Development of Sustainable Infrastructure in Eastern Indonesia

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Abstract. The condition of limited infrastructure in Indonesia positions that current infrastructure is very important to be built immediately to support development in various fields so that economic, trade, industrial and other social activities run more smoothly and develop, so that the dynamics of society in all corners of the country will increase. The cost of producing electricity in Eastern Indonesia, such as Sulawesi, Papua, Maluku and Nusa Tenggara is currently 2 to 5 times the cost of producing electricity in Java, Bali and Sumatra. One of the ways that should be intensified is by building a small-scale Liquid Natural Gas (LNG) infrastructure concept that aims to meet the needs of gas consumers who do not receive gas pipelines or who require small volumes of gas, for example small capacity power plants, especially those in islands in Eastern Indonesia. In this archipelago, it is impossible for all regions to be connected by pipelines that cross the oceans, because of course it requires very large funds. The application of small-scale LNG technology is the right solution for LNG supply in Eastern Indonesia. If the energy infrastructure is available, the quality of human resources must also be improved so that they become human resources who are always active and always adapt to developments.

1. Introduction
Infrastructure is a physical facility developed and needed for government functions such as transportation networks, water supply, flood control, sewage treatment, electricity and similar services to facilitate social and economic goals [1]. Infrastructure development is one important aspect to accelerate the national and strategic development process in driving the wheels of the economy. The rate of economic growth of a country is strongly influenced by the availability of infrastructure as the foundation of economic development, such as road infrastructure, transportation, telecommunication, sanitation and energy.

Several studies have stated that the existence of infrastructure is closely related to the level of development of an area which is marked by the rate of economic growth and social welfare [2]. The results also show that regions with better infrastructure systems tend to have better levels of economic growth and social welfare than regions with limited infrastructure. The role of infrastructure is as a motor of development in the economy and related sectors. Infrastructure also acts as a multiplier effect which will eventually create new business fields and provide output as input for consumption. Infrastructure is believed to be able to accelerate national economic development and increase the level of economic inequality between regions. For this reason, the government needs to accelerate the program of equitable distribution of infrastructure development in a proportional manner throughout
the region so that the development process that occurs is not only in areas that are already developed, but also occurs in other areas that are considered underdeveloped.

There are many challenges in infrastructure development and management, such as infrastructure gaps between regions, inadequate infrastructure networks, including the readiness of human resources as agents of development. The government must prioritize additional investment in infrastructure to improve mutual welfare. The development of new renewable energy infrastructure that is clean or environmentally friendly is also very important, because energy use in Indonesia is still dominated by the use of non-renewable energy originating from fossils, particularly petroleum and coal. Some researchers, such as Chatterjee and Turnovsky, suggest that public investment produces a positive correlation between growth and income inequality. [3] The community as a human resource must always be ready so that development does not cause inequality.

There are many challenges for the government in managing and developing infrastructure to meet the energy needs of the Indonesian people to remote parts of the country. Everyone needs electricity and energy, because electricity is considered something that changes civilization. The development of electricity infrastructure, gas refineries and other infrastructure such as gas pipes and gas distribution terminals needs to be developed. The Ministry of Energy and Mineral Resources will continue to develop infrastructure in the energy sector to implement ‘pro-people programs’ which are prioritized according to community needs, namely the provision of electricity and fuel oil and natural gas. The next task related to fuel supply is the construction of gas refinery infrastructure, gas pipelines and gas distribution terminals.

Natural gas is a vital component of the world’s energy supply, an important source of production, both for fuel and for ammonia, an important component in fertilizer production. Similar to crude oil and coal, natural gas is a fossil fuel derived from the remains of plants, animals, and microorganisms, stored underground for millions of years. Compared to other fossil fuels, natural gas is one of the cleanest energy sources because it has the lowest carbon intensity, is the safest and most useful of all energy sources. However, the order of the use of energy sources in Indonesia to date is oil, coal and natural gas. As the third rank in its use, natural gas has a very important role in energy policy in Indonesia. For this reason, it is necessary to develop a natural gas infrastructure aimed at stimulating domestic industry and maintaining a cleaner living environment. However, in natural gas management, the infrastructure is more complicated than the other two types of fuel.

On the upstream side, apart from the usual lifting production facilities, refineries are also needed to liquefy the gas, in the form of cooling facilities and cryogenic tanks, which require a very large investment. On the downstream side, regasification terminal facilities and pipelines are needed to reach consumers. With its very low temperature requirements, LNG requires regasification facilities and an integrated transportation system. For gas networks in cities there is a special type of natural gas which has a quality that can be used for residential or industrial consumption and must meet the specifications of the transmission pipeline company.

Indonesia currently has great gas potential, but its infrastructure is still weak and needs to be upgraded. Infrastructure development will determine the economics of gas prices which will also attract business actors. The data show that, assuming no new reserves are found and the current level of natural gas consumption, it is estimated that Indonesia’s natural gas will run out in the next 49 years. Indonesia’s natural gas position is often unbalanced some are in deficit or in surplus [4].

Research on the development of energy infrastructure in Eastern Indonesia as an underdeveloped area is still needed, in order to describe the situation and condition of the Small-Scale LNG Business Model in Indonesia. This study uses a simple SWOT analysis and quantitative-qualitative descriptive analysis so that it can determine the right business scenario to apply.

2. Methods

2.1. Methodology
This research uses descriptive-quantitative-qualitative research methods with the observation of various data and information relating to the supply and demand of LNG in Eastern Indonesia in order to obtain a comprehensive study of Infrastructure Development and Human Resources in Eastern Indonesia. Observation and data analysis were carried out using secondary data from various articles
and previous research journals as well as scientific articles related to the focus of natural gas and infrastructure issues, namely for the needs of the LNG supply chain and demand in Eastern Indonesia.

2.2. Descriptive analysis method.
This method is used to describe data and information about the situation and conditions of the LNG business in Indonesia in general and specifically in the eastern part of Indonesia. The analysis is carried out based on the data collected in the form of important issues, literature studies, information data from various sources and observations to get a complete picture of conditions in the field, potential and existing problems, and try to identify in order to answer problems related to goals and objectives.

2.3. Quantitative descriptive analysis method.
This method is used to answer problems in research related to data in the form of numbers as the main data to describe the characteristics of the sample, to explore and search for meanings in the research variables that are expected to answer the formulated problems. This method is to get an overview, as well as to get an overview of certain cases. For a simple approach, energy infrastructure development plans will be developed based on the results of energy studies and existing models. The energy infrastructure developed must be in order to use energy effectively and efficiently and in order to support other sectors such as transportation and industry.

3. Results and Discussion

3.1. Natural gas reserves and their utilization in Indonesia
Indonesia has the third largest natural gas reserves in the Asia Pacific region (after Australia and the People's Republic of China), accounting for 1.5% of total world gas reserves [5]. Most of Indonesia's gas production centers are located offshore, such as in Arun, Aceh-Sumatra, Bontang-East Kalimantan, Tangguh-Papua and Natuna Island. Indonesia's natural gas reserves as of January 1, 2017 amounted to 142.72 TSCF. If no new reserves are found, assuming the current level of natural gas utilization and an average gas production per year of 2.9 TSCF/year, it is estimated that Indonesia's natural gas will be exhausted in about 49 years. Currently, 58.59% of Indonesia's natural gas is absorbed for domestic needs and 41.41% for export. Domestic needs in the country are distributed in various fields of need, as seen in the following table 1:

| Fields of need                          | Percentage |
|----------------------------------------|------------|
| Used for industries                    | 23.18%     |
| The Electricity Sector                 | 14.09%     |
| Fertilizer sector                      | 10.64%     |
| Oil and gas lifting                    | 2.73%      |
| Domestic LNG                           | 5.64%      |
| Domestic LPG                           | 2.17%      |
| Government programs in the form of household jargas and gas station | 0.15% |
| Export of piped gas                    | 12.04%     |
| LNG Export                             | 29.37%     |

In the domestic use of gas, of course, there are several important notes, starting from the industrial sector, to the more volatile realization of natural gas use due to the influence of gas prices which have an impact on the competition for the value of goods. There was a decrease in gas supply to the factory due to a decrease in natural gas. On the other hand, the Indonesian Government's policy per April 1, 2020 stipulates that the current Indonesian LNG gas price for general industries will drop to US $ 6 / mmbtu, for the ceramic industry the gas price is still US $ 7.7 / mmbtu, glass industry US $ 7.5 / mmbtu, rubber glove industry US $ 9.9 / mmbtu, aloechemical industry US $ 8-10 / mmbtu. Gas...
prices for the domestic market are relatively cheap because the average gas price in the Asia Pacific region is US $ 8 / mmbtu.

The natural gas needs for Indonesian industry can be seen in the following table:

| Industry     | 2015   | 2020   |
|--------------|--------|--------|
| Fertilizer   | 791.22 | 1,028.22|
| Petrochemical| 295.00 | 708.00 |
| Ceramics     | 133.95 | 134.68 |
| Steel        | 80.00  | 120.00 |
| Glassware    | 28.38  | 28.60  |
| Glass        | 81.19  | 81.19  |
| Cement       | 9.00   | 10.00  |
| Rubber gloves| 4.67   | 4.70   |

*) in metric standard cubic feet per day (MMscfd)

Even though Indonesia produces about twice as much natural gas as it consumes, the level of domestic gas production has not yet met domestic gas demand, because some of it is exported. This has a broad impact, causing the State Electricity Company (PLN), the largest domestic gas consumer to have a structural shortage of gas supply and forcing these power companies to use fossil fuels to generate electricity, which is considered more expensive and not environmentally friendly.

It is recorded that from 2014 access to electricity was only 84.3 percent, then in 2015 it reached 88.3 percent, in 2017 it increased again to 95.3 percent and until the end of the year, in 2018 98 percent. This figure has exceeded the target set in the 2019 Mid-Term Development Plan (RPJM) of 97.5 percent. According to the Ministry of Energy and Mineral Resources, [4] currently there are still 5.2 million Indonesians who do not have access to electricity.

The Indonesian government will limit gas exports in order to secure domestic supplies and encourage the use of natural gas as a source of fuel for industrial and personal consumption. So far, gas production has been mostly exported because domestic gas production is dominated by foreign companies that are only willing to invest if they are allowed to export the commodity. Currently, foreign companies such as CNOOC Limited, Total E&P Indonesia, Conoco Philips, BP Tangguh, and Exxon Mobil Oil Indonesia contribute around 87% of Indonesia's natural gas production. Only 13% is produced by the state-owned company (Pertamina). About half of total gas production is sold domestically. Gas production in Indonesia is relatively stable, a record high in 2010, when production started from the Tangguh Field in Papua, which is an important field in the country's gas industry and is managed by BP Indonesia. Post 2010, gas production decreased due to supply problems. During the 2012-2017 period, there was a relatively small decrease in natural gas lifting, an average of 1.86% per year. [7] The highest decrease in natural gas lifting occurred in 2017, reaching 4.04%.

3.2. Indonesian Gas Exports

The decline in domestic oil production accompanied by an increase in international oil prices made the Government decide to make efforts to increase the use of domestic gas, since the mid-2000s until now. In recent years, domestic gas use has increased rapidly and exports have decreased. However, the limited infrastructure facilities in the transmission and distribution networks has complicated the development of domestic consumption. The lack of adequate infrastructure also occurs not only because of a lack of investment but also due to the geographical conditions of this archipelago nation. Distribution by tanker is considered easier and cheaper than by pipeline because natural gas reserves are located offshore, far from major gas demand centers.

After Qatar, Malaysia and Australia, Indonesia is currently the fourth largest LNG exporter in the world. However, Indonesia still needs to import LNG from abroad so as not to interfere with export commitments. Indonesia, which was once the largest LNG exporter, also experienced a decline in the global LNG market share, partly due to the reorientation of the Indonesian Government's policy in the mid-2000s which targeted more gas supply for the domestic market in order to increase the use of gas.
as an energy source, by reducing dependence on crude oil. However, this decline is also due to a lack of long-term investment in both exploration and development of the country's gas fields.

3.3. Future projections for the Indonesian gas sector
Indonesia has large gas reserves that can supply domestic and export needs for the next few decades. However, to achieve efficient and productive management of the gas sector requires massive investment in both exploration and distribution infrastructure. Indonesia needs investment of more than US $ 32 billion, mostly from private sector, for natural gas refineries and internal gas-related infrastructure. Domestic gas supplies in 2025 are mainly for the needs of power plants and fertilizer factories. There are three keys that can encourage the use of natural gas in the country. First, the acceleration of infrastructure development that extends to all regions of Indonesia, both in the upstream and downstream sectors. Second, competitive pricing policies while maintaining the investment climate, for both upstream, middle and downstream business actors. Third, the economy of natural gas field development which must be improved in order to attract investors [7].

3.4. Utilization and distribution of LNG gas in Eastern Indonesia
Eastern Indonesia covers 12 provinces, namely South Sulawesi, West Sulawesi, Southeast Sulawesi, Central Sulawesi, Gorontalo, North Sulawesi, North Maluku, Maluku, West Nusa Tenggara, East Nusa Tenggara, West Papua and Papua. Infrastructure is one of the important aspects in the economic development of Eastern Indonesia. Gaps in connectivity, logistics and price control previously received less attention. Moreover, the role of the East Indonesian economy is only 20% of the total gross domestic product (GDP). In fact, there is actually a huge potential, especially in the fields of energy and tourism. Infrastructure development will certainly provide a multiplier effect for the economy.

The distribution of natural gas in Eastern Indonesia is still less than in Western Indonesia, because Eastern Indonesia has a geographical condition in the form of islands and deeper sea, the condition of the piping infrastructure that has been installed is also very little. The concept of transport with Small Scale LNG and regasification terminals emerged as a potential option for transporting natural gas for power generation rather than diesel oil. The following is the distribution pattern of LNG supply fulfillment.

The clustering method is used to simplify analysis and calculations. The use of data mining clustering aims to group data with the same characteristics into a "region". The determination of clustering is qualitative in nature, namely geographic distance and location, distance between plants and between plants and LNG supply. Currently, there are 3 (three) LNG supplier clusters in Eastern Indonesia, which are described as follows:

3.4.1. Cluster 1 of Papua region
There are a number of infrastructures related to the LNG business process:
- There are 31 power plants with a total production of 630 megawatts (MW),
- There are 8 land-based regasification terminals, for LNG storage receiving facilities,
- There are 3 iso tank regasification system facilities, for storage in the form of tanks.
- LNG supply in the Papua cluster is distributed with 3 Primary Hub Floating Storage Regasification Unit (FSRU / FSU) facilities which function as large capacity floating LNG storage and distribution facilities located in West Papua (FSU Sorong), East Papua (FSU Jayapura) and Papua South (FSU / Timika).
- A total of 138 MMSCFD, assisted by LNG Ship facilities to distribute LNG needs to consumers for power generation needs in the Papua region.
- LNG with a large capacity is located in West Papua (FSU Sorong) with a total of 46 MMSCFD to meet LNG needs, East Papua (FSU Jayapura) with a total LNG need of 50 MMSCFD, and South Papua (FSU / Timika) with a total LNG need of 41 MMSCFD. The fulfillment of a total of 138 MMSCFD is assisted by the LNG Ship facility to distribute LNG needs to consumers, especially to meet the needs of power plants in the Papua region.
3.4.2. Cluster 2 of Maluku-Sulawesi region
There are a number of infrastructures related to the LNG business process:

- There are 25 power plants: a total of 895 megawatts (MW),
- There are 6 land based regasification terminal facilities,
- There are 10 isotank regasification system facilities (storage in the form of tanks).
- LNG supply in the Maluku-Sulawesi cluster is distributed with 3 Primary Hub Floating Storage Regasification Unit (FSRU / FSU) facilities which function as a large capacity floating LNG storage and distribution facility located: in North Sulawesi (FSU Manado), East Halmahera (FSRU HalTim) and Ambon (FSRU Ambon)
- Fulfillment of a total of 234 MMSCFD, assisted by an LNG Vessel facility to distribute LNG needs, especially to meet the needs of power plants (134 MMSCFD) and the smelter mining product processing industry (100 MMSCFD).

3.4.3. Cluster 3 of Nusa Tenggara region. There are a number of infrastructures related to the LNG business process:

- There are 30 power plants, a total of 1,750 MW of electricity production,
- There are 12 land based regasification terminal facilities,
- There are 10 isotank regasification system facilities.
- There are 4 Primary Hub Floating Storage Regasification Unit (FSRU / FSU) facilities located in South Sulawesi (FSRU Makassar), South Sulawesi (FSRU Pomala), West Nusa Tenggara (FSRU Lombok) and East Nusa Tenggara (FSRU Kupang).
- Total cluster III (Nusa Tenggara Region) is the region with the largest demand for LNG supply in Eastern Indonesia, especially in relation to the fulfillment of the smelter and power plant industries.

3.5. Special port for natural gas
According to the Decree of the Minister of Transportation Number 55 of 2002, special ports are defined as ports that are managed for their own interests for certain activities, while the hierarchy of roles and functions of special ports is classified into 3, namely: national / international ports, regional ports and local ports. A special port for natural gas is a port that only serves a series of loading and unloading activities for natural gas such as tanker berths, natural gas loading and temporary storage of natural gas before shipment. Similar to common ports, special ports are controlled and managed by the government, the Ministry of Transportation. However, due to constraints such as limited funds, facilities and infrastructure as well as human resources, the government collaborated with PT. PERTAMINA (state oil and gas mining company). The components of facilities in a special natural gas port are as follows:

- Supporting facilities for the smooth operation of gas tankers consist of: shipping lanes, shipping navigation assistance facilities, tug boats, ships carrying rope / cross from ship to mooring post / bolder and radio communication
- The supporting facilities for loading activities consist of: jetty, breasting dolphin, boat protection so that it does not collide directly with the jetty's head, mooring poles so that when the ship is parked the ship remains calm, fenders to reduce ship impact energy for breasting dolphin construction, footpaths and ladders, mooring buoys, this facility can be moved as needed, and the loading arm, a device for connecting the pump manifold on the ship and the distribution pipe.
- A storage tank, a facility that is used to store LNG before it is handed over to another party or for its own use. In this storage tank, LNG is temporarily stored before being regasified and flowed to the piping network. Conditions in the tank have a temperature of -162°C with atmospheric pressure. The reason for choosing this condition is because at a temperature of -162°C the LNG vapor pressure is close to atmospheric pressure. If there is heat entering the tank, some of the LNG will evaporate and give an authorization effect to the LNG in the storage tank, while the tank temperature does not change.
- Facility of LNG transportation activities can be distributed through installed gas pipes or by using LNG transport vehicles to supply natural gas to the point of destination. If the destination location of the LNG user is far enough, then an LNG carrier ship which is designed in addition to
regasification on the ship is to facilitate the regasification process, which will then flow the transported gas through pipes at the destination for distribution to consumers LNG users.

- Pier facilities, which the type of pier that is most suitable to serve gas transporting vessels is the jetty or pier type. With this jetty / pier, the loading and unloading process of the natural gas special port is released at a point which is the place where the natural gas is released through the distribution pipes. Another advantage of the jetty is that there is no need for a large dredge because it is shaped like a bridge that just into the sea so that there is sufficient depth for the tanker to anchor. The installed capacity of the natural gas special port jetty depends on the following: waiting time \( t_w \), guide ship time \( t_g \), lay time \( T \), ship size (DWT) and the need for the wharf annual activity.
- Loading-unloading facilities. There are several facilities to complete loading-unloading requirements in order to facilitate the operationalization of facilities at the special port.

3.6. The small scale of LNG business model

3.6.1. Application of the small scale of LNG business model in Eastern Indonesia

There is an increasing need for gas as the main fuel for electricity generation to replace diesel oil which has a higher electricity cost than natural gas. However, the distribution of natural gas in Eastern Indonesia is still less than that of Western Indonesia, because Eastern Indonesia has a geographic condition of the archipelago and the sea is deeper, so the piping infrastructure that has been installed is still very little. From these problems, natural gas transportation with the concept of Small Scale LNG (Mini LNG) and its regasification terminal is a potential option for transporting natural gas as a power plant to replace diesel oil. However, the process of shipping LNG by ship, which must be determined in type and size until it is received at the regasification terminal and gas distribution to consumers is a very complex supply chain.

The supply chain for LNG technology is generally divided into 4 parts: (1) exploration, natural gas is still a wellhead, (2) liquefaction, natural gas is liquefied to facilitate transportation to consumers, (3) shipping to consumers with a far distance from the source, and (4) regasification, gas is turned back into gas to be distributed to the end consumers.

3.6.2. Small scale LNG infrastructure

To implement the small scale LNG business model, also known as Mini LNG, various facilities are required, with small sizes. The facilities needed to build a small scale LNG infrastructure include:

3.6.3. Small scale LNG terminal

Small scale LNG terminal, as a loading / receiving terminal, terminal for loading and unloading gas from production wells, which is transported by ship in liquid form and sent to the place of use, before being transferred to the FSU (Floating Storage Unit) to be stored and streamed to the FRU (Floating Regasification Unit) and reprocessed into gas again.

3.6.4. Small scale regasification facility

The small-scale LNG regasification facility can be in the form of trucks and ships. The construction of this facility is to support gas distribution to power plants.

3.6.5. Small scale LNG carriers

Currently, there is no shipyard in Indonesia that can produce small scale LNG carriers. Therefore, it is necessary to conduct a technical and economic analysis for the construction of the small scale LNG carrier shipyard in Indonesia by taking into account market aspects, ship building standards, and investment feasibility for the project. It is a big enough opportunity for Indonesia to develop this shipping sector.

3.6.6. Floating Storage Regasification Unit (FSRU)

There are several specifications of this FSRU, including:

- The FSRU, also known as a special type of vessel, is a vital component required during the transit and transfer of LNG through sea channels. Although LNG is a fuel component that is very
suitable and environmentally friendly, in reality its transportation is difficult and dangerous, so it must be very careful. This is where the FSRU plays an important role.

- FSRU vessels can be classified as offshore vessels. The FSRU can be completed in two ways: (1) Method-1, is installed as a separate unit from an LNG ship to become an independent unit and placed at a specific destination as an offshore installation. The main advantage of such an installation is that the process of heating and liquefying the gas can be carried out on the ship itself without having to unload the fuel in a semi-frozen liquid state. (2) Method-2, the old LNG tanker is modified with an offshore installation as a floating LNG unit, which can be either a mobile unit or an immovable offshore unit. 2.6.5. Regasification unit. The next important component of the Floating Storage Regasification Unit or FSRU is the “R” which indicates the regasification capacity. This is to convert liquefied natural gas (LNG), which is transported at −162 °C (−260 °F), back to natural gas at atmospheric temperatures.

3.6.7. Truck / small boat.
Trucks or small boats are required for LNG distribution. It is also possible for LNG commodities to be distributed via trucks to retail consumers (LNG trucking). In the first phase, infrastructure development will focus on regasification facilities in the offshore area and use temporary storage, with the utilization of medium-sized LNG ships that are suitable for the size of the existing jetty (dock) at the Special Port Terminal.

3.7. Analysis
3.7.1. Simple SWOT analysis
In terms of external conditions, there are several opportunities and challenges. There are many possibilities for cooperation in the forum of the three countries of Indonesia, Japan and the United States, including the development of technology and the LNG export-import trade model. The potential of the Indonesian market (demand and supply sides) for the LNG business is still wide open, so of course there are many business opportunities that could be implemented if the three countries invest together in Indonesia. The key to observing some of the conditions for the development of small scale LNG are:

- Economy: the cost advantage of LNG energy is less than alternative energy sources for end users, including gas in the absence of pipeline infrastructure.
- Environment: small scale LNG can bring attractive environmental benefits, both for gas production (preventing combustion) as well as end customer use (LNG for transport / power & heating generation), compared to alternative fossil fuels. This includes emissions of CO2, SOx, NOx, other particles and noise.
- Policy: government decisions to increase the level of energy independence for the country or region by developing alternative energy supplies.
- The categories of strength (internal condition) are as follows:
  - Technology: small-scale LNG research and technology is still being carried out. For example, a more efficient and cost-effective small-scale gas liquefaction process technology is being developed. LNG engine technology for transportation has also developed rapidly. However, in Indonesia there are still limitations in developing port design research and there is no shipyard that can produce small-scale LNG carriers as needed. It is necessary to develop reliable human resources who can develop appropriate technology.
  - Financing: the availability of relatively “cheap” funds can attract localities to invest in small scale LNG projects and could attract new players to the market. Small scale LNG projects require lower investment because they are smaller than the funding requirements of conventional projects. Procurement of ships
  - Fiscal policy: in some cases, small LNG production projects can help increase natural gas consumption, either as a temporary supply or to supply remote areas that are not connected to the main transportation network. Therefore, the (local) government can provide an attractive fiscal package for LNG infrastructure development. Various countries in Europe have proposed building small-scale import terminals, supported by subsidies from the EU government of around
10-20% of the terminal construction costs. Conversely, fuel that is more polluting can be taxed at a higher rate.

- Developed policies and regulations. Enforcement for the occurrence of environmental benefits is usually enforced by government intervention through policies or regulations (ECA zones).

3.7.2. Economic analysis
From the economic perspective, Indonesia is trying to keep investors interested in upstream gas activities. Various collaborations have been established, especially developed countries, such as Japan and the United States. There are many possibilities for cooperation in the forum for the meeting of the three countries, including technology development and LNG export-import trade. The potential of the Indonesian market for LNG is still wide open so that there are many business opportunities that will be worked on if investing in Indonesia. Some of the results of cooperation with Japan and the US in technology development include:

- Application of Low-Cost Small-scale LNG Technology with LNG tank technology.
- The principles of implementing new model projects such as modularization, containerization, replication and standardization allow the further growth of the LNG Business. Small-scale LNG businesses create opportunities for efficient operation and maintenance strategies, i.e. unmanned operations, multidisciplinary staff, etc.
- The alternative to limited supply of small-scale LNG presents a challenge, to operate and design all elements in the supply chain more effectively-efficiently and more competitive.
- Economically financially: the benefits are greater, because LNG energy costs are less than alternative energy sources for end users, including gas in the absence of pipeline infrastructure.
- Environmental economy: Small-scale LNG can bring better environmental benefits, using LNG for transportation, power & heating, with better emissions and lower noise levels.

3.7.3. Social analysis
In the second phase of long-term development in the Eastern Indonesia region, there are main factors that need to be considered, including the diversity of situations and conditions, the development of the agricultural and tourism sectors. The development of these sectors is in order to solve the problems of poverty in rural areas and in urban areas, to increase people's income, especially in the fields of agribusiness, agro-industry, tourism, infrastructure and employment.

Eastern Indonesia has problems related to the quantity and quality of human resources which are still low. Several indicators such as capacity, labor participation rate and unemployment, education participation rate, level of knowledge and ability of workers, skilled labor are still low. These problems are also related to limitations in the sectors of transportation, communication, energy, economy, housing, markets, waste management, poverty, health, and others. Several solutions need to be considered immediately, including:

- By looking at the potentials and problems, local governments in the Eastern Indonesia region must improve the quality and quantity of human resources in the maritime sector, including agriculture, livestock, fisheries, marine and tourism, that have great potential in this region.
- Through education / training in these fields, the younger generation can increase competitiveness, adopt new technologies more quickly, be better at management, will not be inferior to other countries and will not be easily colonized intellectually.
- With infrastructure in the fields of maritime, transportation, communication and energy that have been built and are increasingly meeting the needs, it is hoped that the people of Eastern Indonesia will be more creative, innovative and productive.

3.8. Human Resources Development in Eastern Indonesia
In the World Bank Report 'The Ease of Doing Business', it is stated that Indonesia's infrastructure ranking has increased from 120 (in 2014) to 73 (in 2019). Apart from transportation infrastructure, various infrastructures that support other industries such as infrastructure, communication-information, health and other social networks have also been developed. Energy infrastructure which is a basic need has also been built in parallel. If the energy infrastructure is available, it must also be followed by improving the quality of human resources so that they become human resources who are
always active and always adapt to the era of accelerated changes in world situations and conditions, based on world competitiveness and the latest technology.

Improving the quality of human resources in Eastern Indonesia is very important to face globalization and future challenges and to maintain sustainable development. In equitable distribution of infrastructure development in Eastern Indonesia, which is an underdeveloped, frontier, and outermost area, it must also be supported by the existence of quality and superior human resources. Equitable development can minimize inequality between one region and another. The government's priority in providing social facilities includes health and education facilities. Ease of public access to social facilities and infrastructure can support the creation of reliable human resources.

The oil and gas industry is a high-risk industry because it involves large funds and high technology with a high failure rate. To minimize the potential risk of loss, competent human resources are needed. The participation of local communities in Eastern Indonesia is absolutely necessary. The government or related business entities must be able to provide training to improve the skills of existing human resources by collaborating with other parties who have proven competent in improving the skills and capabilities of human resources. The right human resource development strategy will produce quality and intelligent human resources who have the following characteristics:

• Have added value, solid, smart, expertise, professionalism, comprehensive, etc.
• Have the ability to think systematically (able to think rationally, abstract a problem systematically through an objective scientific approach, etc.).
• Capability of experimentation and test (able to analyzing data from various angles).
• Capability to collaboration (able to work together, synergize, cooperation, joint venture, etc.).
• Can take advantage of all the infrastructure that has been built more creatively, productively, mastering the latest technology and able to keep up with the export-import activities of goods and services in this region so that they are no longer in the import surplus.

4. Conclusions

• Indonesia is believed to still have abundant natural gas reserves. The main problem faced today is distribution. Various schemes have been studied and implemented by the government to be able to supply gas to those in need.
• Electricity is the mainstay of natural gas absorber, but until now it has not been used optimally. The existence of gas-powered generators is also in line with energy diversification efforts that the government must continue to implement effectively in order to support environmental conservation.
• The concept of small-scale LNG is very possible to be applied in Eastern Indonesia, which is a very large archipelago country and cannot be accessed only through a gas pipeline network.
• It must be known the potential, infrastructure needs, challenges and opportunities in the small-scale LNG business. Entrepreneurs must actively make infrastructure development costs cheaper than building pipes. They must also be able to create competitive LNG prices and be able to compete with other energy sources.
• Currently there is no shipyard that can produce small-scale LNG carriers in Indonesia. It is necessary to carry out in-depth technical and economic analysis regarding the construction of a small-scale LNG carrier shipyard on the aspects of the market, ship building standards, and the feasibility of investing. This is a great opportunity for the maritime industry in Indonesia.
• It needs a lot of studies for the construction of docks, ports and coastal structures related to the LNG business. All research and ongoing engineering activities are required to take advantage of opportunities. Experts and related agencies can take part in the development of a small-scale LNG plant.
• It is necessary to develop human resources in the Eastern Indonesia so that they can be involved in the development and use of built infrastructure and participate in preserving the environment as a result of the application of the latest technology.
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