Indonesia energy security concept to improve sustainability of new and renewable energy utilization in Indonesia with quintuple helix model: 4A+1S for national defense

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Abstract. The scarcity issues of fossil fuels prompted the government to formulate and establish a National Energy Policy (Law No. 79/2014), which targets that by 2025 the national energy needs of 23% will be met by new and renewable energy (NRE). Meanwhile, the condition of NRE utilization in Indonesia is still low, which is around 9%. A qualitative approach is a methodology used in this paper. The data used are secondary. The result shows that the development of the diversity of NRE utilization in each region in Indonesia based on the availability of potential local energy resources. The Concept of Energy Security (4A+1S: Availability, Accessibility, Affordability, Acceptability, Sustainability) in a quintuple helix model can optimize the use of NRE. It can increase the triple helix model of National Defense (Sovereignty, Integrity, and Safety), improving the roadmap and the role of local content mapping. Both are based on geographical, demographic, and lifestyle of the community, so that it can use as a reference in the plan to develop national long-term diversity of energy use of local and national government.

1. Introduction

Energy plays a vital role in sustainability of the state in the present and future. The condition of Indonesia's energy in realizing energy security currently still has many problems. One of it is dependence on fossil fuels, gives an impact on the low of renewable energy usage, that is 5.3% in 2013, 6.4% in 2014, 6.7% in 2015, 7.7% in 2016, 8.43% in years 2017 and the target to reach 9% by 2018 [1]. The development of NRE used in Indonesia in period of 2015-2019 is 9.15% [2]. According to the government's programs in nawacita, which includes support for the availability of long-term energy supply and make it secure for national defense, by realizing energy security through sustainable renewable energy development or environmentally friendly Sustainable Development Goals (SDGs), including Indonesia. The Indonesian government, through the target of primary energy mix (25% petroleum, 22% natural gas, 30% coal and 23% NRE) by 2025, has a strong desire to realize the SDGs for national energy independence and security.

In the Indonesia Energy outlook 2019 [1], the government continues to strive to increase the role of using NRE to achieve Indonesia's energy independence. Some of the efforts implemented by the
government are implementing policies on the use of NRE, including Peraturan Presiden No. 4 Tahun 2016 (Pasal 14) concerning the acceleration of electricity infrastructure. Also, the government issued a policy to encourage the use of biodiesel based on Permen ESDM No. 41 of 2018 concerning the use of Biofuels in various sectors. The biofuels consist of 20% fatty Acid Methyl Ester (FAME), mixed with Oil Fuel (BBM) or also known as B20 [3]. According to keep the national stability, the government needs to meet the needs of fuel of Indonesian Army. For example, to fill the fuel needs for combat equipment and submarines operational. The average needs per year are around 627 thousand-kilo liters (kl) [4]. The increase in the number of Indonesian army’s defense equipment will undoubtedly increase the demand for fuel. The importance of energy supply security is not only realized by the Indonesian government, but it has become an international issue. The International Energy Agency (IEA), an international organization that has focused on dealing with energy security, made a strategic decision that obliged countries to have energy buffer reserves for 90 days to avoid an energy crisis that could be caused by various factors. Energy buffer reserves represent the amount of energy and availability of the energy sources stored nationally that can use to meet energy needs within a particular time. Indonesia is one of the countries that stored energy as buffer reserves; it aims to avoid chaos due to the absence of an energy supply. Until now, Indonesia's oil buffer reserves only can cover the energy need up to 30 days. This data illustrates that the level of dependence of Indonesia's defense system on fossil fuels is still very high. Therefore, the use of NRE needs to rise to increase Indonesia’s independence in the energy sector to support national defense [5].

The use of NRE in Indonesia is an alternative substitute for fossil energy, proven friendly to the environment, with many natural resource potentials owned by Indonesia so that it can reduce dependence on other countries. Energy sector is also an important sector in national development and a component that has a considerable influence on social, economic, political and defense and security issues of a country, especially Indonesia. Energy availability has a significant impact on Indonesia's economic growth [6]. Currently, Indonesia has entered the era of the Industry 4.0 Revolution, where digitalization has occurred in various fields, including economic activity. The acceleration of digitization has accelerated by the COVID-19 pandemic; thus, the need for all sectors for electricity supply will be even higher. To maintain the stability of the country, the aspects that can fulfill energy security must consider, because it is closely related to the national security of the Indonesian State. Energy security is the ability of a country to provide energy nationally by maximizing the sustainable use of its local natural resources potential [7]. Therefore, this paper will examine the concept of national energy security, which is necessary for the welfare of the people and improving the national defense system.

2. Method
This research categories as literature review, which defines as a set of research related to the method of collecting literature or research data, with the object of research studied through observation on previous research. The data collected through various literature (scientific journal and document) that studies or critically-review knowledge, ideas or findings of academic-oriented literature. Also, the literature formulates theoretical and methodological contributions for specific topics. Hence, it can categorize as a literature review comprises meta-synthesis descriptive qualitative technique. The stages of the literature review with the meta-synthesis descriptive qualitative technique as follows: (1) Organize and formulate i.e., organizing, formulating, and conducting the kinds of literature that will review. The literatures selected based on its relevance to the theme of the literature review. The organizing stages are kinds of literature: identifying the ideas, general-purpose, and conclusion of the literature by reading the abstract, some of the introductory paragraph, and its conclusion, as well as grouping the kinds of literature based on specific categories; (2) Identify; i.e., identifying the controversial issues of the literature. The Controversial issue is deemed essential to be analysed to produce an interesting article to read; (3) Synthesize and analyse qualitative findings; i.e., combining the result of literature
organization into an integrated summary by looking at the intertextuality between the literature; (4) Present findings; i.e., maintaining quality control and presenting the analyzed [8].

3. Results and Discussions

3.1. The concept of energy security, national security and national defense

The importance of energy to support the stability of a country makes the energy sector become an exciting sector to discuss. To achieve energy security in a country, it is not enough just the role of the government. However, public intervention is also sufficient to support the realization of energy security nationally [9]. National Energy Security is a condition that guarantees the availability of energy, public access to the energy sector at affordable prices in the long term, and sustainability while still paying attention to environmental protection.

Furthermore, Indonesia’s energy system must include the 4A + 1S concept, includes:
(1) Availability of the energy sources, meaning Indonesia must be able to meet the energy needs evenly in all Indonesia area
(2) Accessibility, the available energy means that the energy must be able to be accessed by all Indonesians throughout the territory of the NKRI (Negara Kesatuan Republik Indonesia), Indonesia's topography, which consists of archipelagic areas is a challenge for distributing final energy to the community
(3) Affordability, means all Indonesian people must be able to access the final energy at affordable prices
(4) Acceptability, means where all energy users must accept the kinds of energy used. Both in terms of exploitation and terms of utilization. Besides, along with environmental issues struggling for by the world today, the kinds of energy used must also well correlated with the environment
(5) Sustainability, means the energy source used must be able to be used continuously in the long-term and sustainable [10]. To describe the concept showed in Figure 1. The pyramid shows the energy concept of the quintuple helix model: 4A + 1S.

![Figure 1. The concept of energy security with the quintuple helix 4a + 1s model consists of; (1) Availability, (2) Accessibility, (3) affordability, (4) acceptability and (5) sustainability.](image)

National Defense is a condition of a country that has the ability, deterrence, and resilience in facing and overcoming all forms. They are threats, disturbances, obstacles and challenges from all aspects of life (asta gatra), to ensure the continuity of the nation and state. The astra gatra aspect divided into three dimensions, i.e., natural resources, geography, and demography. It also have five factors: ideology, politics, economy, socio-culture, and defense-security) [9]. In UU No 3 Tahun 2002, it stated that State Defense is all efforts to defend the sovereignty of the state, the territorial integrity of the NKRI, and the safety of the entire nation from threats and disturbances to the integrity of the nation and state, which arranged, in a universal system [11]. One manifestation is the attitude of State Defense, as attitude and behavior of citizens. It animated with their love for the Republic of Indonesia, which base on Pancasila and the 1945 Constitution. This country ensuring the survival of the nation and state, which showed in Figure 2 and 3.
National Energy Security adopts the 4A + 1S concept in the form of a quintuple helix prism model. It realizes by the development of an energy infrastructure system to brace up the ideology, politics, economy, social, culture, defense and security in the triple helix model of National Defense (Sovereignty, Integrity and Safety). It is seen by the hexagonal State Defense Model (love the country, willingness to sacrifice for the country and the nation, believe that Pancasila is the state ideology, have national and state awareness and have the initial ability to defend the state, both physically and psychologically). Both triple helix model and hexagonal State Defense Model can involve integration in each energy stakeholder by involving industry, defense, state-owned enterprises, academics and the public. It gives a reflection of the values of defending the state and support aspects of national energy. Security encompasses 4A + 1S, which supports the realization of State sovereignty from territorial integrity and national safety as stated in the *UU Pertahanan Negara No 3 Tahun 2000.* It showed in Figure 4.
3.2. Effective efforts to support the acceleration of NRE use 23%
There are several practical efforts to support the acceleration of the use of NRE 23% in realizing energy security in Indonesia, including:

(a) Forming a separate NRE business entity assigned by the government to develop, utilize, and purchase NRE, after each region has a regional energy general plan as a potential use of local resources.
(b) Implementing and improving feed-in rates from NRE generators to electricity business entities that apply as long as NRE electricity is higher than the price of electricity from other primary energy sources.
(c) Prepare guidelines for the provision of energy subsidies by local governments, which budgets are in the local budgeting.
(d) Budget for sustainable renewable energy infrastructure development for villages that will not electrify in the long term.
(e) Assigning national infrastructure financing institutions to finance NRE development projects.
(f) Develop a small power system based on NRE for electricity supply in areas that are not covered by grid expansion.
(g) Strengthening regulations and legislation, including synchronization of the laws and regulations and revised regulations that hinder investment and production of NRE.
(h) Intensification, development of energy infrastructure, diversification and conservation energy are steps taken as an effort to accelerate the use of NRE 23%.

In more detail, they help to improve availability, by implementing energy intensification policies by increasing the achievement of the non-fossil energy mix. Also, it is necessary to pay attention to the development of infrastructure and energy access that can support energy diversification by developing NRE. Table 1 shows an overview of potential of NRE in Indonesia.

| Kinds of Energy | Potency          |
|----------------|------------------|
| Hydropower     | 94.3 GW          |
| Geothermal     | 28.5 GW          |
| Bioenergy:     |                  |
| Bio Power Plant| 32.6 GW          |
| Biofuel:       | 200 Thousand Bph |
| Solar          | 207.8 GWp        |
| Wind           | 60.6 GW          |

3.3. Lessons from other countries for energy security
Reflecting on several other countries in managing energy, if we study more deeply, there are many things that we can take as lessons in energy management. So that Indonesia can maintain national defense and stability, especially in energy supply. German and Japan are countries that can become examples of managing the energy are limited resources country [12].

Germany is a country that limited natural resources. They concentrate more on developing renewable energy technology as an effort to secure its energy supply, but on the other hand, contribute to the creation of sustainable development. Learning from the oil crisis in 1973, the German government began to change their energy security strategy by investing their national budget for research and development of renewable energy technologies, especially solar power and turbines. In the late 1980s, the solar and turbine power program became the largest in Europe.

Entering the year 2000, the German government began developing biofuels as a step to reduce fossil fuel consumption by intervening in policies from the farmer level to market and create synergies between industry and scientists. Efforts to develop and renewable energy use cannot separate from the support of non-governmental organizations and political parties after the oil crisis, energy policy in Germany focused more on the use of coal and nuclear power. Since the mid-1970s, the German Society has protested and asked the government to focus on energy efficiency and the use of renewable energy.
In 1982, there was a significant increase in budget allocation for renewable energy, namely by 20 million to 300 million billion.

Germany focuses on developing wind and solar energy turbines. About 40 researches are funded by industry and academic organizations for small to medium scale turbine development. Eighteen universities, 39 companies, and 12 research institutions receive funding from the central government. The German government provides subsidies for at least 14 wind turbine suppliers. Germany received 124 turbines in the 1983-1991 periods. This program is an essential part of the smallest national market in the 1980s, with a total installation of 20 MW at the end of 1989. The existence of Eurosolar is an organization that campaigns for renewable energy in a political structure that is independent of political parties, companies and interest groups even though some of its members are members of the German parliament from various parties. The support from various organizations, together with the parliament, encourages the government to implement renewable energy policies. Germany has also started trying to switch gasoline to biofuels as a recommendation from the European Union to increase the use of renewable energy in all sectors.

In 2002, the German parliament decided to exempt all biofuels from the fuel tax. This exemption was implemented until the end of 2009, and the government is required to report on progress. It introduces the biofuel market and developments in the prices of biomass, crude oil and other fuels annually so that they can be adapted if needed. Not only tax exemption, but the German government also intervenes in the market with the existence of a national market body, the Federal Monopoly Administration for Spirits (Bundesmonopolverwaltung für Branntwein). It is responsible for buying and marketing ethanol produced from agriculture and having a strong influence on the bio-ethanol market.

Japan experienced severe problems in the 1970s due to energy disruption supplies following the 1973 oil crisis. The impact of the hampered energy supply included the absence of domestic natural resources in the form of energy, causing Japan not to face many competitors. In obtaining energy supplies during the cold war, Japan faces the possibility of disruption to energy supplies from the Middle East, as Japan's largest oil supplier. It happened because of political instability in the region after the Iraq war, which still leaves acute problems, as well as the threat of terrorism.

Japan's efforts to improve the country's Energy Security are utilizing state diversification and fundamentalism. In more detail, several ways that Japan has taken to maintain the stability of its national energy supply include reducing dependence on imported oil by diversifying energy from oil to natural gas, coal and nuclear power. Japan also continues to seek energy sources in new areas as an effort to diversify geographically. Countries such as Russia, Central Asia and Africa will become Japan's new priorities in its energy security policy. Also, Japan is actively increasing its own needs by developing new techniques for gathering energy, such as solar or wind power technology. However, the scope of development is still minimal due to high production costs and the need for natural weather conditions.

4. Conclusions

The concept of national energy security (4A + 1S) needs to improve the welfare of the people and improve the national defense system. It was realized through significant efforts to utilize the potential of local regional resources in supporting the accelerated use of NRE. This is actively supported by the central-regional government, state-owned, private industries, academics, and society in the synergy of state defense in national defense. Strong energy security will be one of the factors that support Indonesia’s national energy security.

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