IJE available online at www.ije-pyc.org
INDONESIAN JOURNAL OF ENERGY

# Study of Gas Resources Utilization of Tangguh, Masela, and Kasuri Blocks for East Indonesia Regional Development

T. Ariadji[1,*], L. A.Yusgiantoro[2], D. Susanto[3] , D. Sunarjanto[4], D. Sismartono[4], W.A. Akbar[4], Wisnu P. Taher[2], Arsegianto[1]

[1]*Bandung Institute of Technology*
[2]*Special Task for Upstream Oil and Gas Regulatory of Indonesia*
[3] *Graduate Program, Bhayangkara Jakarta Raya University*
[4]*LEMIGAS Research and Development Centre for Oil and Gas Technology*

Received 13 October 2017; accepted 29 January 2018
Available online 28 February 2018

**Abstract.** This study is intended to evaluate, analyze and give recommendations for prudently utilizing gas production to maximize regional economic developments. A method to relate sectors and inter-regions, i.e., Inter-regional Input-Output (IRIO) Model, is employed to predict the impact of the upstream potential on the down stream. This techno-economic study examines the allocated gas from three gas field blocks altogether at Maluku and West Papua Provinces, i.e., Tangguh, Masela, and Kasuri, to supply the demands of (1) power plants; (2) fertilizer industries, and (3) petrochemicals industries. This study identifies development processes, investment parameters from pre-construction to operation, implementation parameters, and output parameters, both for the upstream and downstream sectors during 2016-2035. The IRIO model uses the 2010 IRIO Table published by BAPPENAS which consists of 35 sectors and 35 provinces. The shock data used to estimate the economic impacts include those data on infrastructure (CAPEX, OPEX, and supporting facilities), energy consumption (per kWh, per ton fertilizer, and per petrochemical product), workforce, and investments at a particular time. Six simulation modeling scenarios were developed to forecast the future performance of Gross Domestic Product (GDP)/Regional Gross Domestic Products (GRDP), Community Income, and Employment of 4 provinces in Eastern Indonesia. The results indicate that the regional economy could grow significantly by providing electricity first. Hence, the Petrochemical Industry gives more contribution than the Fertilizer Industry. The contribution (compared to BAU condition) increases sharply before taking a peak period and then declines in the year 2025. The best scenario results in a rise of the regional GDP at about 19 percent, wages at about 20 percent, and employment at about 55 percent. Maluku Province deserves the most economic improvement followed by West Papua Province. North Maluku and Papua provinces are not as well-off as those two provinces although there has been an indication of some employment in North Maluku Province.

JEL Classification: E23
Keywords: Gas resources, Input-Output, techno-economic, East Indonesia

## 1. Introduction

This study investigates four (4 provinces in the East Indonesia Region , i.e., Maluku, North Maluku, Papua and West Papua, due to their reasonable distance from the abundant natural gas resource and to the high number of the region's population who are still living under the poverty line as indicated by the low ratio of its Regional GDP (RGDP) relative to the National GDP (NGDP). The ratio of the RGDP of Papua Province relative to the NGDP is the highest, with 1,4 percent in the year 2010; the North Maluku Province, on the other hand, possesses the lowest ratio with 0,2. The Gini ratio of the Papua

* Corresponding author
*E-mail address:* tutukaariadji@tm.itb.ac.id

and West Papua from the year 2012 to 2015 is consistently higher than that of the average national (0.41), showing economic disparities of the people's prosperity. Maluku and North Maluku, however, show much better conditions, indicated by a sharp decline in the ratio profile. The Human Index of all 4 provinces consistently increases year by year, although they are still below that of the national level. In term of employment, indicated by workforce participation number, Papua Province is well above the other three provinces and the national average numbers. These social pictures indicate challenges as well as opportunities to develop the region at the same time hence the human capital development sustains through cooperations among the people of the provinces.

The economic growth of the Maluku province ranges from 4,98 percent in the year 2015 to 6,16 percent in the year 2011, which is considered slightly close to the average national. This growth is mainly based on agriculture and trading activities, in addition to the government spending domination of 20 percent contribution to the Regional GDP. However, the mining sector has grown significantly (21 percent ), an indication of shifting economic basis to the industrial based economy, though without preparation and planning. This condition might not produce a sufficient economic added value and will not create sustainable new jobs. On the other hand, West Papua has a fluctuated economic growth, ranging from 3,63 percent in the year 2012 to 7,36 percent in the year 2013, and it is based on mining, trading, and mine processing. Developing industries based on local potentials by firstly establishing facilities and infrastructures will create a more sustainable and prosperous economy of the region. (Source: BPS, *Maluku dalam Angka*, 2015; *Papua Barat dalam Angka*, 2015; *Statistik Indonesia*, 2015).

To investigate sectors' potentials, we employed Klassen Typology by comparing their growths, and the analysis was conducted using the distribution and average provincial growth to differentiate the status of each sector, i.e., Dominant Sector (High Growth, High Distribution), Potential Sector (High Growth, Low Distribution), Saturated Sector (Low Growth, High Distribution), and Marginal Sector (Low Growth, Low Distribution). The analysis shows that result electricity, construction mining, and processing industries, are among the Potential Sectors in Maluku. Whereas, in West Papua, trading and transportation are among the Potential Sectors, and construction is the only Dominant Sector. Both in Maluku and West Papua, agriculture is a Saturated Sector, and thus it is deemed necessary to open a new market for the agriculture products.

Tangguh, Masela, and Kasuri blocks are located in the Eastern Indonesia Region, and their resources would be dominant in this area as currently Masela field, especially, is still in the development planning. Following the Government of Indonesia (GoI) to allocate the gas production for the domestic need, examinations over those gas resources are deemed necessary for their sustainable development in the region. This policy is also intended for shifting from oil fuel and for developing the region's economy to overcome the economic growth disparity as indicated in each province economic growth (%) and Gini Ratio.

This study is based on previous feasibility studies and identifies needs to provide, first, sufficient infrastructures, and then a sustainable development, by utilizing the local potentials for a capital move towards a self-sufficient region. For this reason, this study is intended to seek the best scenario of the allocated gas productions from the three gas field blocks at the Maluku and West Papua Provinces, i.e., Tangguh, Masela, and Kasuri, altogether to maximize the regional economic growth. The allocated gas production is utilized to supply (1) power for electricity; (2) fertilizer; and (3) petrochemicals.

Natural gas-related sectors have not taken a crucial part in the Eastern Indonesian Region economy. The oil (and natural gas) refining sector in West Papua Province tends to be more upstream than downstream oriented. It is only in Maluku, North Maluku, and Papua provinces that electricity, gas and water supply sectors show a more downstream orientation, meaning their output is an important input for other sectors in the economy. With the upstream development projects and the utilization of gas energy in the Eastern Indonesian Region area, forward linkage and backward linkage from oil, gas and geothermal mining sectors, oil (and natural gas) refining sector, and fertilizer and petrochemical industry sectors are expected to increase in the future.

The geographical condition of the archipelagic Eastern Indonesian Region requires facilities and infrastructures such as transportation modes, receiving terminals and LNG regasification, as well as gas transporting patterns from LNG Refinery to the Oil and Gas Power Plant (PLTMG) (Kementerian Peridustrian, Bappenas, 2014). Stages of upstream petrochemical industry development in Indonesia for 2015-2019 according to RIPIN (National Industrial Development Master Plan) of Years 2015-2035 are those for Ethylene, Propylene, Butadiene, p-Xylene, o-Xylene, Methanol, and Ammonia (Kementerian Perindustrian, 2014a). Data from the Ministry of Industry of 2014 show that Indonesia has had a deficit of petrochemical products (Kementerian Perindustrian, 2014b). There have been plans to develop petrochemical and fertilizer industries in the Masela Block and Bintuni Bay (Kementerian Perindustrian, 2016a, 2016b). Also, the Bintuni Bay Regency of West Papua will become the WPPI (Central Industrial Growth Area) according to the National Industrial Development Master Plan (RIPIN) 2015-2035 (Kementerian Perindustrian, 2014a). The reason of putting the WPPI in the RIPPIN is to accelerate the spread and distribution of industries through the whole country, where currently the industries are concentrated in Jawa (about 73 percent) to shift to outside Jawa.

## 2. Methodology

In addition to the supply chain of the upstream industry, this study is to probe the economic relationship between upstream and downstream known as forward and backward linkages from the development of new gas energy based industries. Thus, it is followed by an analysis on the contribution of the new industrial region to the regional economic growth by showing the macroeconomic indicators. Fig. 1 below depicts the methodology of the study work, that is, the flow diagram of the economic impacts of gas development projects (upstream) and utilization of gas energy for domestic interest (downstream) in the Eastern Indonesian Region. This study starts with quantifying the allocation of the gas fields' production for this purpose, i.e., domestic needs of East Indonesia for industries and electricity. Hence, infrastructure and investment are required for both direct (industries and electricities) and indirect (roads, etc.) needs. Then, an economic impact analysis is conducted.

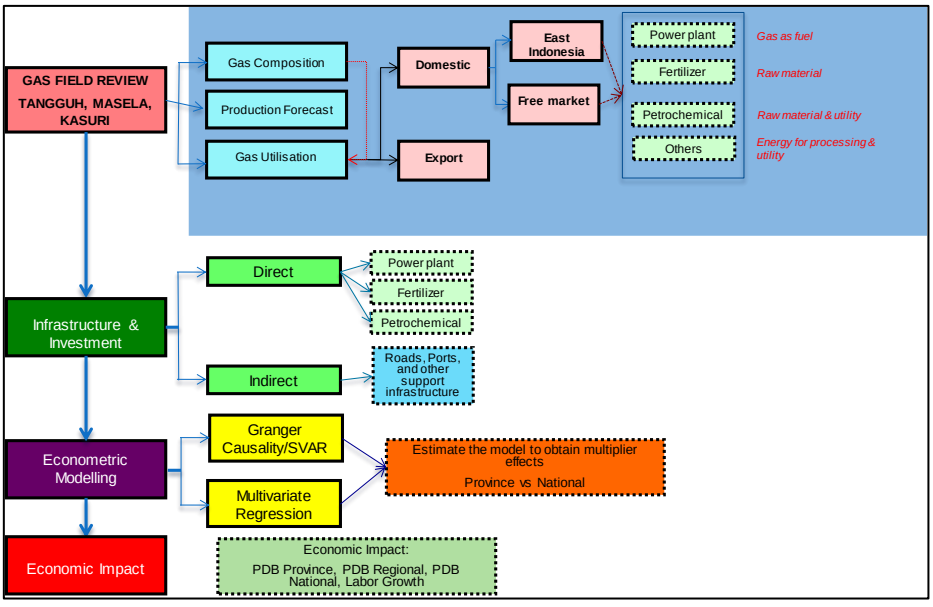



**Figure 1.** Flow Diagram of Study Implementation Activity

Overall, this study covers techno-economic aspects of the upstream (gas fields and downstream sectors in three industries (power plant, fertilizer, and petrochemical) and the economic impacts of these developments on the Eastern Indonesian Region and the nation. The economic impact analysis was performed using IRIO (Inter-regional Input-Output) model of 2010 developed by BAPPENAS (BAPPENAS, 2015). IRIO is an IO model that analyzes inter-sectoral and inter-regional linkages.

The stage of the techno-economic study consists of two sub-groups, namely (1) techno-economic analysis, and (2) economic impact analysis. The techno-economic study comprises (A) mapping potential demands for power plants, fertilizers, and petrochemicals around the location of the Tangguh, Masela, and Kasuri blocks, (B) performing analysis and calculation of gas energy utilization of Tangguh, Masela, and Kasuri blocks, (C) analyzing and designing the development of power plant, fertilizer, and petrochemical industries in Maluku and Papua, and (D) arranging the analysis results of technical designs, investment requirements, operational costs, and the estimated final demands. Fig. 2 shows a framework of thinking for the economic impact analysis. Building natural gas facility projetcs certainly will increase investment, and utilization of the gas production for industries and electricity will increase the output, added value (PDRB), labor growth, and community income of the region closest to the resources, that is, the 4 provinces (Maluku, North Maluku, Papua and West Papua), 5 big Islands in Indonesia, and the country. To simplify the calculation of the inter-regional economic impact analysis using IRIO but still carry the nature condition of the national economic relationship to and from the East Indonesia Region, we have divided it into 6 regions as aggregates: 4 regions representing 4 big islands, 1 region representing East Indonesia Region, and 1 region representing the rest of the islands.

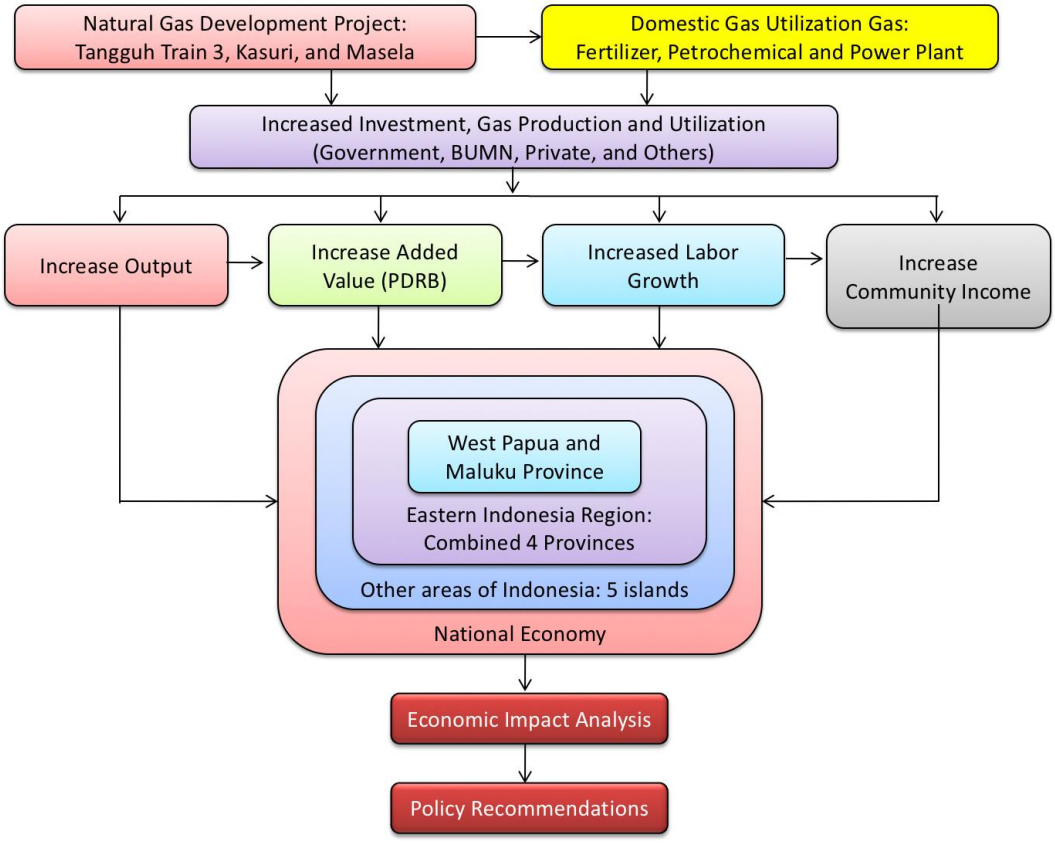



**Figure 2.** Thinking Framework for Economic Impact Analysis.

Thus, the analysis of economic impact involves the following procedure: (A) creating an IRIO data aggregation on the basis of six (6) regions consisted of 4 big islands (Jawa, Sumatra, Kalimantan, Sulawesi), East Indonesia region (Papua and Maluku islands area), and Bali and Nusa Tenggara islands, and four (4) provinces in Eastern Indonesian Region (Papua, West Papua, Maluku and North Maluku); (B) analyzing IRIO 2010 data by conducting a summary of IRIO data as required, such as calculating multiplier effects, forward and backward linkage numbers, inter-province goods and service flows, between regions but within Eastern Indonesian Region, and between provinces within and outside Eastern Indonesian Region; (C) creating simulation scenarios for an economic impact analysis; (D) preparing the matrix of Leontief technology, reversed matrix (multiplier matrix), and calculating or

estimating the economic impact of the development and utilization of upstream and downstream natural gas at Eastern Indonesian Region, both at regional and national levels; (E) performing an interpretation or analysis of the economic impact.

In this study, the IRIO's baseline data to be used are those already drawn up by Bappenas in 2015, in the form of Indonesian IRIO table of 2010 consisting of 35 sectors and 33 provinces. The reason for using the 2010 statistic data is because the 2010 data is the newest formal release from BPS (Central Bureau of Statistics). There are data from 2015 but still classified as in-house information of BAPPENAS. We believe that the 2010 IRIO Table is still valid and reliable to be used for estimating economic impacts as the economic and real sector structure did not change significantly from 2010 to 2015. A more substantial reason is that in the case of Indonesia, the slow down in economic growth may be held back by productivity growth as some have recently expressed concerns about Indonesia's low productivity performance. This conjecture is supported by the fact that capital formation in the last 5 years has slowed down in around 4-5 percent annually (World Development Indicator Data) compared to about more than 10 percent in the 1980's and 1990's and also a slow down in employment growth. With these informations we believe that there have not been much changes in terms of technology in the last 5 years so that using the 2010 IRIO data will provide reasonable and acceptable estimates. Furthermore, there were no economic shocks during that period, and and the relationship among sectors and among regions in the IRIO model did not seem to change substantially as shown by a stable coefficient. Realizing the IRIO Model is a discrete approach carrying this 2010 data for the basis of forecasting until the year 2035, we did yearly multiple shocks. The GDP impact does not necessarily declining, the contribution percentage that is declining due to BAU increasing. We intentionally employed this approach to obtain a simplified, faster method as the first and rough results that show some general figures to stimulate a more thorough and rigorous approach.

Another concern is that the data availability is limited and therefore taking assumptions is deemed necessary. For instance, investment and operating costs for electricity facilities in the region, should be properly assumed, and the gas demand for fertilizer and petrochemical industries are obtained from the Ministry of Industry and Trade such that the techno-economic analysis requires a rule of thumb justifications. Also, it is important to note that a certain region has a specific data relationship for each sector, and this depends on the region potentials as not all regions have the same potentials and sectors.

As the focus of this study is to investigate the impacts of gas development and gas energy utilization projects in the Eastern Indonesian Region, which includes Maluku, North Maluku, West Papua and Papua provinces, there is a modification of the IRIO data into 9 areas: 1) Sumatera Island (10 provinces combined); 2) Java Island (5 combined); 3) Kalimantan Island (4 combined); 4) Sulawesi Island (6 combined); 5) Bali Island - Nusa Tenggara (3 provinces combined); 6) Maluku Province; 7) North Maluku Province; 8) West Papua Province and 9) Papua Province. However, the number of sectors remains similar to that of the data in the IRIO Table in 2010, which is thirty-five (35). This study will use the condition of the national economy in 2010 as an illustration of the relationships between one sector and another and between one region and another, which is assumed to remain in the period of analysis, i.e., 2016 to 2035. This is so far the best effort that can be done regarding the implementation of this study due to the limited availability of the existing data and the relationships between one sector and other sectors and between one region and another region in the IRIO Table, which generally remain significantly unchanged within a medium term (10 years). The IRIO table also generates backward and forward linkages. The sectors directly related to the upstream development projects and the downstream development of the natural gas industry are, among others, (a) oil, gas, and geothermal mining sectors, (b) oil (and natural gas) refinery sector, (c) fertilizer and petrochemical industry sectors, and (d) electricity, gas, and water sector.

The 2010 condition showed that the oil and gas mining, as well as natural gas sectors, were apparent in Maluku and West Papua provinces, and the oil (and natural gas) refining sectors in West Papua province. Meanwhile, the fertilizer industry and petrochemical industry were apparent in the Maluku province. Electricity, gas, and clean, fresh water have relatively developed in all of the provinces of the Eastern Indonesian Region, especially North Maluku and West Papua. The indicator for this

development is the values of the forward linkage, which are higher than their backward linkage. The sectors of oil (and natural gas) refinery and fertilizer industry sector, as well as petrochemicals, have a value of backward greater than that of the forward linkage within the Eastern Indonesian Region; this indicates that the downstream of both sectors did not develop in 2010.

### *2.1 Scenarios Development Using IRIO*

The scope of the economic impact analysis of gas energy utilization in the Eastern Indonesian Region can be further detailed as follows: (a) this study has analyzed the economic impacts of the natural gas development projects in Tangguh Train 3 (West Papua), Kasuri Block (West Papua) and Masela Block (Maluku), (b) the utilization of the natural gas for domestic use: Fertilizer Industry, Petrochemical Industry and Gas Power Plant (PLTG) in West Papua Province and Maluku Province, (c) an analysis of the economic impacts on the economy of the provinces of Maluku, North Maluku, West Papua, Papua, Eastern Indonesia Area (4 Provinces combined), other 5 regions/islands (Sumatra Island, Java Island, Kalimantan Island, Sulawesi Island, and Bali-Nustra islands), and the national economy, (d) the Impact analysis for the next 20 years (2016-2035), which covers the pre-construction, construction and operational times of each project/activity, and (e) an analysis of the economic impact indicators in accordance with the IRIO Model capability. It consists of output, gross added value (NTB) or GRDP, household income (community) and workers, and other indicators that are the derivative indicators of these four indicators of economic impacts.

There are six (6) scenarios developed for the economic impact analysis of gas energy utilization in the Eastern Indonesian Region: (1) Baseline scenario (Business as Usual - BAU) (SIM0): without any natural gas development project or domestic natural gas utilization in the Eastern Indonesian Region; (2) Natural Gas Development (SIM1): with natural gas development projects (Tangguh Train 3, Kasuri, and Masela), and utilization similar to that of BAU (upstream development); (3) Natural Gas Development and Domestic Natural Gas Utilization for electricity in the Eastern Indonesian Region (SIM2); (4) Natural Gas Development and Utilization of domestic natural gas for electricity and fertilizer industry in the Eastern Indonesian Region (SIM3); (5) Natural Gas Development and Utilization of domestic natural gas for electricity and petrochemical industry in the Eastern Indonesian Region (SIM4); and (6) Natural Gas Development and Utilization of domestic natural gas for electricity, fertilizer industry, and petrochemical industry in the Eastern Indonesian Region (SIM5).

Some assumptions are used to construct baseline scenarios (BAU or SIM0) include: (A) projection of the population according to BPS population projection data by province for the years 2016-2035, (B) the total work force according to the average proportion of the population during 2010-2015 for each region, (C) the number of employment and unemployment according to the average in 2010-2015, (D) the PDRB of the Constant Price that grows with the pattern of that of 2015, (E) PDRB of Applicable Prices calculated by using inflation assumption (inflatoir of PDRB Deflator) by region, and (F) output and people's income assumed to be equal to its proportion against Gross Added Value (NTB) as in IRIO 2010 table.

### *2.2 Types and Sources of Data Required*

Table 2 summarizes of the types and sources of data needed to analyze the economic impacts of gas development projects (upstream) and utilization of gas energy for domestic purposes(downstream) in the Eastern Indonesian Region.

**Table 2.** Types and Sources of Data Required

| No. | Data Type | Source | Information |
|---|---|---|---|
| **1** | Table of National Input-Output | (BPS, 2015a) | Year 2010 (185 Sectors) |
| **2** | Table of Inter-Regional Input- Output (IRIO) Indonesia | (Bappenas, 2015) | Year 2010 (35 Sectors x 33 Provinces) |
| **3** | GDP of Indonesia | (BPS, 2015b) | Years 2000-2015 |
| **4** | PDRB of Provinces | (BPS, 2015c) | Years 2000-2015 |
| **5** | Population and Workers: Total and by national Sector | (BPS, 2015d) | Years 2000-2015 |
| **6** | Investment Plan for Natural Gas Development Projects | (SKKMIGAS, 2014) | Tangguh Train 3, Kasuri and Masela |
| **7** | Fertilizer Industry investment plan | (SKKMIGAS, 2016a) | Estimated from years 2016-2035 |
| **8** | Petrochemical Industry Investment Plan | (SKKMIGAS, 2016a) | Estimated from years 2016-2035 |
| **9** | Investment Plan for Gasoline Power Station | (SKKMIGAS, 2016b) | Estimated from years 2016-2035 |
| **10** | Production, Domestic Utilization and Domestic Gas Prices | (SKKMIGAS, 2016c) | Years 2010-2015 and the projection will be until 2035 |

## 3. Results and Discussion

### *3.1 Development Scenarios*

There are six predefined simulation scenarios, which cover the condition of business as usual, with only upstream projects, upstream projects with power stations, and those with added fertilizer industry and petrochemicals. In the discussion of each simulation scenario, shock values are generated, comprising investment shock, operating cost and consumption. The shocks are divided into 9 locations of shock sources and again by their relevant sectors. The researchers conducted the economic impact analysis by arranging six simulation scenarios, taking into consideration production capacity and gas allocation, gas selling price, and gas required to produce optimum projects with constant productions. Tangguh LNG Train 3, Onshore LNG Masela Development, and Kasuri Block fulfilled the gas needs for the projects as seen in Table 3.

**Table 3.** Simulation scenarios of Opportunities for Gas Energy Utilization of Eastern Indonesian Region

| Simulation (SIM) | Project |
|---|---|
| **Simulation 0 (SIM0)** | With Oil and Gas Project |
| **Simulation 1 (SIM1)** | Oil and Gas Upstream Project |
| **Simulation 2 (SIM2)** | SIM1 + Electricity Power Plant |
| **Simulation 3 (SIM3)** | SIM2 + Fertilizer Industry |
| **Simulation 4 (SIM4)** | SIM2 + Petrochemical Industry |
| **Simulation 5 (SIM5)** | SIM2 + Fertilizer Industry and Petrochemicals |

### *3.2 Shock Data Processing Results*

The summary of the shock data processing result is the sum of the investment shock, operation shock, and consumption shock. It starts from the upstream with three projects involved, namely Tangguh LNG Train 3, LNG Masela Onshore, and Kasuri Block, and from the downstream, i.e., the generation in the East Indonesia Region, as well as the development of fertilizer and petrochemical industries. There are nine (9) regions as the result of the grouping of the locations of the study. Grouping by region guarantees an easier next stage of data input on the model of economic impact analysis.

With the Onshore Masela LNG plan to start its operation in 2024, the contribution of the Maluku shock increases significantly in that year, for the next two (2) years, reaching the plateau in 2027. The magnitude of the consumption shock consists of the shock of LNG products marketed both export and domestic as the petroleum refining sector and coupled with the shock of the value of resources entering the oil and gas mining sector. The total shock of Maluku on SIM1 during the period of 2016-2035 reaches Rp810,6 trillion, equivalent to 52 percent of the total shock value of SIM1. The portion rises by 3 percent to 56,5 percent on SIM4 where the inclusion of generation and petrochemical industry leads to the addition of shock value of Rp1.015,8 trillion (Fig. 3).

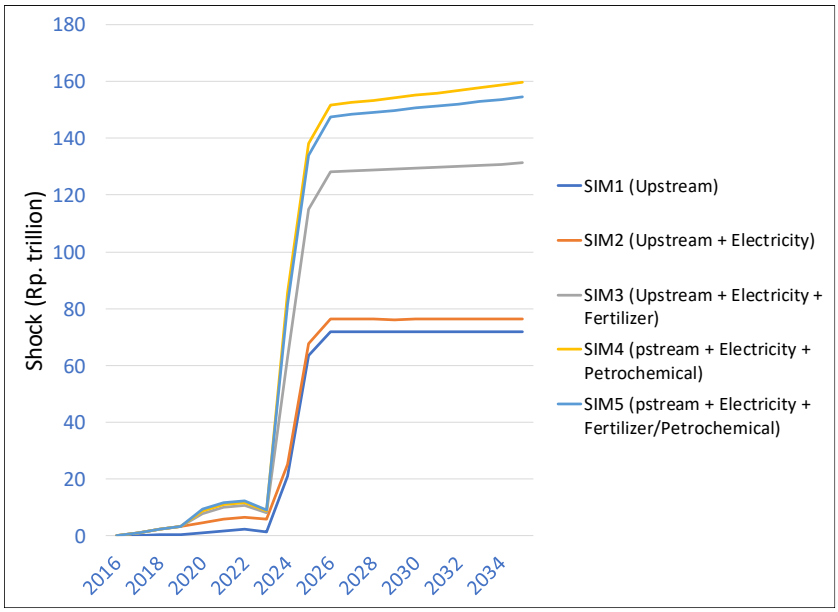



**Figure 3.** Summary of Shocks SIM1 up to SIM5 in Maluku Region

Interestingly, it is evident from the trend of the shock value in North Maluku Province, the contribution of the upstream project development only gives a shock value to the province an amount below Rp5,3 trillion. A more significant impact, which is obvious from the beginning, is the development of the massive electricity in the Eastern Indonesia Region. A sharp, direct increase occurs in the year 2017 with a shock value of Rp1,4 trillion; such a value includes an investment cost of at least 50 MW. In North Maluku alone the total electricity demand reaches 230 MW starting in 2023. The existence of fertilizer and petrochemical industry does not significantly increase the shock value from SIM2 to the next simulation; its added value is around Rp1,0 trillion in the fertilizer industry and Rp. 4.6-5.0 trillion if the one built is a petrochemical industry area. Similar to that in the Province of Maluku, the contribution from North Maluku is apparent during the Onshore LNG Masela operation; the consistent addition of Rp. 273 billion during 2024-2025 (Fig. 4) is the proof.

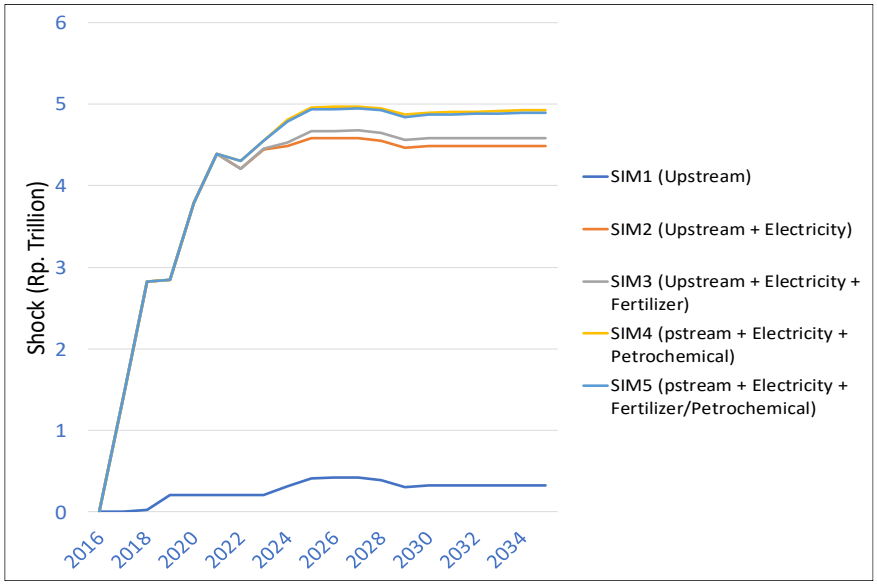



**Figure 4.** Summary of Shocks of SIM1 up to SIM5 in the North Maluku Region

In 2019, it is expected that Tangguh LNG Train 3 will be fully operational with 600 MMSCFD net gas and 3,8 MTPA LNG production capacity.[9] When viewed only from the value of the investment shock alone, the contribution of West Papua Province is not as high as that of the island of Java. For example, in 2016-2018, i.e., the development period, the shock of Java has reached Rp31,7 trillion, but the shock of West Papua is only around Rp9,0 trillion. Similar to Maluku, West Papua's biggest shock is from operation shock and consumption shock. The total shock value of West Papua is only from the upstream project, which reaches a mere of Rp555,4 trillion; the value is 66 percent in the petroleum refining sector, and the remaining 34 percent goes to the oil, gas and geothermal mining sectors. The spike occurring in 2022 or 2023 is due to the gas pipeline project for the fertilizer or petrochemical industrial needs in Bintuni Bay (Figure 10). SIM4 and five (5) indeed coincide in SIM5, and especially for Bintuni building, a fertilizer industry is not recommended.

The added value of SIM2 where West Papua Province is planned to increase its installed electricity capacity is to reach 210 MW, giving a total shock value to Rp609,8 trillion. In SIM3 by adding shock value to the development of fertilizer industry in Bintuni Bay, the shock value again increases to Rp823,3 trillion. Large inventions and large added values to the fertilizer industry can contribute to raising the total shock value to Rp974,6 trillion (Fig. 5).

The trend of shock values in Papua Province is identical with that in North Maluku Province; the contribution on the upstream side is limited to the shock of the operating cost, in which there are other service contributions from Papua Province at the time of upstream project of Rp200 billion per year. The highest shock is given by the investment value of the power plant infrastructure development in 2023 which reaches 315 MW and the biggest need among the other East Indonesia Regions. SIM4 has given the total shock of investment, operation, and consumption of the Papua Province with a value of Rp84,8 trillion, and the annual value has reached over Rp5 trillion in 2026-2035 (Fig. 6).

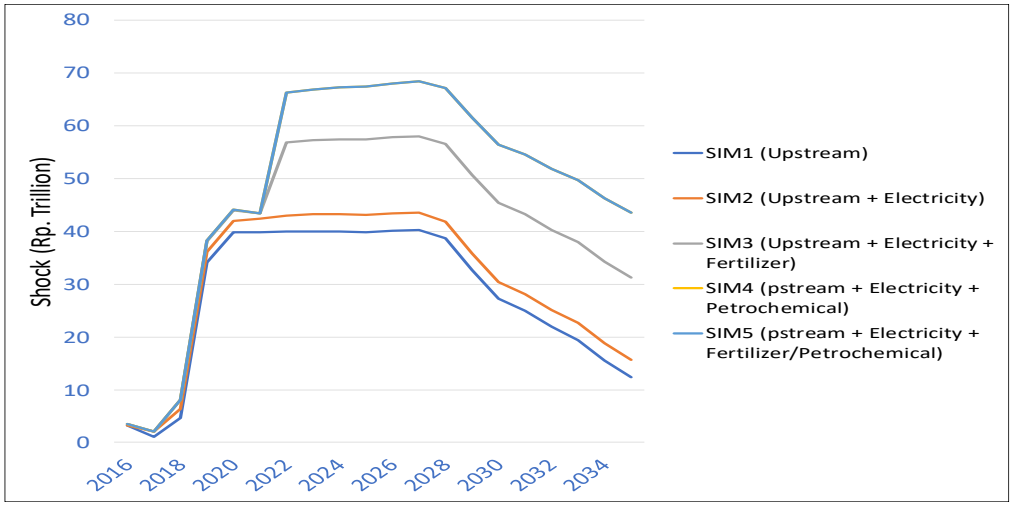



**Figure 5.** Summary of Shocks of SIM1 up to SIM5 in the West Papua Region

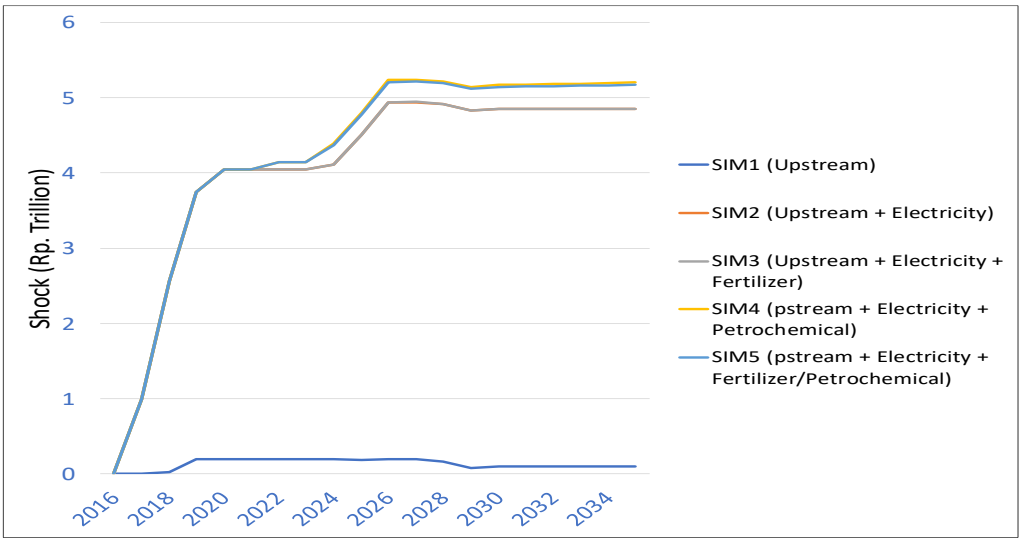



**Figure 6.** Summary of Shock SIM1 up to SIM5 in the Papua Region

*3.3 Results of Economic Impact*

Before the delivery of the results and discussions of the economic impacts of gas energy utilization in the Eastern Indonesian Region presented first are the basic assumptions, backward and forward linkage values, and multiplier values of the sectors related to natural gases in the Eastern Indonesian Region.

Some of the basic assumptions used in this study are:

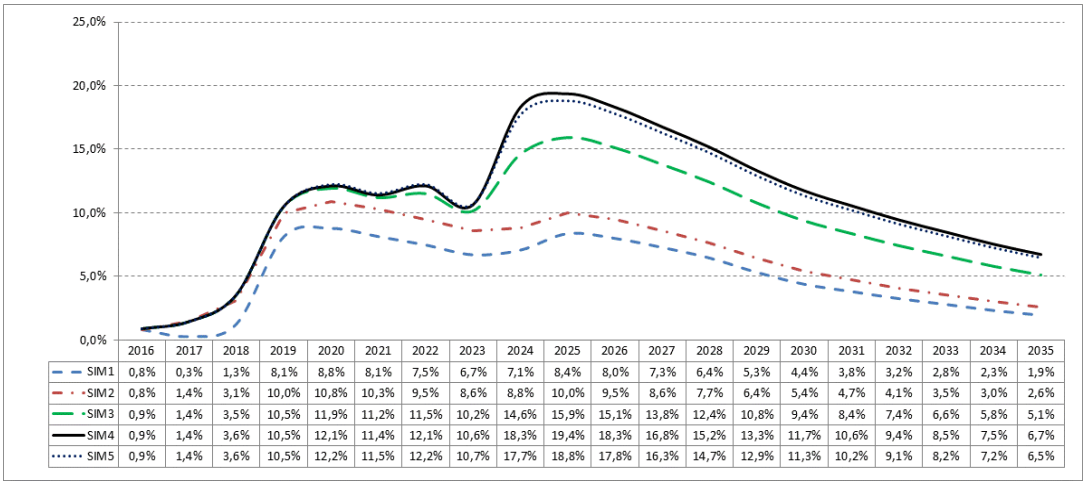
1. The projection of population is done according to the data from the BPS population projection by the province of 2016-2035[7].
2. The workforce is assumed for all formal and non-formal workers attributed to the gas industry. The number of employment and unemployment follows the average in 2010-2015
3. The calculation of the PDRB Applicable Price uses the inflation assumption (inflatable from PDRB Deflator) by region of IRIO Model used according to input-output (technology matrix) 2010 in which year oil, gas, and geothermal sectors belong to sector seven (7) and sector nine (9), which include oil and gas refineries and LNG refineries
4. The approach used is demand side.
5. Output and community's income are assumed to be equal to the proportion of the Gross Added Value (NTB) in IRIO Table 2010

6. The LNG price shall be adjusted to the PoD of Masela, i.e., the formula for exports, set at 13 percent and for domestic LNG at 11 percent of the oil price (set at US$70 /bbl), while for gas pipelines, at US$6 /MMBtu.
7. The priority of the gas production profile of Tangguh and Kasuri is on the petrochemical industry, amounting to 90 MMSCFD each (flat), hence the allocation of LNG for export decreases. The assumption in the WP&B 2017 is 55 percent for goods and 60 percent for service.

A. Impacts on Eastern Indonesian Region Economy

The impact of upstream and downstream developments of natural gas on the economy will be increasingly significant in the economy of smaller regions than that in the national territory. The provinces in Eastern Indonesian Region represent the location where about 90 percent of the final demand change (increase) occurs as a result of the upstream and downstream development of natural gas in this study. Conducting the upstream and downstream project (SIM 1) is the basis for all development scenarios that is able to improve the GDP ranging from 6,7 percent to 8,8 percent to the BAU for a period between year 2019-2015, and facilitating the region with electricity (SIM 2) will raise the GDP by about 1,6 percent to 2 percent to the SIM 1. Furthermore, developing a fertilizer industry (SIM 3) shows an apparent jump phenomenon at the year 2015 by 5,9 percent additional percentage of GDP to the previous scenario. Then, our simulations show that providing electricity and petrochemicals industry scenario (SIM 4) contributes the highest economic impacts, and it is slightly higher than that of the SIM5 (Electricity+Fertilizer industry+Petrochemicals Industry)), and therefore, all numbers discussed here refer to SIM4. It is important to note that the contribution (percentages) initially increases, reaches its peak in 2025/2026, and declines afterward. The decline in the rate of contribution is due to the assumption that BAU is forecasted to increase constantly as its projections are based on economic indicators which also constantly increase, while shock data are stable or in the plateau condition when gas production is reaching its optimum so that its absolute impacts will also constant (plateau). As a result, the magnitudes of absolute impacts compared to those of BAU projections will decline. RGDP in the Eastern Indonesian Region experiences an increase of about 19 percent of the BAU (Figure 7), income of the people in the Eastern Indonesian Region is estimated to increase by 20 percent from BAU (Figure 8) and employment absorption is expected to increase by nearly 55 percent of the BAU conditions (Figure 9), before started to decline.

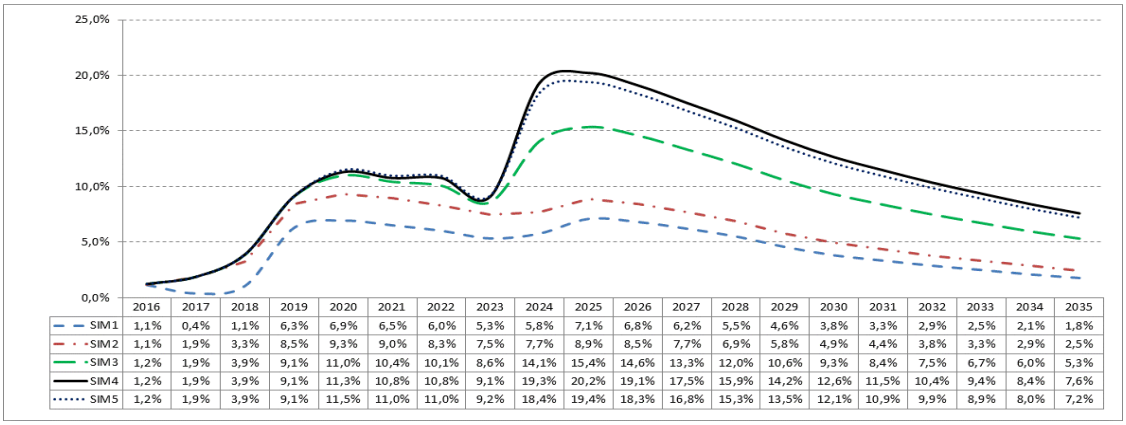
Concerning the development of the fertilizer industry, which has a vast, more direct social impact than the petrochemicals, the SIM 5 scenario shall be investigated further and might be one the best options. To anticipate the decrease in the gas production, the Local Government has to provide more investments in human resources (HR), and in other sectors of the economy besides natural gas, or even developing new upstream gas projects in each region, especially West Papua Province.




| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIM1 | 0,8% | 0,3% | 1,3% | 8,1% | 8,8% | 8,1% | 7,5% | 6,7% | 7,1% | 8,4% | 8,0% | 7,3% | 6,4% | 5,3% | 4,4% | 3,8% | 3,2% | 2,8% | 2,3% | 1,9% |
| SIM2 | 0,8% | 1,4% | 3,1% | 10,0% | 10,8% | 10,3% | 9,5% | 8,6% | 8,8% | 10,0% | 9,5% | 8,6% | 7,7% | 6,4% | 5,4% | 4,7% | 4,1% | 3,5% | 3,0% | 2,6% |
| SIM3 | 0,9% | 1,4% | 3,5% | 10,5% | 11,9% | 11,2% | 11,5% | 10,2% | 14,6% | 15,9% | 15,1% | 13,8% | 12,4% | 10,8% | 9,4% | 8,4% | 7,4% | 6,6% | 5,8% | 5,1% |
| SIM4 | 0,9% | 1,4% | 3,6% | 10,5% | 12,1% | 11,4% | 12,1% | 10,6% | 18,3% | 19,4% | 18,3% | 16,8% | 15,2% | 13,3% | 11,7% | 10,6% | 9,4% | 8,5% | 7,5% | 6,7% |
| SIM5 | 0,9% | 1,4% | 3,6% | 10,5% | 12,2% | 11,5% | 12,2% | 10,7% | 17,7% | 18,8% | 17,8% | 16,3% | 14,7% | 12,9% | 11,3% | 10,2% | 9,1% | 8,2% | 7,2% | 6,5% |

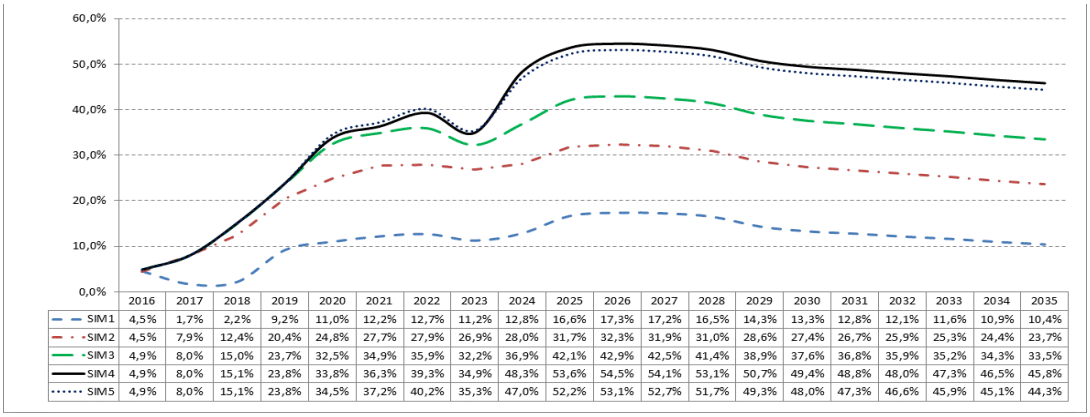
**Figure 7.** Impact of GDP Improvement in Eastern Indonesia Region against BAU (SIM0) by Simulation of Years 2016-2035 (in Percentage)

The anticipation can be done by allocating some portion of the allotted Profit Sharing Fund (DBH) of Natural Gas obtained from the upstream gas development project, either Masela, Tangguh Train 3 or Kasuri.




| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIM1 | 1,1% | 0,4% | 1,1% | 6,3% | 6,9% | 6,5% | 6,0% | 5,3% | 5,8% | 7,1% | 6,8% | 6,2% | 5,5% | 4,6% | 3,8% | 3,3% | 2,9% | 2,5% | 2,1% | 1,8% |
| SIM2 | 1,1% | 1,9% | 3,3% | 8,5% | 9,3% | 9,0% | 8,3% | 7,5% | 7,7% | 8,9% | 8,5% | 7,7% | 6,9% | 5,8% | 4,9% | 4,4% | 3,8% | 3,3% | 2,9% | 2,5% |
| SIM3 | 1,2% | 1,9% | 3,9% | 9,1% | 11,0% | 10,4% | 10,1% | 8,6% | 14,1% | 15,4% | 14,6% | 13,3% | 12,0% | 10,6% | 9,3% | 8,4% | 7,5% | 6,7% | 6,0% | 5,3% |
| SIM4 | 1,2% | 1,9% | 3,9% | 9,1% | 11,3% | 10,8% | 10,8% | 9,1% | 19,3% | 20,2% | 19,1% | 17,5% | 15,9% | 14,2% | 12,6% | 11,5% | 10,4% | 9,4% | 8,4% | 7,6% |
| SIM5 | 1,2% | 1,9% | 3,9% | 9,1% | 11,5% | 11,0% | 11,0% | 9,2% | 18,4% | 19,4% | 18,3% | 16,8% | 15,3% | 13,5% | 12,1% | 10,9% | 9,9% | 8,9% | 8,0% | 7,2% |

**Figure 8.** Impact of Increasing Community Income in Eastern Indonesia Region against BAU (SIM0) According to Simulation Years 2016-2035 (in Percentage)

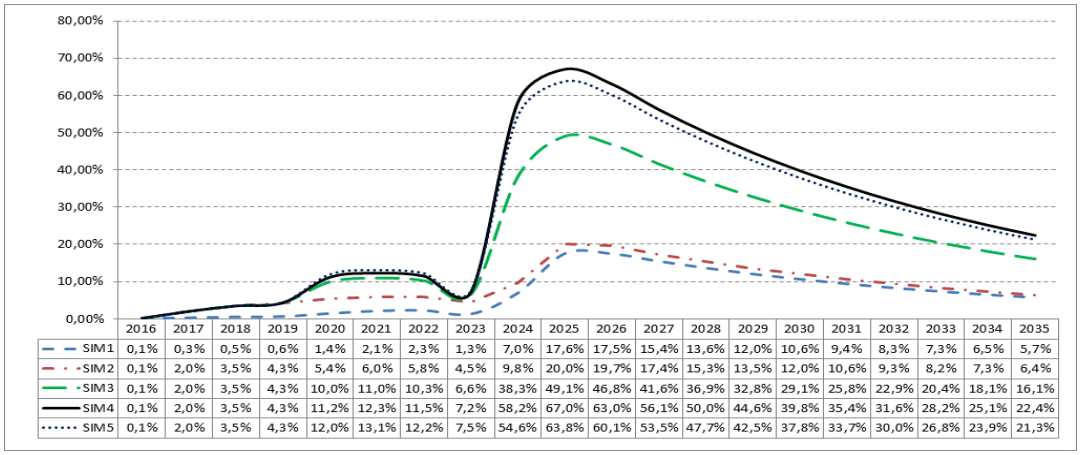



| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIM1 | 4,5% | 1,7% | 2,2% | 9,2% | 11,0% | 12,2% | 12,7% | 11,2% | 12,8% | 16,6% | 17,3% | 17,2% | 16,5% | 14,3% | 13,3% | 12,8% | 12,1% | 11,6% | 10,9% | 10,4% |
| SIM2 | 4,5% | 7,9% | 12,4% | 20,4% | 24,8% | 27,7% | 27,9% | 26,9% | 28,0% | 31,7% | 32,3% | 31,9% | 31,0% | 28,6% | 27,4% | 26,7% | 25,9% | 25,3% | 24,4% | 23,7% |
| SIM3 | 4,9% | 8,0% | 15,0% | 23,7% | 32,5% | 34,9% | 35,9% | 32,2% | 36,9% | 42,1% | 42,9% | 42,5% | 41,4% | 38,9% | 37,6% | 36,8% | 35,9% | 35,2% | 34,3% | 33,5% |
| SIM4 | 4,9% | 8,0% | 15,1% | 23,8% | 33,8% | 36,3% | 39,3% | 34,9% | 48,3% | 53,6% | 54,5% | 54,1% | 53,1% | 50,7% | 49,4% | 48,8% | 48,0% | 47,3% | 46,5% | 45,8% |
| SIM5 | 4,9% | 8,0% | 15,1% | 23,8% | 34,5% | 37,2% | 40,2% | 35,3% | 47,0% | 52,2% | 53,1% | 52,7% | 51,7% | 49,3% | 48,0% | 47,3% | 46,6% | 45,9% | 45,1% | 44,3% |

**Figure 9.** Impact of Increased Employment in Eastern Indonesia Region Relative to BAU (SIM0) by Simulation of Years 2016-2035 (in Percentage)

B. Impact on the Economy of Maluku Province

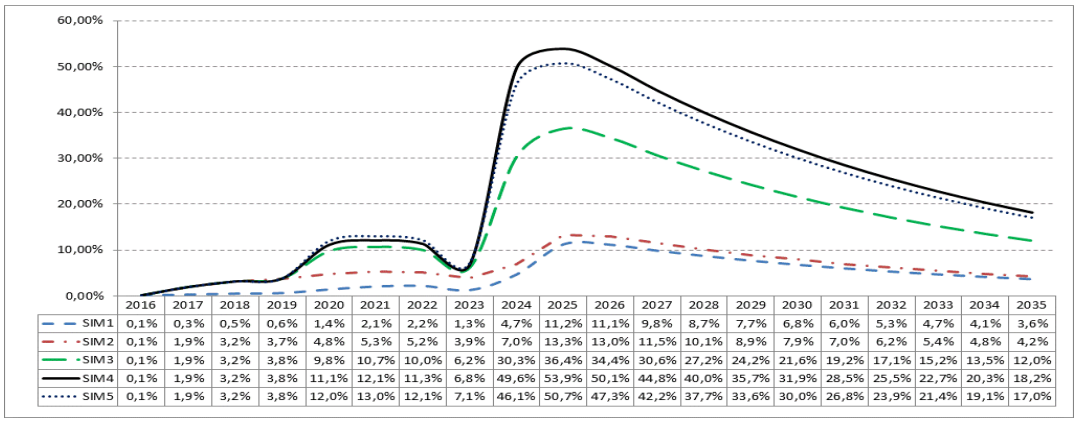
About 54 to 60 percent of increases in the final demand of various simulations in the upstream and downstream developments of gas takes place in Maluku Province. Therefore, both in value and percentage, the most significant impact for the provinces in the Eastern Indonesian Region occurs in Maluku; it is either in the increase of GRDP, community's incomes, or employment.[12,13] In terms of values, the impacts of upstream and downstream developments of gas in Maluku Province on GRDP, the income of the people, and employment will increase from time to time until 2035, due to the gas production in the Masela block that is predicted to remain stable from 2026 to 2035. The resulted patterns of the impact of values that occur in Maluku are different from those in other provinces in Indonesia, particularly in the Eastern Indonesian Region.




| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIM1 | 0,1% | 0,3% | 0,5% | 0,6% | 1,4% | 2,1% | 2,3% | 1,3% | 7,0% | 17,6% | 17,5% | 15,4% | 13,6% | 12,0% | 10,6% | 9,4% | 8,3% | 7,3% | 6,5% | 5,7% |
| SIM2 | 0,1% | 2,0% | 3,5% | 4,3% | 5,4% | 6,0% | 5,8% | 4,5% | 9,8% | 20,0% | 19,7% | 17,4% | 15,3% | 13,5% | 12,0% | 10,6% | 9,3% | 8,2% | 7,3% | 6,4% |
| SIM3 | 0,1% | 2,0% | 3,5% | 4,3% | 10,0% | 11,0% | 10,3% | 6,6% | 38,3% | 49,1% | 46,8% | 41,6% | 36,9% | 32,8% | 29,1% | 25,8% | 22,9% | 20,4% | 18,1% | 16,1% |
| SIM4 | 0,1% | 2,0% | 3,5% | 4,3% | 11,2% | 12,3% | 11,5% | 7,2% | 58,2% | 67,0% | 63,0% | 56,1% | 50,0% | 44,6% | 39,8% | 35,4% | 31,6% | 28,2% | 25,1% | 22,4% |
| SIM5 | 0,1% | 2,0% | 3,5% | 4,3% | 12,0% | 13,1% | 12,2% | 7,5% | 54,6% | 63,8% | 60,1% | 53,5% | 47,7% | 42,5% | 37,8% | 33,7% | 30,0% | 26,8% | 23,9% | 21,3% |

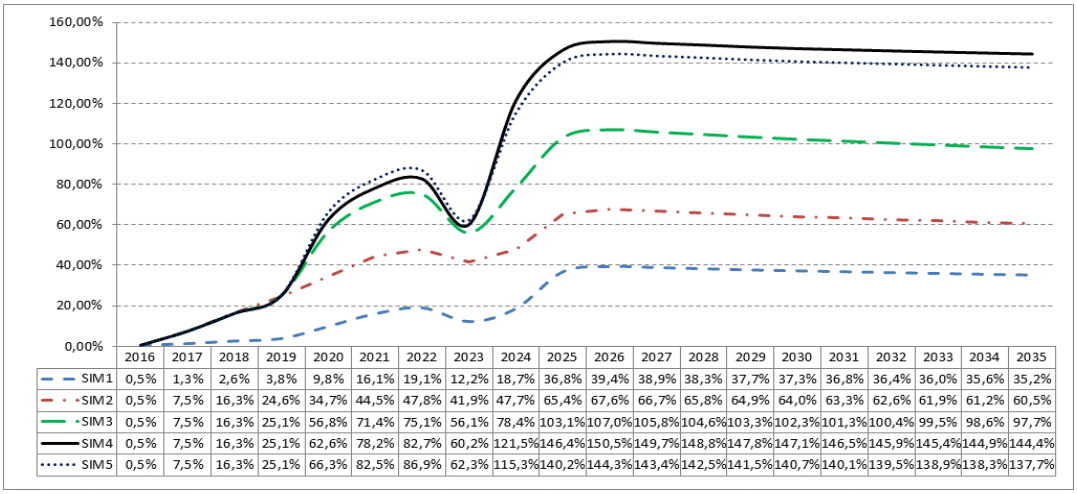
**Figure 10.** Impact of Increasing GDP of Maluku Province According to Simulations of BAU (SIM0) Years 2016-2035 (in Percentage)

In terms of percentage (i.e., the contribution relative to BAU condition), however, the simulations show declining figures after reaching its peak in 2025, particularly in both GRDP (Figure 10) and community's income (Figure 11). At its peaks, the upstream and downstream development of natural gas could have an increase in GRDP of about 67 percent and community's income by 54 percent. The rate of contribution for employment in Maluku Province, on the other hand, provides different patterns where it does not show declining pattern. This can be explained in part by the development of fertilizer and petrochemical industries which is expected to absorb more workers starting from the year of 2024 (see SIM3, SIM4, and SIM5). With the decline in contribution rates for GRDP and community's income, the Provincial Government of Maluku shall anticipate such decline in order to keep the economy in a good phase.




| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIM1 | 0,1% | 0,3% | 0,5% | 0,6% | 1,4% | 2,1% | 2,2% | 1,3% | 4,7% | 11,2% | 11,1% | 9,8% | 8,7% | 7,7% | 6,8% | 6,0% | 5,3% | 4,7% | 4,1% | 3,6% |
| SIM2 | 0,1% | 1,9% | 3,2% | 3,7% | 4,8% | 5,3% | 5,2% | 3,9% | 7,0% | 13,3% | 13,0% | 11,5% | 10,1% | 8,9% | 7,9% | 7,0% | 6,2% | 5,4% | 4,8% | 4,2% |
| SIM3 | 0,1% | 1,9% | 3,2% | 3,8% | 9,8% | 10,7% | 10,0% | 6,2% | 30,3% | 36,4% | 34,4% | 30,6% | 27,2% | 24,2% | 21,6% | 19,2% | 17,1% | 15,2% | 13,5% | 12,0% |
| SIM4 | 0,1% | 1,9% | 3,2% | 3,8% | 11,1% | 12,1% | 11,3% | 6,8% | 49,6% | 53,9% | 50,1% | 44,8% | 40,0% | 35,7% | 31,9% | 28,5% | 25,5% | 22,7% | 20,3% | 18,2% |
| SIM5 | 0,1% | 1,9% | 3,2% | 3,8% | 12,0% | 13,0% | 12,1% | 7,1% | 46,1% | 50,7% | 47,3% | 42,2% | 37,7% | 33,6% | 30,0% | 26,8% | 23,9% | 21,4% | 19,1% | 17,0% |

**Figure 11.** Impact of Increasing Income in Maluku Province According to Simulations of BAU (SIM0) Years 2016-2035 (in Percentage)




| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIM1 | 0,5% | 1,3% | 2,6% | 3,8% | 9,8% | 16,1% | 19,1% | 12,2% | 18,7% | 36,8% | 39,4% | 38,9% | 38,3% | 37,7% | 37,3% | 36,8% | 36,4% | 36,0% | 35,6% | 35,2% |
| SIM2 | 0,5% | 7,5% | 16,3% | 24,6% | 34,7% | 44,5% | 47,8% | 41,9% | 47,7% | 65,4% | 67,6% | 66,7% | 65,8% | 64,9% | 64,0% | 63,3% | 62,6% | 61,9% | 61,2% | 60,5% |
| SIM3 | 0,5% | 7,5% | 16,3% | 25,1% | 56,8% | 71,4% | 75,1% | 56,1% | 78,4% | 103,1% | 107,0% | 105,8% | 104,6% | 103,3% | 102,3% | 101,3% | 100,4% | 99,5% | 98,6% | 97,7% |
| SIM4 | 0,5% | 7,5% | 16,3% | 25,1% | 62,6% | 78,2% | 82,7% | 60,2% | 121,5% | 146,4% | 150,5% | 149,7% | 148,8% | 147,8% | 147,1% | 146,5% | 145,9% | 145,4% | 144,9% | 144,4% |
| SIM5 | 0,5% | 7,5% | 16,3% | 25,1% | 66,3% | 82,5% | 86,9% | 62,3% | 115,3% | 140,2% | 144,3% | 143,4% | 142,5% | 141,5% | 140,7% | 140,1% | 139,5% | 138,9% | 138,3% | 137,7% |

**Figure 12.** Impact of Increasing Employment in Maluku Province According to Simulations of BAU (SIM0) Years 2016-2035 (in Percentage)

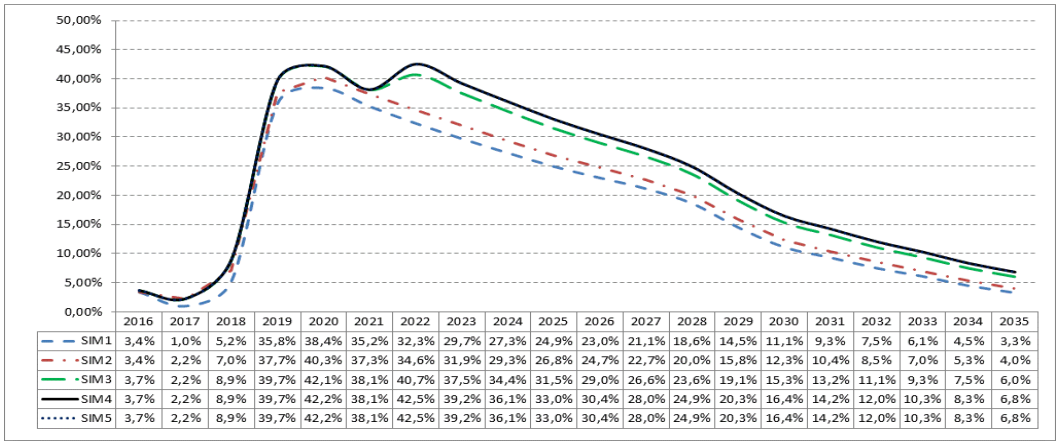
Based on the simulation results above, a conclusion can be drawn that the impact of upstream natural gas development and utilization of natural gas in the Eastern Indonesian Region, measured by the percentage of the increase from BAU, significantly increases at the beginning, especially at the start of the project development and the peak of production. The highest rise in the percentage occurs in around 2025 and 2026, after which the impact percentage begins to decline drastically, especially for the PDRB and the community's income. As for the increases in employment, on the other hand, the decline occurs slowly. The government needs to anticipate significant decreases in the increasing impacts of 2025/2026 by developing or performing transformations in other sectors to avoid resource curse while maintaining a faster economic growth of the Eastern Indonesian Region. Mitigation against the possibility of a decline in the economy can also be done by continuously investing in the oil and gas sector.

C. Impact on the Economy of West Papua Province

West Papua is the second largest province in the Eastern Indonesian Region where upstream and downstream developments of natural gas of Tangguh Train 3 and Kasuri are located. Our simulations indicate that the economic impact in the form of values of GRDP, incomes, and employment is increasing. However, it starts to decline earlier than that of the Maluku case as the gas production of Tangguh and Kasuri will start to decline as early as 2028. The pattern of the impacts is similar to that of the national economy and the economy of the Eastern Indonesian Region.

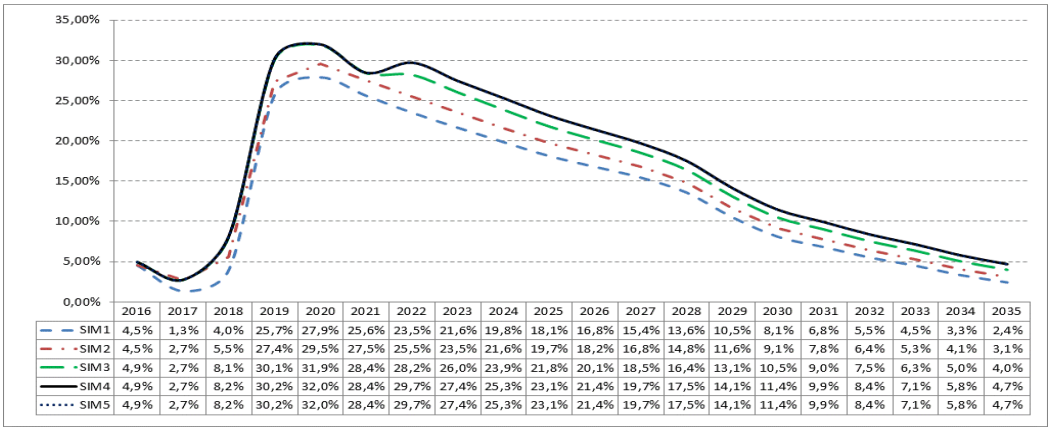
In terms of rate of contribution (SIM4), the upstream and downstream developments of the natural gas in the Eastern Indonesian Region have an impact on the increase of GRDP of West Papua Province by about 42 percent (Fig. 13) and on community's income by 32 percent (Fig. 14) on their peaks that occur in 2020 (where production reaches its peak). The impact on employment is somewhat different. As shown in Figure 15, the impact on employment is expected to double, i.e., 100 percent above the BAU scenario. One possible explanation is that the BAU data on employment in West Papua is quite low so that the development of mainstream and downstream industries will absorb a number of new workers as what happens under the BAU condition. However, careful interpretations should be given to such numbers. Another point on the employment aspect is that the impact decline is slower than those of GRDP and income.

Further investigations on the results indicate that the rate of decline in both GRDP and income are quite fast, suggesting immediate anticipation and response from the local government as well as the central government.



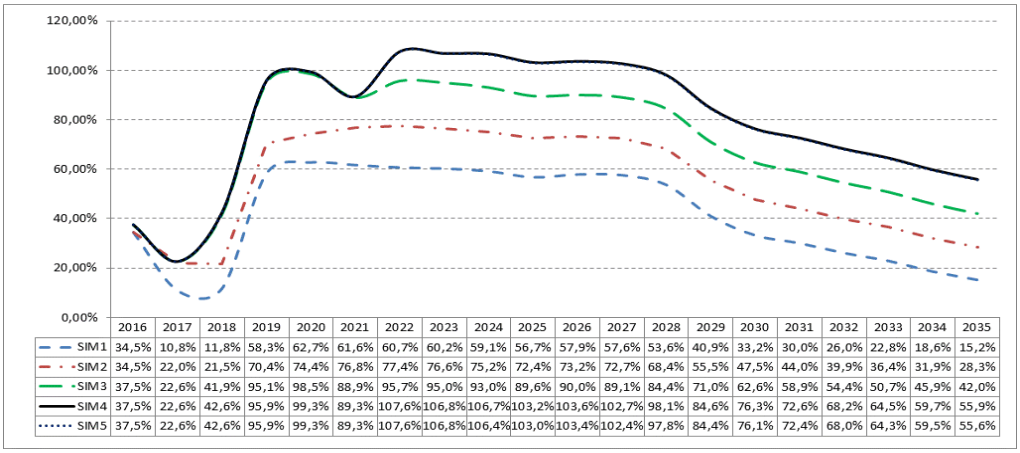

| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIM1 | 3,4% | 1,0% | 5,2% | 35,8% | 38,4% | 35,2% | 32,3% | 29,7% | 27,3% | 24,9% | 23,0% | 21,1% | 18,6% | 14,5% | 11,1% | 9,3% | 7,5% | 6,1% | 4,5% | 3,3% |
| SIM2 | 3,4% | 2,2% | 7,0% | 37,7% | 40,3% | 37,3% | 34,6% | 31,9% | 29,3% | 26,8% | 24,7% | 22,7% | 20,0% | 15,8% | 12,3% | 10,4% | 8,5% | 7,0% | 5,3% | 4,0% |
| SIM3 | 3,7% | 2,2% | 8,9% | 39,7% | 42,1% | 38,1% | 40,7% | 37,5% | 34,4% | 31,5% | 29,0% | 26,6% | 23,6% | 19,1% | 15,3% | 13,2% | 11,1% | 9,3% | 7,5% | 6,0% |
| SIM4 | 3,7% | 2,2% | 8,9% | 39,7% | 42,2% | 38,1% | 42,5% | 39,2% | 36,1% | 33,0% | 30,4% | 28,0% | 24,9% | 20,3% | 16,4% | 14,2% | 12,0% | 10,3% | 8,3% | 6,8% |
| SIM5 | 3,7% | 2,2% | 8,9% | 39,7% | 42,2% | 38,1% | 42,5% | 39,2% | 36,1% | 33,0% | 30,4% | 28,0% | 24,9% | 20,3% | 16,4% | 14,2% | 12,0% | 10,3% | 8,3% | 6,8% |

**Figure 13.** Impact of GDP Improvement of West Papua Province According to Simulations of BAU (SIM0) Years 2016-2035 (in Percentage)




| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIM1 | 4,5% | 1,3% | 4,0% | 25,7% | 27,9% | 25,6% | 23,5% | 21,6% | 19,8% | 18,1% | 16,8% | 15,4% | 13,6% | 10,5% | 8,1% | 6,8% | 5,5% | 4,5% | 3,3% | 2,4% |
| SIM2 | 4,5% | 2,7% | 5,5% | 27,4% | 29,5% | 27,5% | 25,5% | 23,5% | 21,6% | 19,7% | 18,2% | 16,8% | 14,8% | 11,6% | 9,1% | 7,8% | 6,4% | 5,3% | 4,1% | 3,1% |
| SIM3 | 4,9% | 2,7% | 8,1% | 30,1% | 31,9% | 28,4% | 28,2% | 26,0% | 23,9% | 21,8% | 20,1% | 18,5% | 16,4% | 13,1% | 10,5% | 9,0% | 7,5% | 6,3% | 5,0% | 4,0% |
| SIM4 | 4,9% | 2,7% | 8,2% | 30,2% | 32,0% | 28,4% | 29,7% | 27,4% | 25,3% | 23,1% | 21,4% | 19,7% | 17,5% | 14,1% | 11,4% | 9,9% | 8,4% | 7,1% | 5,8% | 4,7% |
| SIM5 | 4,9% | 2,7% | 8,2% | 30,2% | 32,0% | 28,4% | 29,7% | 27,4% | 25,3% | 23,1% | 21,4% | 19,7% | 17,5% | 14,1% | 11,4% | 9,9% | 8,4% | 7,1% | 5,8% | 4,7% |

**Figure 14.** Impact of Increase in Community's Income of West Papua Province According to Simulations relative to BAU (SIM0) in years 2016-2035 (in Percentage)




| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIM1 | 34,5% | 10,8% | 11,8% | 58,3% | 62,7% | 61,6% | 60,7% | 60,2% | 59,1% | 56,7% | 57,9% | 57,6% | 53,6% | 40,9% | 33,2% | 30,0% | 26,0% | 22,8% | 18,6% | 15,2% |
| SIM2 | 34,5% | 22,0% | 21,5% | 70,4% | 74,4% | 76,8% | 77,4% | 76,6% | 75,2% | 72,4% | 73,2% | 72,7% | 68,4% | 55,5% | 47,5% | 44,0% | 39,9% | 36,4% | 31,9% | 28,3% |
| SIM3 | 37,5% | 22,6% | 41,9% | 95,1% | 98,5% | 88,9% | 95,7% | 95,0% | 93,0% | 89,6% | 90,0% | 89,1% | 84,4% | 71,0% | 62,6% | 58,9% | 54,4% | 50,7% | 45,9% | 42,0% |
| SIM4 | 37,5% | 22,6% | 42,6% | 95,9% | 99,3% | 89,3% | 107,6% | 106,8% | 106,7% | 103,2% | 103,6% | 102,7% | 98,1% | 84,6% | 76,3% | 72,6% | 68,2% | 64,5% | 59,7% | 55,9% |
| SIM5 | 37,5% | 22,6% | 42,6% | 95,9% | 99,3% | 89,3% | 107,6% | 106,8% | 106,4% | 103,0% | 103,4% | 102,4% | 97,8% | 84,4% | 76,1% | 72,4% | 68,0% | 64,3% | 59,5% | 55,6% |

**Figure 15.** Impact of Employment Increase of West Papua Province According to Simulations relative to BAU (SIM0) in years 2016-2035 (in Percentage)

## 4. Conclusion

Based on the results of the techno-economic analysis and the economic impact analysis of the upstream and the downstream sectors on the Eastern Indonesia Region, the following concludes this study:

1. The upstream and downstream project (SIM 1) is probably the most dominant contribution for all development scenarios, which is able to improve the Regional GDP ranging from 6,7 percent to 8,8 percent to the BAU for a period between the year 2019-2015.
2. This study indicates that providing electricity is a must do and thereby developing industries of fertilizer and petrochemicals will be able to improve the economy significantly.
3. Developing the fertilizer industry has a potential to boost the economy in the year 2015 by 5,9 percent, an additional percentage of GDP to the BAU after the establishment of the project and electricity facilities.
4. Although there is an indication that the development of fertilizer industry together with petrochemicals industry (SIM 5) is very slightly lower than the development of only petrochemicals industry (SIM 4), it is clear that the former will be able to contribute much bigger social impact. This shall, therefore, be taken into consideration for further investigation.
5. This study suggests that providing electricity and developing petrochemicals industry (SIM4) would contribute the highest economic impacts, i.e., RGDP in the Eastern Indonesian Region, which experiences an increase of about 19 percent of that of the BAU. The income of the people in the Eastern Indonesian Region is estimated to increase by 20 percent from BAU, and employment is expected to increase by nearly 55 percent of the BAU conditions, which is predicted to occur in 2026.
6. Maluku province has the greatest impact of upstream and downstream development (54 – 60 percent); the increase of GDP of Maluku Province reaches 67 percent, and the increase of people's income reaches 54 percent when compared to that of BAU scenario that occurs in the year 2025. The impact in the form of increased employment is also quite high, i.e., a rise of 150 percent when compared to that of BAU
7. The profile of the economic impact in West Papua Province is that the highest point of the increase of GRDP occurs in the year 2019 amounting to 39,7 percent, community's income to 32 percent (2020), and West Papua's employment an increase to 107 percent in 2024.
8. A general conclusion regarding the pattern of economic impacts is that the rate of the contribution relative to BAU initially increases, reaches its peak, and then declines. The period of decline occurs as soon as the gas production reaches its peak. This pattern provides an alarm for the government (local and central) of the possible drawback economic impacts. The governments shall develop or provide investments in other sectors (non-oil and gas) necessarily enough to offset the decline in the economic contribution of the oil and gas sector and to keep the economy in a good phase. This may include developing agricultural sector, tourism sector, and maritime and fishery sectors. More investments on oil and gas to find new oil and gas fields are also an option.

## Acknowledgments

We would like to express our gratitude to SKK Migas and LEMIGAS for their support and trust to the team of the study on the economic impact of gas development in East Indonesia. Also, the authors are in debt to the team of the study of Gas Resources Utilization of Tangguh, Masela, and Kasuri Blocks for East Indonesia.

**References**

BAPPENAS. (2015). Peta konektivitas ekonomi antar Pulau dan Wilayah Indonesia Timur, IRIO Indonesia tahun 2010.

BPS Provinsi Maluku. (2016). Indeks Pembangunan Manusia Provinsi Maluku 2015.

BPS Provinsi Maluku. (2016). Indikator Kesejahteraan Rakyat Provinsi Maluku 2015.

BPS Provinsi Maluku. (2016). Produk Domestik Regional Bruto Provinsi Maluku menurut Lapangan Usaha 2011-2015.

BPS Provinsi Maluku. (2016). *Provinsi Maluku Dalam Angka 2016.*

BPS. (2015a). Tabel Input-Output Indonesia 2010.

BPS. (2015b). Maluku dalam Angka.

BPS. (2015c). Papua Barat dalam Angka.

BPS. (2015d). Statistik Indonesia.

Kementerian Perindustrian, Bappenas. (2014). *Rencana Pembangunan 14 Kawasan Industri (RPJMN 2015-2019).*

Kementerian Perindustrian. (2014a). *Rencana Induk Pengembangan Industri Nasional (RIPIN) 2015-2035, Pusat Komunikasi Publik.*

Kementerian Perindustrian. (2014b). *Profil Industri Petrokimia Hulu.*

Kementerian Perindustrian. (2016b). *SK Menteri Perindustrian No. 634/M-IND/11/2016 Tanggal 4 November 2016 mengenai Kebutuhan Gas Bumi dari Blok Masela untuk Pembangunan Industri Petrokimia di Maluku.*

*Proyek Pembangunan Industri Petrokimia di Teluk Bintuni* [Presentasi oleh Direktur Industri Kimia Hulu, Ditjen Industri Kimia, Tekstil, dan Aneka, Kementerian Perindustrian, Bali 23-24 November 2016]. (2016a). Jakarta: Kementerian Perindustrian

SKK Migas. (2014). *Proyek LNG Tangguh: UPP Tangguh Train-3* [not published].

SKK Migas. (2016a). *Kajian Pengembangan dan Hilirisasi industri berbasis Gas "WK Masela, Tangguh & Kasuri", Divisi Pengkajian & Pengembangan* [not published].

SKK Migas. (2016b). *Pre Feasibility Study LNG Distribution for Electricity in Papua* Region [not published].

SKK Migas. (2016c). *Pembuatan peta potensi permintaan energi gas untuk pembangunan Kelistrikan, Industri Pupuk dan Petrokimia di Wilayah Indonesia Timur (dari Lokasi Blok Tangguh, Masela, dan Kasuri)* [not published].

*World Development Indicators*. (n.d.). The World Bank. Retrieved from https://datacatalog.worldbank.org/dataset/world-development-indicators