



Challenges and opportunities: application of clean and affordable energy in the development of the national capital of the archipelago

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Article Info:

Received: 31 - 08 - 2022

Accepted: 21 - 09 - 2022

Keywords:

Affordable energy, clean, hydroelectric power, Kayan River

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Abstract. *IKN is in a good and sufficient position in terms of energy security, especially in terms of renewable energy. To prevent harm to Kalimantan's ecology and natural beauty, it is vital to pay attention to and routinely check factors of energy efficiency and emission levels. This research aimed to look at the challenges and opportunities of implementing clean and affordable energy in the development of the National Capital of the Archipelago. This study used qualitative research methods that described the findings through online media, and the data source of this research is online news media. The data was obtained using the Ncapture feature on the Nvivo 12 Plus. The results of the study showed that the development of the Kayan River Hydroelectric Power Plant encourages economic development by as much as 37%, environmental development by as much as 35%, and social development by as much as 28%. Then the second challenge of hydropower development is environmental development, as much as 33.33%. The third challenge is economic development, which is 31.82%. Kayan hydropower construction will consist of five dams, the first phase will produce a 900-megawatt dam, the second dam of 1,200 megawatts, the third dam of 1,800 megawatts, the fourth dam of 1,800, and the fifth dam of 3,200 megawatts.*

How to cite (CSE Style 8th Edition):

Vayed DA, Purnomo EP. 2023. Challenges and opportunities: application of clean and affordable energy in the development of the national capital of the archipelago. *JPSL* 13(1): 102–113. <http://dx.doi.org/10.29244/jpsl.13.1.102–113>.

INTRODUCTION

This study aims to look at the challenges and opportunities of implementing clean and affordable energy in the development of the capital city of a new country (Teo et al. 2020). Clean and affordable energy is indeed an essential need for humans today. The application of clean and affordable energy does not only focus on the energy source but also has to take advantage of how the presence of this energy can positively impact the ecosystem. Environment, sustainable development, and economic growth (Knez et al. 2022). Non-renewable energy is a hot topic currently being discussed globally because the available energy has begun to decrease (Fadhlorrohan et al. 2020). Therefore, Sustainable development goals are a solution to developing clean and affordable energy for all humans (Khairina et al. 2020).

Sustainable Development Goals (SDG's) have seventeen indicators, one of which is clean and affordable energy (Truby et al. 2022). In essence, energy can be divided into two types: renewable and non-renewable. Renewable energy is produced from sustainable energy sources (Berg et al. 2020). Examples of renewable energy are wind power, solar system power, geothermal, water, sea tides, biogas energy, biofuel and biomass, which are classified as clean energy classified as energy sourced from renewable energy which is controlled

by the state and used for the greatest prosperity of the people (Adzikri et al. 2017). The state controls energy products in Indonesia based on the constitution article 33 paragraph 3, which reads that the earth, water, and natural resources contained therein are owned by the state and used for the greatest prosperity of the people. The article emphasizes that there are three essential elements, namely the earth, water, and the natural wealth contained therein (Azhar and Satriawan 2018).

Clean and affordable energy is a sustainable development goal of the State of Indonesia in 2030 (Setyono et al. 2019). Clean and affordable energy is a sustainable development goal of the State of Indonesia in 2030 (Setyono et al. 2019). Based on data from the Ministry of Energy and Mineral Resources, the potential for renewable energy in Indonesia reaches 417.8 gigawatts GW, the largest energy source from the energy potential of the solar system or the sun, which is 207.8 GW. Furthermore, the position of the two energy sources from water or hydroelectric power plants has a potential power of 27 GW, and other EBT potentials from the ocean or ocean currents as much as 17 GW, geothermal 23.9 GW, Bayu 60.6 GW, and 32,6 GW of bioenergy (Augustone and Pamungkas 2020). Especially in the capital city area, new countries have started implementing clean and affordable energy sources to maintain environmental ecosystems, sustainable development, and economic growth (Sobur 2005). Seeing the large reserves of energy sources owned, especially clean and affordable energy, there is no concern about the supply of energy in the new proposed Capital Region of the Archipelago (Mutaqin et al. 2021).

Along with increasing population and economic growth, electrical energy is increasing rapidly (Arora et al. 2021). The relocation of the new state capital to Kalimantan Island is part of this, which is in dire need of large amounts of energy and the implementation of clean and affordable energy systems such as water and solar after the establishment of Kalimantan as the capital of the archipelago (Chuliá-Jordán et al. 2022). Energy management must be carried out wisely and requires appropriate and thorough strategies to be able to provide value for environmental ecosystems, sustainable development, and economic growth (Purnomo et al. 2021).

The relocation of the nation's capital city in the Kalimantan area has had careful consideration. The right decision has the characteristics as intended in the various policy products, namely a large land area, and most of it is still in the form of forest, water areas consisting of river and sea areas as well as airspace in the area so that it becomes an excellent opportunity to build clean and affordable energy sources (Shimamura and Mizunoya 2020). The opportunity to develop clean and affordable energy sources in IKN (*Ibu Kota Nusantara*/ Capital City of Nusantara) must also be considered. Some challenges must be faced in the development of IKN, forest degradation in the IKN is caused by the use of forests in the IKN area as non-forestry such as settlement areas, mining, and even there is a threat to animal habitat in Kalimantan, which is one of the habitats for protected or essential species of animals and plants, has the potential for carbon emissions and forest clearing plantations. Sourced from secondary forest 29 thousand tons CO₂ Equivalent and plantation forest 154 thousand tons CO₂ Equivalent, and has the potential for flooding, especially in IKN areas that are prone to flood disasters, such as in Sepaku, Samboja, and Muara Java Districts and especially around watersheds (Mutaqin et al. 2021).

It should be noted that Kalimantan is the world's lungs that function as oxygen producers, carbon dioxide absorbers, and global climate balancers (Andriyani et al. 2018). As a territorial unit, the first step in spatial and regional planning is to analyze and identify the various characteristics of the space and region (Ogundipe et al. 2021). Especially in the construction of clean and affordable power plants to meet the energy needs of the new state capital area to ensure a region whose development direction remains environmentally oriented, constructive and planned arrangements to analyze regional development for the long term (Burke and Siyaranamual 2019).

The development of electrical energy sources in the capital area of the new state of Indonesia by utilizing the large rivers in Kalimantan, starting with the use of the Kayan River, which is one of the largest rivers in Kalimantan, which is equipped with the construction of a long-distance transmission network that connects it to the Kalimantan interconnected transmission system (Herdiana 2020). Other significant rivers are also

utilized to support electricity in the capital area of the new state of Indonesia utilizing the Mahakam river in East Kalimantan and Barito in South Kalimantan, and the Kapuas river in West Kalimantan (Herdiana 2020).

The dynamics in national development, especially in building clean and affordable energy sources, often face various weaknesses. On the one hand, it is expected to be able to improve the quality of people's lives and reduce dependence on non-renewable energy. Still, on the other side, the risks that must be faced are that it can cause concerns about the declining quality of the environment in the long term (Iqbal and Piwowar-Sulej 2022). This concern shows the development of the New Capital City, which makes clean and affordable energy the primary energy source in providing access to electricity to evenly distribute electrical energy in the new capital city of Indonesia so that it can have an impact on environmental threats to the surrounding population (Klemm and Wiese 2022). Observing the various problems between environmental exploitation that have an impact on the activities of the surrounding community and, on the other hand, improving human welfare is absolute. In the end, the environment as a material resource cannot be avoided from exploration and exploitation, which have implications for the community environment, which many people consider a violation of human rights (Alm et al. 2022).

Social, economic, and environmental preservation are the three pillars of sustainable development. Sugandi explains that the three main pillars are interrelated (Mansour et al. 2022). The economic pillar explains that the development of hydroelectric power plants in the new capital city of Indonesia must be seen from the development of solid infrastructure and sanitation facilities, water availability, reducing gaps between countries, and increasing inclusive economic growth (Holmlid 2022). The pillar of social development that must be seen in the process of developing this hydroelectric power plant is whether the hydropower plant built in the capital area of the new state of Indonesia can build a healthy and prosperous life for the community around the hydropower development area (Nabaloum et al. 2022). Meanwhile, in the environmental development pillar, it is seen from the extent to which the development of this hydropower plant affects the surrounding environment, such as sustainable urban and settlement development, handling the impacts of climate change, and the provision of clean water and proper sanitation. The environment in the general framework of upholding "Good Governance" (Okoroafor et al. 2022)

Developing clean and affordable energy in the Capital Region of the Archipelago, every process of developing clean and affordable energy sources, especially hydropower plants, is always based on the proper foundation for development, and challenges are often encountered in the development process (Sevin 2014). Previous research articles by Hanan Nugroho discussed Moving the New Capital City of the Unitary State of the Republic of Indonesia to East Kalimantan: Strategy for Meeting Energy Needs and Consumption (Nugroho 2020). Therefore, this research is more focused on assessing the challenges and opportunities faced by the government in building clean and affordable energy (hydropower) in the Indonesian capital so that they can maintain environmental ecosystems, social development, and economic growth based on three main pillars. Sustainable development impacts the government so that the process of developing clean and affordable energy sources for the capital city of the new country can run smoothly, and the development process is by the targets to be achieved. This research looks at it from the point of view of sustainable development theory.

METHOD

A method used in this research was a qualitative method. It aimed to describe the data obtained in a systematic, factual, and accurate manner regarding the facts contained in a text of news information by the media (Soehardi et al. 2021). This research data was secondary data obtained from online news media relevant to the studied research. Table 1 shows the sources of news analyzed by researchers related to the construction of the Kayan river hydropower plant in IKN.

Based on the table, we can see that researchers analyzed 6 online media. This study used the six online news media, of course, by looking at the online media brand trust (Strömbäck et al. 2020), and has high credibility based on Semrush, which was an online-based software to assist in planning and implementing

efforts in SEO (search engine optimization), SEM (search engine marketing) and social media research and video advertising. Semrush also updates the ranking of news websites (sites) or online media worldwide, including in Indonesia, every day. Furthermore, the stages of data analysis can be seen in Figure 1.

The data was obtained using the Ncapture feature on the Nvivo 12 Plus. The Ncapture feature is a web browser extension developed to capture web content in the form of the website content, social media, and other document content, such as scientific articles. Analyze Nvivo 12 Plus using the crosstab query analysis feature. This feature shows the percentage of news data coded manually using the NVivo 12 Plus feature. Next, the author uses word cloud analysis, one of the Nvivo12 Plus feature tools, to see words or concepts that often appear in research files to visualize and collect data/words that have similarities and differences.

Table 1 Online media sources

Online media	Website	Media consumption	Brand trust online media	News related to Kayan hydroelectric power plant development at IKN
Detik.com	https://www.detik.com	65%	61%	50
Kompas online	https://www.kompas.com	48%	65%	48
CNN.com	https://www.cnnindonesia.com/	35%	66%	40
Sindo News	https://www.sindonews.com	16%	49%	42
Tribunnews Online	https://www.tribunnews.com/	32%	52%	53
Metro Tv News Online	https://www.metrotvnews.com/	28%	55%	44

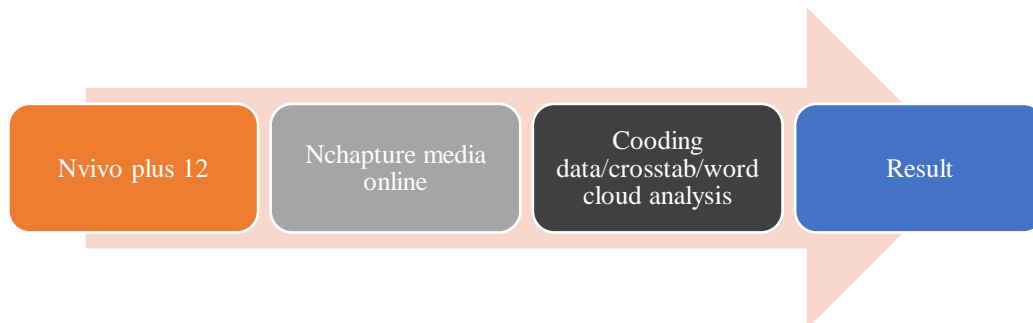


Figure 1 Data analysis techniques

RESULTS AND DISCUSSION

Application of clean and affordable energy for the Capital of the Archipelago

The discourse of moving the capital city of a new country has been carried out with various careful considerations even since the era of President Soekarno. The Kalimantan region has become the right solution to replace Jakarta as the capital city of Indonesia (Tukimun 2022). The choice of the Kalimantan region was the proper consideration. Apart from being safe from earthquakes, the large area, the Kalimantan region, became a strategic area with a geographical location in the middle of Indonesia (Muazir and Hsieh 2021). As stated by Daryono on August 10, 2022, the reasons for moving the capital city of the new country of Indonesia are based on several aspects, better environmental quality, equitable distribution of the economy and population, the carrying capacity of the surrounding environment, safe from significant disasters, availability of energy, amid the territory of the Republic of Indonesia, representation of national identity, and the risk of

minor disaster impacts (Omar 2004). As the capital city of a new country (which will not only support its function as a centre for government administration), the population of the city does not rule out the possibility that it will increase in the future, around the capital city area will become the center of various kinds of economic activities that will continue to grow (Wahyudi et al. 2019).

The demand for energy needs to be used along with the construction of the new capital city project, all of which will increase the need for resources, including clean and affordable energy (Syahroni et al. 2020). The fulfillment of energy for Indonesia's new state capital is one of the drivers of government administration, including developed public services such as education services, hospitals, malls, etc. (Raman et al. 2019). Without energy, no activity can be carried out. The capital cannot carry out its functions properly if the energy supply and utilization system does not run optimally, especially clean and affordable energy, because the capital city of the archipelago nation in East Kalimantan will later be planned to become clean and affordable energy as the main energy source in Indonesia. organization of activities in the capital city of the Archipelago (Latifah et al. 2021).

The application of clean and affordable energy sources in the new nation's capital city has conducted studies in Penajam Paser Utara and Kutai Kartanegara, East Kalimantan. The study results show that the Kayan river hydropower plant is one of the electricity suppliers for the new capital city, and it has been analyzed in detail by Bappenas as a supporting capacity for the development project for the new capital city of Indonesia. As stated by Moeldoko, the presidential staff, "We hope that the Kayan River Hydropower Plant will be able to produce large enough electricity, which is not too far from the East Kalimantan River. So I think it's been calculated" (Sulistiyono 2019). The Kayan river hydroelectric power plant will be built in five stages (Figure 2).

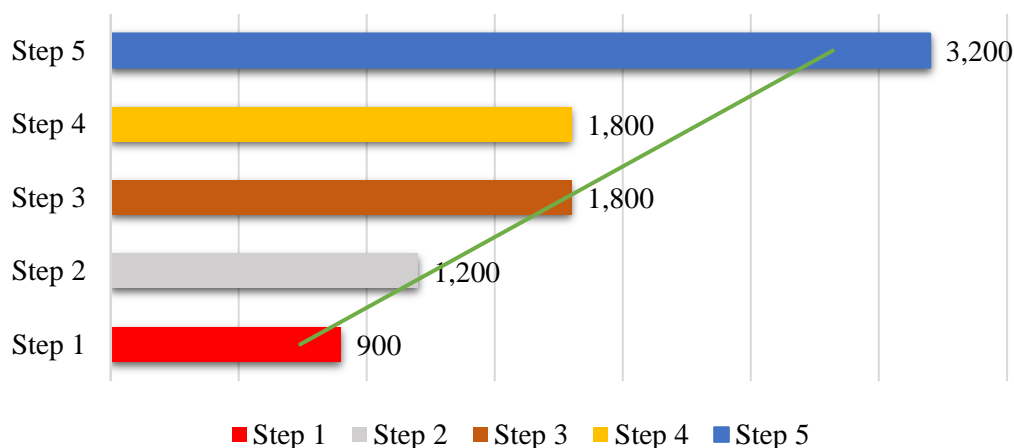


Figure 2 The stages of development of the Kayan river hydropower plant
(Source: PT. Kayan Hydro Energy (KHE))

The potential of the Kayan river can be seen in its swift current. Based on a survey conducted by PT Indonesia Dafeng Heshun Energi Industri (IDHE) in 2019 showed that the Kayan River, located in Bulungan Regency, has a potential water flow of 1,000 m³ per second which is capable of generating up to 1,000 megawatts of electricity through a hydroelectric power plant and flanked by a hydroelectric power plant. Stones and water discharge never run out (Mahendra 2019). Therefore, the development of the Kayan hydropower plant is the development of a clean and affordable energy source to meet the energy needs of the Indonesian capital in 2024.

The Kayan hydropower plant will consist of five dams, the first phase of the dam (Kayan 1) will be built to produce 900 megawatts, the second dam stage (Kayan 2) is 1,200 megawatts, the third dam (Kayan 3) 1,800 megawatts, the fourth dam (Kayan 4) 1,800, and the fifth dam (Kayan 5) 3,200 megawatts. The construction of this project is included in the national strategic plan based on presidential regulation number 58 of 2018.

Based on Figure 3, The Kayan River has a relatively swift current in the upper reaches of the river with a grade or above average difficulty level. The Kayan River can also be used as a whitewater rafting tourist attraction. More than 20 villages (Log Lejuh, Long Peleban, Pejalin Untutan, Mara, Njilung, Lembuh, Njurang, Long Njoerang, Puak, Long Biyah, Basahan) where the Kayan river passes that have different sub-tribes at a glance use the same language.



Figure 3 Map of the Kayan River hydropower dam (Source: Rain Forest Journalism Fund 2021)

The opportunity for developing the Kayan River Hydroelectric Power Plant as an energy source for The Capital of the Archipelago

Indonesia is committed to developing clean and affordable energy use in the new capital city of Indonesia, based on the topography of the island of Kalimantan, which is fed by a large river, one of which is the Kayan River. Thus making the Kalimantan region a source of potential water energy that is quite large. The Indonesian government continues to pursue its target of efforts to achieve clean and affordable energy in the new capital city of Indonesia, one of which is through the construction of the Kayan River Hydroelectric Power Plant located in Bulungan Regency, North Kalimantan. The structure of mega projects carried out by the Indonesian government has been carried out with very mature preparations with clear policy directions. The national strategic plan has included even the Kayan river hydropower plant. Building a rich hydropower plant to realize clean and affordable energy must see what opportunities are created to implement sustainable development based on the three pillars of sustainable development. As defined by the United Nations, sustainable development is a development process that does not only cover land and cities. Still, it must look at all elements, including economic, social, and environmental development (Pokharel et al. 2021). The opportunities for the development of the Kayan river hydropower plant can be see in Figure 4 and 5.



Figure 4 Word cloud with The Nvivo Application about Kayan River Hydropower Plant development opportunity

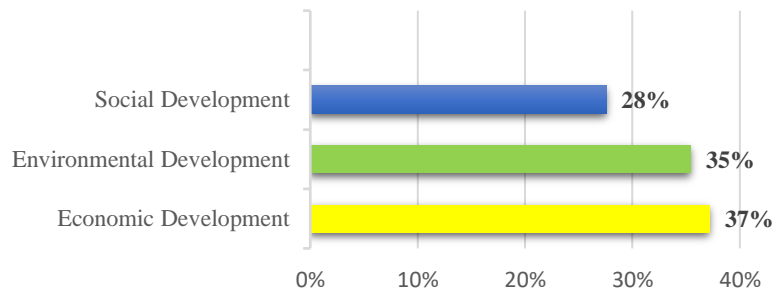


Figure 5 Kayan River hydropower plant development opportunity
(Source: processed data used by The NVivo Application)

Figures 4 and 5 shows that the significant opportunity in the development of the Kayan river hydropower plant is the opportunity for economic growth, which is as much as 37%. PT Kayan Hydro Energy (KHE) has stated that it will develop clean and affordable energy by developing the Kayan Cascade Hydroelectric Power Plant (PLTA), which consists of five developments. The dam is located on the Kayan River, Peso District, Bulungan Regency, North Kalimantan Province. KHE Khaerony, as the Director of Operations, noted that the total investment value of KHE for this hydropower plant reached 17.6 billion USD from the hydropower target for the construction of each dam. Kharony also stated that the Kayan river hydropower target was by the initial planning, namely construction completed in 2025 and the commercial operation date (COD) stage in 2026 (Muhammad 2021).

The second opportunity is the opportunity in environmental development, as much as 35%. The Kayan River Hydroelectric Power Plant's story considers the sustainability of ecological growth by providing environmentally friendly energy compared to fossil energy, which can damage the environment. Kayan river hydropower can also maintain ecological sustainability and does not have the potential to emit excessive greenhouse carbon emissions like other power plants (Sulaiman et al. 2021). The last opportunity is social development, as much as 28%. Kayan river hydropower development is also encouraged to have an influence on social development for the surrounding community; with the Kayan river hydropower plant expected to be able to supply electricity to rural community groups who have not been touched by electricity so that equal distribution of energy can be realized at a low price to improve the social welfare of the community and to realize sustainable development, besides that the Kayan river hydropower dam can be used as a tourist destination, the reservoir tourism potential can provide additional income for the surrounding community (Sulaiman et al. 2021).

Based on the results of the word cloud analysis, it can be seen that the news media narrative is dominated by one word, and the highest word range is "PLTA (*Pembangkit Listrik Tenaga Air*; Hydroelectric Power Plant)", with a word count of 742 words. In addition, there is also the word "Kayan", and the result is 631. From this section, it can be seen that the news media uses well-known phrases such as "PLTA" to become a popular word used in the issue of the development of the Kayan river hydropower plant.

The Challenges of Developing The Kayan River Hydroelectric Power Plant as an Energy Source for the Capital of the Archipelago

Developing a large-capacity energy source is inseparable from a challenge often faced, including creating the Kayan River Hydroelectric Power Plant. The development of the Kayan River Hydroelectric Power Plant will be projected as a dominant source of electrical energy in the national energy system because the Kayan River Hydroelectric Power Plant can accommodate a considerable electricity capacity, especially in Southeast Asia. The challenges faced in the construction of the Kayan river hydropower plant are seen in Figure 6 and 7.



Figure 6 The challenges of Kayan River Hydropower Development

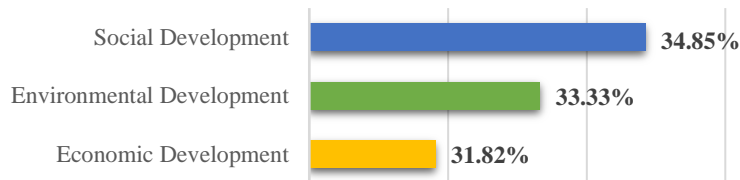


Figure 7 The Challenges of Kayan River Hydropower Development (Source: processed data used by The NVivo Application)

The graph above shows that the big challenge in the development of the Kayan river hydropower plant is the challenge in social development, which is 34.85%. The impact of hydropower is undeniable on the social community in the environment around the Kayan River. Some areas will be threatened by flooding, the quality of river water in the upstream and downstream areas will change, and also have an impact on the social life of the community around the river, the pattern of life will be threatened to change from the location of business places, settlements, livelihoods and so on. This condition is a joint consideration of how the impact will occur, how much influence it will have on the community, and for how long. Along the Kayan River, some residents rely heavily on river flow as a source of livelihood.

Long Pelban and Long Lejuh villages, Peso District, Bulungan Regency, and North Kalimantan are the two villages that will be directly affected by the development of the Sungai Kayan hydropower plant compared to other villages. These two villages will later be sunk (Derri et al. 2021). This, of course, takes a long time to process land compensation and relocate residents. One thing that must be a concern for the plan for the development of the Sungai Kayan hydropower plant is the recognition of the rights and protection of the community around the site of the development of the Sungai Kayan hydropower plant. Then the second challenge in the hydropower development process is environmental development, as much as 33.33%. The length of the Kayan River reaches 576 kilometers, with the central axis connecting the upstream area of the Bahau River, Malinau Regency, and downstream of the Kayan River, Bulungan Regency. The daily transportation of indigenous peoples in transporting food products, and non-forest products (NTFPs) through upstream areas and national parks with high conservation value.

Meanwhile, the downstream area is functioned by pond farmers to provide nutrients and mangrove ecosystems and housing for various aquatic animals and probosci monkeys. When a hydropower project is built, the government must protect and maintain the ecosystem around the Kayan River development. The third challenge is economic development, which is 31.82%. The challenges of economic growth in constructing hydropower plants are considered to have caused the community to relocate from their place of origin to a new place. In contrast, the community used the river border as vegetable gardening land, rice fields, and so on.

Based on the results of the word cloud analysis, it can be seen that the news media narrative is dominated by one word, and the highest word range is "PLTA", with a word count of 562 words. In addition, there is also the word "Kayan", and the result is 472. From this section, it can be seen that the news media uses well-known words such as "PLTA" to become a popular word used in the issue of the development of the Kayan river hydropower plant.

CONCLUSION

Indonesia is committed to developing the use of clean and affordable energy in the new capital city of Indonesia, based on the topography of the island of Kalimantan, which is fed by a large river, one of which is the Kayan River. There is an excellent opportunity in the development of the Kayan river hydropower, an opportunity for economic development KHE Khaerony as the Director of Operations, noted that the total investment value of KHE for this hydropower plant reached 17.6 billion USD from the hydropower target for the construction of each dam. The second opportunity is the opportunity in environmental development, namely the development of the Kayan River Hydroelectric Power Plant, which considers the sustainability of environmental development by providing energy that is friendly to the environment compared to fossil energy which can damage the environment. Kayan river hydropower development is also encouraged to have an influence on social development for the surrounding community with the Kayan river hydropower plant is expected to be able to supply electricity to rural community groups who have not been touched by electricity so that equal distribution of energy can be realized at a low price to improve the social welfare of the community.

Developing energy with a large capacity is inseparable from a challenge often faced. The big challenge in the development of the Kayan river hydropower plant is the challenge of social development. Some areas will be threatened with flooding, the quality of river water in the upstream and the downstream regions will change, and also have an impact on the social life of the community around the river, the pattern of life will be threatened to change from the location of the place of business. Settlements, livelihoods, and so on. Then the second challenge in the hydropower development process is environmental development. When the hydropower project is built, the government must protect and maintain the ecosystem around the Kayan River development. The third challenge is economic development, namely the challenge of economic development in hydropower development. It is considered to cause people to relocate from their place of origin to a new place. At the same time, the community uses the river border as vegetable gardening land, rice fields, and so on.

ACKNOWLEDGMENT

The authors thank the University of Muhammadiyah Yogyakarta for facilitating this research. The author also wants thank to all members of the Yogyakarta Muhammadiyah University who have contributed greatly to the process of writing articles.

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