construction of power plants and new networks can start after more than a year. Meanwhile, the electricity needs of the community continue to soar, cannot wait for the completion of electricity infrastructure projects. There will be an electricity crisis if the infrastructure is too late to be built.

Technology Aspect

According to BPPT (2015), there are already applied technologies, such as Clean Coal Technology (CCT) applied to coal power plant, because coal power plant is still needed until the future, according to the priority direction of energy development in national energy policy.

However, because coal is an energy that has high CO2 emissions, then CCT is needed as a form of technology that is more environmentally friendly and has high efficiency. The use of the latest technology is ultra-super critical (USC) boilers in steam power plants. This technology operates at pressures and temperatures above the critical point of water, where the gas and liquid phases are in equilibrium resulting in higher efficiency. Power plants with USC technology have a higher efficiency of about 8% -10% compared to other coal-based power plants, which require less coal consumption. Therefore, this power plant produces lower exhaust emissions, making it more environmentally friendly.

Developing new and renewable energy technologies that are more efficient especially in the foreshore islands bordering other countries and remote areas but has renewable energy potential. The government sets a target portion of new energy and renewable energy to at least by 23% by 2025 remains to be achieved despite the realization of the development of power plants utilizing renewable energy technologies such as geothermal, hydropower, solar power, etc. and other new energy types such as hydrogen, coal bed methane, liquefied coal, and gasified coal has not been able to meet the target, then nuclear energy as one of the choice of utilization of new energy source can serve as an alternative fulfillment of these targets.

Legal Aspect

Legal basis on energy development in Indonesia based on Law number 30/2007 on Energy and Law number 30/2009 on Electricity. Both laws are always connected to each other because electrical energy is a form of downstream energy conversion from other forms of energy. Law 30 of 2009 further stipulates the general plan of electricity and regulation of electricity supply business activities, regulation of electricity supporting services business as well as technical aspects including safety, environmental protection, the feasibility of the installation operation, the competence of technical personnel and standardization.

Government Regulation number 79/2014 on National Energy Policy more specifically regulates the use of primary energy which is represented in the form of energy mix portion and the target of primary energy use (coal, gas, fuel, and renewable energy) that must be fulfilled in 2025 and 2050. Since national energy policy provides primary energy use targets, it also affects the drafting of the general plan of national electricity, as well as the drafting of the general plan of national energy.

General plan of national energy and general plan of national electricity should also refer to the general plan of regional energy and general plan of regional electricity prepared by the Regional Government. All of them are unity which can refer to each other based on the energy potential of each region. Specifically, for general plan of national electricity should refer to Law number 30 of 2009 and also government regulation number 14 of 2012 jo. government regulation number 23 of 2014 (a derivative of Law Number 30 of 2009) concerning Electricity Supply Business Activity. Government regulation number 23 of 2014 provides a regulation concerning the business activities of electricity supply that must be obeyed by the Holder of Power Supply Business License in making the Power Supply Business Plan and must refer to general plan of national electricity.

Environment Aspect

At the G20 summit in Pittsburgh, Pennsylvania, the United States, and COP 21 in Paris, Indonesia has committed to reducing greenhouse gas emissions by 29% from "business as usual" levels by 2030 or 41% with international assistance. For that reason, the priority of development and utilization of new and renewable energy continues to be encouraged utilization in addition to meet the needs of electricity as well in order to reduce the level of CO2 emissions by providing an attractive investment schemes and more competitive power selling price. In addition, policy should be encouraged related to the use of boilers supercritical and ultra-supercritical for coal-fired power plant developed on the island of Java and more efficient technologies in Sumatra and Eastern Indonesia so as to reduce the use of coal. Also consider the use of technology Integrated Gasification Combined Cycle (IGCC) and Carbon Capture and Storage (CCS) to significantly reduce CO2 emissions.

Some examples of new and renewable energy that can be applied in Indonesia in order to commit to reducing environmental emissions are floating photovoltaic solar power plant, efficient solar powered lamp, wind power plant, the development of thorium in Indonesia, public charging station.

According to data from PLN (2017), PLN already signed a joint venture for the development of Floating Photovoltaic Solar Power Plant with Masdar, a renewable energy development company from the United Arab Emirates (UAE). Floating Photovoltaic Solar Power Plant is not necessary land acquisition so that the investment cost is cheaper. The project will operate in phases in 2019 until 2020 with a capacity of 200 MW. The project requires an investment of US $ 180 million with annual revenue estimated to reach US $ 23 million. It is expected that the price of electricity from the Floating Photovoltaic Solar Power Plant in Cirata can be below 6.5 cents US $ per kwh, so that it can compete with the generation of fossil energy (PLN, 2017).

Directorate General of Electricity (2017) defines that efficient solar powered lamp is suitable as a pre-electrification program for house in villages which geographically and distribution of the people are scattered and it is difficult to be covered by PLN's grid. Currently there are 2.500 villages that remain in the darkness, so the Government has a target to illuminating unelectrified villages within 2 years (2017-2018), especially for villages that are still remain in the darkness (DGE, 2017). Construction of 75 MW wind power plant in Sidrap, South Sulawesi continues to be accelerated as one of the Government's efforts to increase the new and renewable energy mix.

According to data from Directorate General of Electricity (2017), this power plant capable to meet the electricity needs for 70.000 household customers with 900 VA power in South Sulawesi. The required investment amounts to USD 150 million. This project is the first and largest wind power plant in Indonesia that utilizes the land of approximately 100 hectares. It is expected to strengthen the electricity system in South Sulawesi so that the electricity reserve of South Sulawesi reaches 500 MW in 2018 (DGE, 2017).

According to Batan (2016), Thorium is expected to be a major component in future power generation. But for now there is no single country that uses thorium as the main component for fuel power plants. The potential of thorium content in Indonesia is estimated to reach 210,000 - 270,000 tons, which is stored in Bangka, West Kalimantan and West Sulawesi. Only a few countries like China and India are taking advantage of thorium but still in research scale. Thorium is a natural radioactive element such as uranium, but thorium cannot stand alone as a fuel. Thorium can respond if triggered with other nuclear fuel, such as uranium.

From the results of this reaction will produce elements of fission products, neutrons, and heat. This heat will be used to generate electricity. Therefore, it is necessary to conduct further study by Batan to investigate thorium prospect in the future (National Nuclear Energy Agency of Republic of Indonesia, 2017). Electric vehicles have significant potential to improve energy security, reduce carbon emissions, and improve air quality. Therefore, it is necessary for the development of public charging station to accommodate the needs of electric motors and electric cars. According to data from PLN (2017), until the end of 2017 has available 1.352 units of public charging stations spread across Indonesia and will gradually continue to add 1.000 units until 2025.

Benchmarking with India and Brazil

Since the beginning of market arrangements in the electricity industry has been introduced to ensure effective and efficient operations, optimal reliability, appropriate incentives, and able to attract investment. Referring to IEA (2016), below is the comparison of electricity industry between India, Brazil, and Indonesia, details in Table 1.

Table 1.
Type of Electricity Industry between India, Brazil, and Indonesia (IEA, 2016)

Indicator	India	Brazil	Indonesia
Type of Industry	Unbundling + IPP	Wholesale Market	Vertically Integrated Utility + IPP
Characteristic of Competition	Early adoption of market mechanisms	Market mechanism	Basic competition
Implementation	There are also private power producers, it's just that vertically integrated power utilities are divided into different companies (power plants, transmission lines, distribution and / or electricity sales).	An independent operator system or regional transmission organization acts as a central entity that sends electricity to consumers of the electricity manufacturer on the basis of bid. The transmission network is open access and a regulatory body is also established to oversee the implementation of the electric competition.	In addition to vertically integrated power utilities, there is also an Independent Power Producer (IPP). IPP builds, owns and operates power plants and sells electricity at predetermined prices to utilities.

We have to determine some important indicators or components when we make scenario planning for our organization or institution. The first thing to do to make scenario planning is determining key focal issues, determine some important driving forces are involved, define the critical uncertainty of the previous driving forces, formulate the logic scenario along with the narrative, the implications and options, and strategies used according to the scenario.

This research focus on energy fulfillment strategy for the next ten years especially in the electricity industry sector. The data to be used will come from the annual report of the Directorate General of Electricity, Data from PLN, and interviews with experts in the electricity sector to get the deepest problems, critical uncertainty factors, also the implications and options of scenarios related to this research.

Driving Forces and Uncertainties factor

We can explore to determine what driving forces will have an impact on our organization in the future. Conducting the analysis of driving forces is an important step in the industrial world and as a foundation to face the potential of competition that will emerge and have a wide impact on the internal condition of the organization and the image that will emerge.

There are three important steps in the identification of driving forces:

- Explore what indicators are influential in an industry.
- Conduct research on the causes of problems that lead to the decline of industry attractiveness.
- Determine strategies for possible impacts in the future

There are ten driving forces that should be a concern in the fulfillment of electricity needs in Indonesia, namely population growth, economic growth, inflation, electricity tariff, technology, security of primary energy supply, government regulation support, environment issues and land acquisition, investment availability, and geopolitics.

Below is critical uncertainties matrix then will be developed to form 2x2 matrix. There are two driving forces that become critical uncertainties after discussion with experts. Those two driving forces which have high level of impact and degree of uncertainty are economic growth and security of primary energy supply.

Degree of Uncertainty

Low	Medium	High	Level of Impact
E. Technology.	D. Electricity Tariff. G. Government regulation support. I. Investment availability J. Geopolitics	B. Economic Growth. F. Security of Primary Energy Supply.	High
	A. Population Growth. C. Inflation.		Medium
	H. Environment issue and land acquisition.		Low

Figure 6.
Critical Uncertainties Matrix

Scenario Matrix

The first quadrant matrix is situation about low security of primary energy supply with high economic growth and the title is Alert Industry. The second quadrant is situation about high security of primary energy supply with high economic growth and the title is Full of Light Industry. The third quadrant is situation about high security of primary energy supply with low economic growth and the title is Climbdown Industry. The last quadrant is situation about low security of primary energy supply with low economic growth and the title is Blackout Industry.

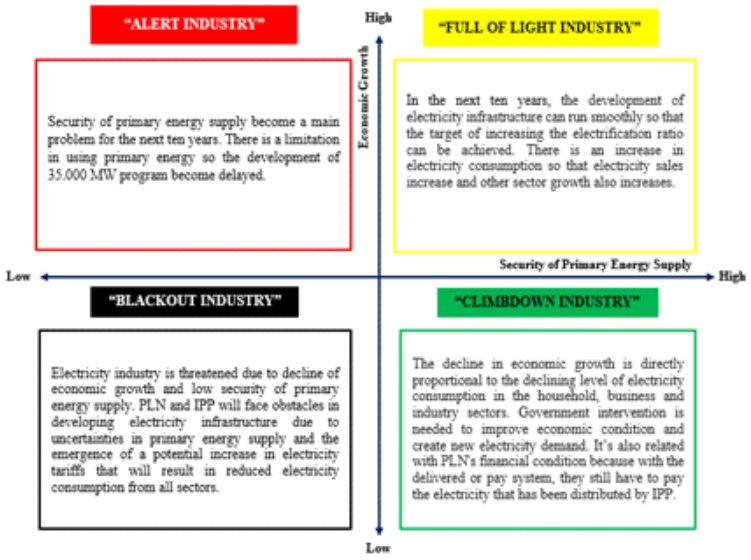

Figure 7.
Scenario Matrix of Electricity Industry

Narratives Alert Industry

In this scenario, Middle Eastern political conflict and tensions are still occurring and have a major impact on world oil and gas supplies. As a result, world energy prices continue to rise. At the regional level, the South China Sea region is a source of conflict and widespread due to economic competition and the seizure of primary energy sources. Disputes between North Korea and neighboring countries have not subsided, of course, all of these conditions have led to a rise in primary energy prices that have a direct impact on Indonesia as a country that imports fuel and gas as a source of supply for power generation. This geopolitical condition forced the government to focus on the consumption of the domestic economy as a key driver of its national growth. Based on these challenges, the Indonesian government implemented a policy of energy self-sufficiency national focuses on saving energy consumption and maximizing use domestic energy resources.

Narratives Full of Light Industry

In this scenario, Indonesia is in stable political condition. No change in policies and programs for the construction of a 35.000 MW power plant will be continued by the Government. The government also provides regulatory support and incentives for the development of power plants sourced from renewable energy. The condition of the guaranteed primary energy supply causes the completion of the power plant construction project to run in accordance with the target. Electricity industry can grow and electricity consumption of society as well as business and industry sectors continue to increase which impact on the improvement of national economy. But there is a potential emergence of problems that need to be watched by the government. The priority of the national energy mix policy to increase the portion of renewable energy can lead to unhealthy competition between regions. This comes from providing incentives for renewable energy development that is tailored to the potential of each region.

Narratives Climbdown Industry

In this scenario, there is a potential for change in the direction of policy in the new government. All power stakeholders are working hard to draw up laws and regulations to follow up on public pressure on electricity subsidies, easier access to electricity, and development of power plants from renewable energy. But it is not accompanied by effective policy implementation and impact on the resignation of electricity infrastructure projects. The main issues are legal uncertainty, bureaucratic turmoil, unconformity between government institutions, and the actions of rare hunter speculators. This has resulted in declining economic growth and accompanied by a decrease in consumption of electricity both from home, business and industry sectors. This certainly affects the sale of electricity which also decreased and had an impact on PLN's financial condition in developing electricity infrastructure. There is a potential for postponing IPP electricity infrastructure development plans due to changes in power infrastructure development plans from PLN.

Narratives Blackout Industry

In this scenario, the electricity sector will face the most difficult situation as a result of the declining economic growth conditions accompanied by the emergence of problems in primary energy supply. The instability of the political condition and the policy of renewable energy that uncompleted yet has caused the dependence on the fossil fuel power plant is still high. While the price of primary energy in the world such as fuel, coal, and gas also increased, causing an increase in the cost of basic electricity supply. While the coal producers prefer to export out to get a bigger profit. The increase in the cost of electricity supply is causing the impact of electricity tariff increase. At the same time, the ability to provide electricity subsidy is also limited so that the increase of electricity tariff cannot be avoided.

Option Consideration

Scenarios for uncertainty that have been analyzed will give both opportunities and threats that is created from the external forces creation. In this stage will be given a list of strategies to implement and option to consider. Below is implications and options for each scenario.

Table 2.
Implication and Option

Scenario	Implication	Option
Alert Industry	Disruption of primary energy supply Limitation of primary energy supply 35.000 MW program will be delayed Electricity industry growth stagnant	Implementing Domestic Market Obligation Priority is given to the achievement of national energy self-sufficiency Accelerated Infrastructure development of CPP (coal processing plant) in Java, Sumatra and Kalimantan Perform fuel cost efficiency and purchase of electricity Setting up long -term contracts for gas supplies to power plants and accelerating the development of gas infrastructure Implementation of mine mouth power plant The utilization of natural gas at the mouth of wells (wellhead) for power generation The acceleration of strategic cooperation with renewable energy developers from other countries that have the ability to build renewable energy infrastructure at a more competitive price

Table 2.
Implication and Option

Scenario	Implication	Option
Full of Light Industry	Unconformity of central and regional policies The quality of human resources in the energy sector is not evenly distributed between the center and the region Electricity industry is more competitive and sustain Good financial condition in PLN and IPP	Maximize the potential of renewable energy in accordance with the potential of the local area Increased human resource capacity facilitated by the central government Build new power plant project with public private partnership scheme Accelerated completion of electricity infrastructure projects The acceleration of strategic cooperation with renewable energy developers from other countries that have the ability to build renewable energy infrastructure at a more competitive price
Climbdown Industry	Electricity industry is growing less rapidly PLN's financial condition has declined Electricity consumption decrease	Creating new electricity demand by accelerating the development of Special Economic Zones The simplification of non-subsidized electricity tariffs with capacities under 4400 VA into a 5500 VA group, so customers can more optimally use electricity for productive activities Acceleration of regulation and socialization related to the use of electric motorcycle Cooperating with educational institutions and also the business sector to research and accelerate the use of electric motors with good quality and competitive prices Addition of the construction of a general electric charging station for the needs of the electric motorcycle Set up a policy of providing targeted electricity subsidies Build new power plant project with public private partnership scheme The acceleration of strategic cooperation with renewable energy developers from other countries that have the ability to build renewable energy infrastructure at a more competitive price Setting up long-term contracts for gas supplies to power plants and accelerating the development of gas infrastructure Implement domestic market obligation (DMO) policy optimally Accelerating implementation of mine mouth power plant Accelerating the utilization of natural gas at the mouth of wells (wellhead) for power generation
Blackout Industry	Limitation of primary energy supply Electricity tariff increase Electricity industry weaken There is no new electricity infrastructure development Electricity consumption decrease	Perform fuel cost efficiency and purchase of electricity Providing targeted electricity subsidies The acceleration of strategic cooperation with renewable energy developers from other countries that have the ability to build renewable energy infrastructure at a more competitive price Clean coal technology and carbon capture storage (CCS) implementation Developing new power plant project with public private partnership scheme (PPP)

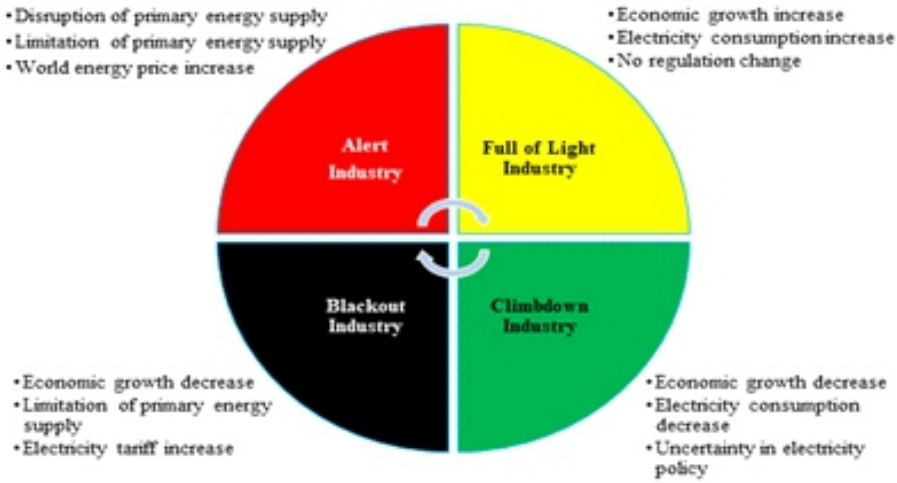

Figure 8.
Early Warning Signals

Integration
Early warning signals are signs of potentially significant impact that we can observe in order to determine if a particular scenario is beginning to thrive. By identification early warning signals, we can also determine our possible future direction. Above are early warning signals for each scenario.

Conclusion

Currently the electricity industry in Indonesia is under the Climbdown Industry Scenario with a downward trend in economic growth. This is evident in 2011 with an economic growth of 6,5% to only 5,02% in 2016. The decline in economic growth resulted in a decrease in the level of electricity consumption from the household, business, and industry sectors. This certainly affects the decrease of electricity sales revenue and impact on the financial condition of PLN in the development of electricity infrastructure. With the goal of research not only adapting to future uncertainty, but also being able to transform from the current condition of the Climbdown Scenario to move into Full of Light Scenario. Referring to Adam Kahane (2013), there are four steps that have been done to implement transformative scenario planning, such as conducting interviews with experts in the electricity sector, analyzing current electrical issues, compiling four scenarios along with detailed narrative of the situation that will occur, and determining the implications of the problems that will occur along with the options of solution to overcome them. So the last step that must be done is to take action to change the system. Some recommendations that can be implemented are creating new electricity demand policy and Ensuring security of primary energy supply becomes a sustainable policy, see figure 9.

Creating new electricity demand policy can be done by building a scattered special economic zones that has been equipped with reliable electricity infrastructure. It aims to increase the interest of industry and business sector to develop their business in the special economic zones so that the electricity consumption and economic growth will increase. Creating new electricity demand policy can also be done by the simplification of non-subsidized electricity tariffs with capacities under 4400 VA into a 5500 VA group, so customers can more optimally use electricity for productive activities, such as using an electric stove and also for the purposes of electric motor charging. Furthermore, creating new electricity demand policy can also be done by acceleration of regulation and socialization related to the use of electric motorcycle.

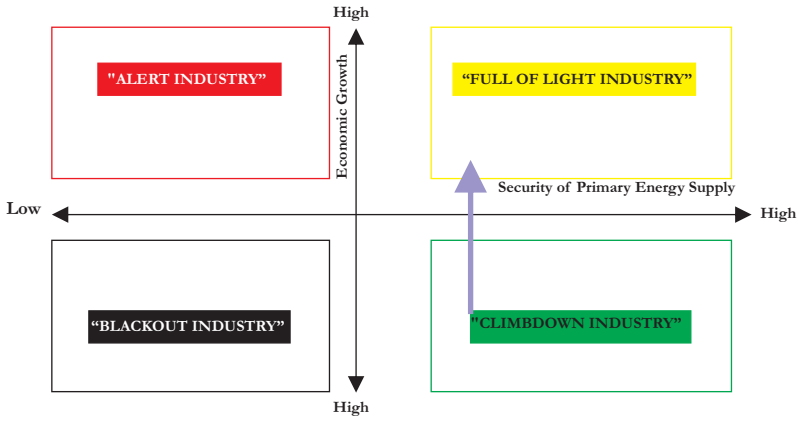

Figure 9.
Transformative Scenario

This is as one step to reduce the impact of emissions and also able to improve Indonesia's electricity consumption, cooperating with educational institutions and also the business sector to research and accelerate the use of electric motors with good quality and competitive prices, addition of the construction of a general electric charging station for the needs of the electric motorcycle, set up a policy of providing targeted electricity subsidies with the aim of providing electricity subsidies only for lower economic society such as 450 and 900 VA household group and build new power plant project with public private partnership scheme.

Meanwhile, ensuring security of primary energy supply becomes a sustainable policy can be done in several ways. Firstly, it can be done by the acceleration of strategic cooperation with renewable energy developers from other countries that have the ability to build renewable energy infrastructure at a more competitive price. This is done to reduce dependence on fossil energy and be self-reliant with renewable energy in the future. Secondly, ensuring security of primary energy supply becomes a sustainable policy can also be conducted by setting up long-term contracts for gas supplies to power plants and accelerating the development of gas infrastructure. Furthermore, it can be achieved by implementing domestic market obligation (DMO) policy optimally, accelerating implementation of mine mouth power plant and accelerating the utilization of natural gas at the mouth of wells (wellhead) for power generation.

Suggestions for further research

Need to conduct a study of energy mix in Indonesia focusing on the use of new and renewable energy with scenario planning approach so that it can know the implications and options what will happen until the year 2050.

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