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Optimization of Pipeline Natural Gas Selling Price in the Oil and Gas Downstream Business Activities in the Industrial Sector in East Java Region

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Abstract

Indonesia regulates the pipeline gas selling price in oil and gas downstream business activities by issuing the Minister of Energy and Mineral Resources Regulation Number 58 of 2017. It has formulated the gas price by calculating the trading companies' internal rate of return and margin but has not yet considered the purchasing power of their consumers and the gas price zone determination for when the gas price will be implemented. The study aims to optimize the gas price for industrial sector in the existing sales areas in 10 cities in East Java. The optimization is conducted by considering the pricing zones, producer net backs, and consumer social welfare on the gas price calculation. The optimal gas price is calculated using multi-objective optimization method to obtain the optimum point between the net back and social welfare functions. The study found that the gas pool is an optimal pricing zone due to have minimum effect for consumers and easy implementation for trading gas companies and government. The gas pool price can cover several cities that have different levels of market maturity. The optimal gas price in East Java gas pool is around 10.36 to 13.08 USD/MMBTU that the formulation of gas prices regulation is on this range.

Keywords: *distribution pipeline, gas price, energy economics, energy policy, net back, social welfare*

1. Introduction

Natural gas is one of the strategic energy resources in Indonesia. The domestic production of gas is owned by the state and is principally used to achieve the nation's prosperity. To optimize the gas utilization in the country, the government encourages the development of natural gas pipelines infrastructure throughout the region [1]. A step toward this goal was issuing the Minister of Energy and Mineral Resources (MEMR) Regulation Number 58 of year 2017 concerning the Pipeline Gas Selling Price in Oil and Gas Downstream Business Activities [2]. This Minister Regulation regulates natural gas selling price at the consumer levels across many sectors, such as the electricity production and industrial sectors. The price is controlled by setting the Internal Rate of Return (IRR) and trading margins. This means that Indonesia has a new pricing policy by fully implementing a cost-of-service regulation system in the gas distribution pipeline as well as gas transmission pipeline.

The new policy will impact the natural gas trading companies and their consumers. According to Zhang et al. (2017), natural gas prices greatly influence the prices of other products in the commodity market as well as most aspects of the macro-economy [3]. The natural gas price will affect the prices of other commodities price that use natural gas as a feedstock and/or an energy source. If natural gas is used for feedstock, its price will affect

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the selling price of the final product; if it is used for energy, the industry will consider using the alternative energy source, such as diesel oil, liquefied petroleum gas (LPG), and compressed natural gas (CNG).

To achieve the target of 24% natural gas share in the primary energy mix by 2025 [4], the government needs to make the price of natural gas more competitive than those of other fossil energy sources that are not environmentally friendly. There are two important ways for optimizing the determination of the natural gas selling price in the national downstream business: 1. controlling the fair gas pricing between the gas trading companies and their consumers and 2. controlling the fair gas pricing among regions in Indonesia. Before the MEMR Regulation Number 58 of year 2017 was issued, gas trading companies had applied the gas price based on a zone system, which had the same gas pipeline infrastructure (looping) and other business-to-business pricing systems. The MEMR regulation has formulated the gas selling price by calculating the trading companies return but has not yet considered the return on their consumer. The regulation also does not include the gas price zone determination for when the gas price will be implemented.

When gas prices are determined by a zone system, the prices are the same for each category of network operating pressure in a distribution network area without considering the locations of the receiving and delivery points [5]. The natural gas prices in several countries have shown a convergence in which gas differences tend to decrease. For the state of art, Kuper et al. (2016) evaluate the contribution of nine institutional changes to the integration of the Dutch and German gas markets [6]. Chiappini et al. (2019) studied and focused on the worldwide integrated market between U.S., European and Asian [7]. Bastianin et al. (2019) studied the determinants of cross-country convergence of natural gas prices for industrial consumers in fourteen European countries [8]. Therefore, the objective of this paper is to analyse and optimize the pipeline gas selling price by considering the determination zones, producer net backs, and consumer social welfare.

2. Methodology

In this study, the downstream gas selling price is optimized by considering the size of the pricing zone, the social welfare values of consumers, and the producer net backs to obtain a balance price. This study examines three sizes of pricing zones: 1) the Distribution Network Area (WJD), 2) the Gas Pool Area, and 3) the National Area. Social welfare and net back factors are examined with two IRR variable methods: 1) MEMR Regulation Number 58 of year 2017 (PME 58/17) and 2) Weighted Average Cost of Capital (WACC). The determination of gas prices is conducted by linear multi-objective optimization using the graph method.

2.1. The Natural Gas Selling Price

The downstream gas selling price (DP) is the selling price of natural gas through pipes in the downstream business activities for manufacturing industries (ISIC code: section C) as the one of natural gas trading companies's consumers sector [9]. The types of manufacturing are except industries that use gas as raw material (feedstock) and power plant. DP is the maximum weighted average price that is used as a reference by the trading companies in the imposition of prices on their consumers [2]. The calculation in this study is performed using the free cash flow method with the following basic formula:

$$DP = UP + DPC + TC \quad (1)$$

$$DPC = TPC + RCC + \frac{DEP+OPEX+TAX+RE+LEVY}{Q} \quad (2)$$

where, in Equation 1 DP is the downstream gas selling price (US$/MMBTU), UP is the upstream gas price (US$/MMBTU), DPC is the distribution pipeline cost (US$/MMBTU), and TC is the trading cost (US$/MMBTU). In Equation 2, TPC is the

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transmission pipeline cost (US$/MMBTU), RCC is the regasification or compression cost (US$/MMBTU), DEP is the annual depreciation (US$), OPEX is the annual operational expenditure (US$), TAX is the annual tax (US$), RE is the annual return (US$), LEVY is the annual levy (US$), Q is the annual quantity (MMBTU).

The DP is calculated in two IRR variable methods. First, IRR is equal to 11% that is maximize IRR for existing distribution pipeline system according to PME 58/17. Second, the IRR is equal to WACC calculated with economic data in Indonesia and United States (US) as reference country. Variables in the WACC include risk free rate, beta, base premium for mature equity market, Indonesian internal country risk premium (ICRP), etc. Capital funding consist of equity and debt which ratio is obtained from the annual report 2018 of a natural gas trading company in Indonesia. The value is 47.7% equity and 52.3% debt.

There are same parameter for IRR PME 58/17 and WACC, as below:

1) The trading cost value is 7% of upstream gas price;
2) The pipeline economic lifetime is 15 years;
3) The maximum inflation is 2% (US basis calculation);
4) The depreciation is on straight line with salvage value = 0;
5) The government tax is 25% and the levy is 0.3%;

2.2. Pricing Zones.

Figure 1 illustrates the pricing zone of WJD, gas pool, and national. WJD is the smallest area for determining the natural gas selling price. In this study, it is assumed to be a city administration area. Each city in the WJD pricing will has own natural gas price. The Gas Pool is a pricing zone that usually consists of several WJDs that have one natural gas distribution pipeline infrastructure system (looping). Cities with same gas pool will have similar price. Then, the National Area is the biggest pricing zone that applies gas price nationally without any price difference among cities.

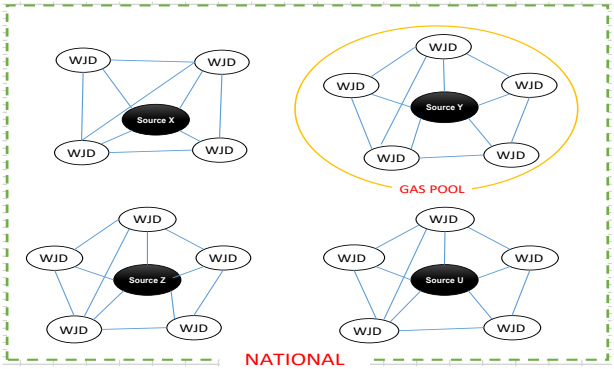

Figure 1. Pricing Zones in the Downstream Gas Selling Price

2.3. Consumer Social Welfare and Producer Net backs.

The social welfare value is often used as an objective function in calculating competitive equilibrium in commodity markets. On the consumer side, the welfare value of a good or service is a consumer surplus calculated from the difference between the value of the buyer at the level of consumption of a good and the value that the buyer must pay to get the good.

$$SW = (WP - DP)Q_i \quad (3)$$

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The calculation of willingness to pay (WP) from natural gas consumers is represented in the form of substitution energy prices from natural gas. In this case, the substitution energy price is the average price of coal, fuel oil and bulk LPG that used to manufacturing industries in Indonesia (Equation 5).

$$WP = \sum_{i=1}^{I} y_i ESP_i \quad (4)$$

Kenton (2019) defines net back value (NB) as the difference in cost to bring one unit of product to the market with revenue from the sale of the same product. In this study, net back representing the interests of government from upstream to downstream natural gas business. The following is the equation for producer net backs for natural gas trading business in the downstream scheme:

$$NB = (DP - DPC - TC - TPC - RCC - UPC - CSC)Q_i \quad (5)$$

where in Equation (3) to (5), SW is the social welfare (US$), WP is the willingness to pay (US$/MMBTU), ESP is the substitution energy prices (US$/MMBTU), NB is the net back (US$), DP is the downstream gas selling price (US$/MMBTU), UPC is the upstream production cost (US$/MMBTU), CSC is the contractor sharing cost in the upstream production sharing contract.

3. Scope of Study

This study is conducted in an existing area that already has a natural gas distribution network in Eastern Java. There are 10 distribution network areas (WJD) which is a part of the East Java gas pool. The limitation of this research is the calculation of the natural gas selling prices for manufacture industrial (ISIC code: section C) consumers exclude gas as feed stock and power plants. The scheme of natural gas distribution through pipeline in the East Java province start from domestic gas wells in East Java end to industrial consumers using transmission and distribution pipeline. Natural gas selling price calculation is applied to trading companies by calculating costs incurred up to the industrial consumers. Furthermore, the data in the study are data from 2018 so that the results of gas price optimization could change according to Indonesia Crude Petroleum (ICP).

4. Optimization of Downstream Gas Selling Price

Multi-objective optimization is used to obtain value of two function, NB and SW. A curve between NB-SW and the selling price of natural gas to obtain the intersection as its optimum downstream gas selling price (DP). This method is in accordance with the study of Bhattacharya (2011) which illustrates the point of equilibrium between the surplus of buyers and sellers at the intersection of 2 linear lines [10]. The initial value to determine the sensitivity of the NB and SW is modeled in the specified range of DP. The range starts from 4 to 26 US$/MMBTU.

5. Result and Discussion

5.1. Willingness to Pay Value (WP)

Based on Equation 4, the value of natural gas WP is the average of its substitute fuels in the form of coal, fuel oil (kerosene, CN 48, IDO, and MFO) and liquefied petroleum gas (LPG). The national calculation of WP uses the demand data of substitute fuel that is listed in HESI 2018 and the substitution energy price data in 2018 [11]. The national WP value is 11.81 US$/MMBTU (WP1). Then, the gas pool WP from demand data of substitute fuel in East Java province is 17.3 US$/MMBTU (WP2). WP1 and WP2 are used for SW1 and SW2 calculation (Equation 3).

5.2. Result of Downstream Gas Selling Price Calculation

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There are 4 calculation basis of downstream gas selling price: IRR 11% from PME 58/11(DP1), IRR 8.86% from calculation of WACC (DP2), multi-objective optimization with NB & national SW (DP3), and multi-objective optimization with NB & gas pool SW (DP4). Figure 2 shows the process of multi-objective optimization and Figure 3 (a-c) is the graph of DP calculation result for each pricing zone.

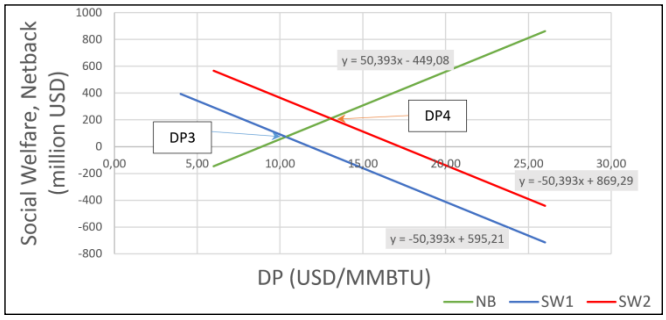
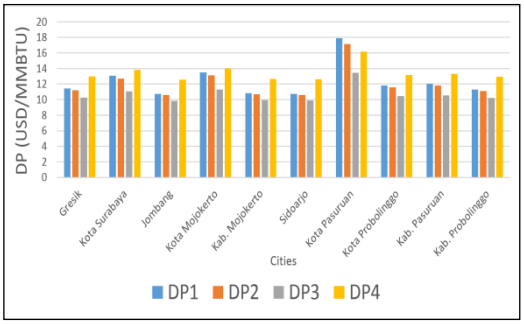
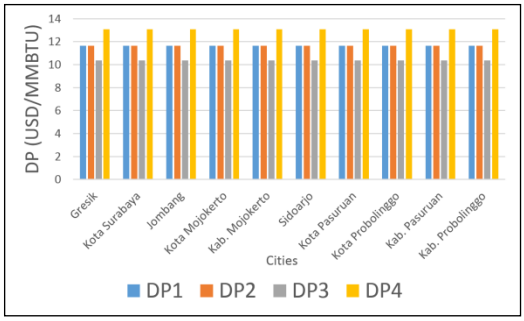


Figure 2. Multi-objective optimization in East Java Gas Pool

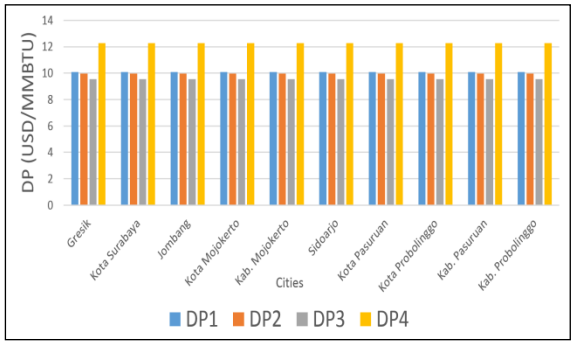
Figure 3 (a) shows that each city has its own prices that are different from each other. This shows that each WJD or city is burdened with price components independently without cross subsidies with other regions. The highest price is Kota Pasuruan (DP1=17.89; DP2=17.89; DP3=13.10; DP4=16.17) and the lowest is Jombang (DP1=10.73; DP2=10.60; DP3=9.83; DP4=12.58).



(a)



(b)



(c)

Figure 3. Calculation Result of Downstream Gas Selling Price. (a) WJD (b) Gas Pool (c) National

Figure 3 (b) shows cities that are in the same gas pool will get the same DP calculation results (DP1=11.65; DP2=11.64; DP3=10.36; DP4=13.08). This happens because of the equal distribution of infrastructure costs.

Figure 3 (c) shows the results of the calculation of the DP for the national pricing zone where prices are set equally nationally. The DP result is DP1=10.10, DP2=9.97, DP3=9.56, and DP4=12.27.

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Based on the calculation method of downstream gas selling price, the most of calculation result shows DP4 > DP1 > DP2 > DP3 except WJD Kota Pasuruan (DP1 > DP2 > DP4 > DP3). DP1 is the result of price calculation based on regulations while DP2 is based on WACC which is commonly used by companies to calculate infrastructure tariffs. DP1 is greater than DP2 that indicates there is a space for price increases if the regulations be implemented.

5.3. Pricing Zone

5.3.1. WJD Pricing Zone: There are 10 cities or WJD in East Java gas pool. It will be very difficult for Government to analyze, determine, and regulate specified price each cities include another province in Indonesia. The price calculation can be difficult for companies due to the WJD gas network is interconnected with other WJDs in one gas pool. It will not easy to separate the assets and operational cost that mostly counted in one network or gas pool. The WJD price zone also made wide disparities price among cities (see Figure 3-a).

5.3.2. Gas Pool Pricing Zone: The government will easily assign, regulate, and monitor prices. The trading companies will be easily to manage the economics of pipeline systems. The price also show the actual condition of the price forming components. There is no price disparity between consumers within one region of East Java province.

5.3.3. National Pricing Zone: The government will easily assign, regulate and monitor prices. In other hand, it make company with wide network systems will be difficult to separate profits and losses and to determine business strategies when entering new markets. The new markets will affect the overall economic balance of gas companies. It has also an effect on some consumers who had prices upper the determination price getting the benefits of falling prices and some to feel disadvantaged due to price increases.

Therefore, the optimal pricing zone should be a gas pool zone due to have minimum effect for consumers and easy implementation for gas companies and government.

5.4. Willingness to Pay (WP) Factor

DP4 > DP3 because of the differential on WP basis. The WP1 value (11.81 US$/MMBTU) for DP3 calculation is lower than WP2 value (17.3 US$/MMBTU) for DP4 calculation. WP1 is a weighing price of substitute fuel of gas such as fuel oil and coal in manufacturing industries in East Java province. The demand province is dominated by fuel oil (18.44-24.38 US$/MMBTU). While the WP2 is a weighing price of substitute fuel in national demand that is dominated by coal, the cheapest fuel for manufacture. DP3 and DP4 act as a ceiling price, the maximum price that consumer accepting the price. On Figure 3, the value position of DP1 and DP2 is between DP3 and DP4 that indicate still on the willingness to pay of consumer. Those price accepted in industrial market who have purchasing ability to fuel oil like as East Java.

5.5. Cost Factor of Production Pipeline Gas

Figure 4 is a graph for annual cost to produce the pipeline gas that is calculated from upstream to downstream business activities. The highest cost is dominated by UPC, the upstream production cost before the pipeline gas sell in wellhead-delivery point. Existing Indonesia gas wells are still using a PSC (production sharing contract) with cost recovery mechanism for the production cost. The gas supply for East Java came from own region well with production cost (UPC) around 10.1-38.8 US$/BOE or 3.0-6.7 US$/MMBTU.

The average UPC cost for 143 BBTUD pipeline gas in east Java is 4.37 US$/MMBTU. Some country data in the study of EIA (2019) has a various production costs in 2018: Bangladesh (1.3-4.2 US$/MMBTU), India (2.2-5.9 US$/MMBTU), Pakistan (2.2-4.8

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US$/MMBTU), Thailand (4.0-8.7 US$/MMBTU), and China (3.4-6.0 US$/MMBTU) [12].

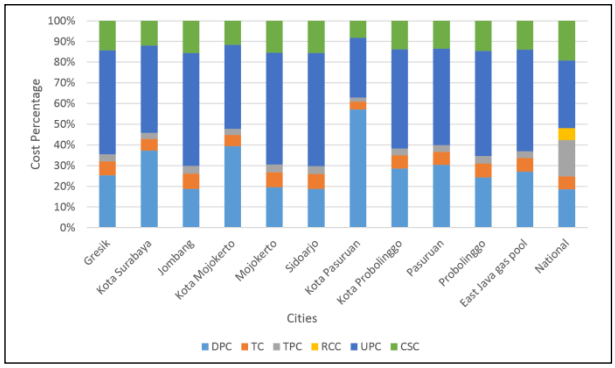

Figure 4. Profile of Gas Pipeline Production Cost

The second biggest cost is distribution pipeline infrastructure cost (DPC). It is calculated using the maximum IRR 11% for existing pipeline system which is based on regulatory guidelines in economic calculations on the PME 58/17. The DPC cost will decrease if using the IRR equal to WACC (8,86%). If gas prices should be lowered, the both of biggest costs need to be reduced.

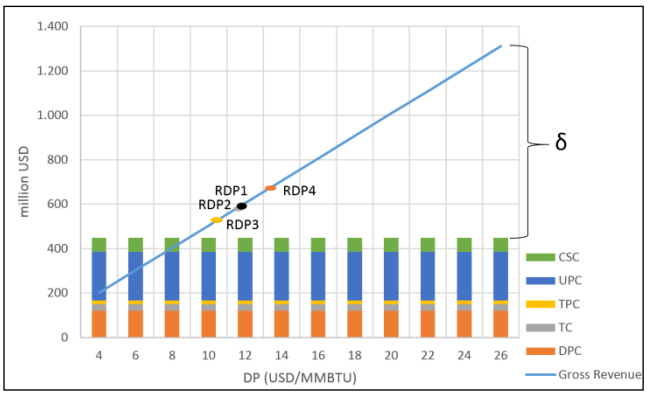

Figure 5. Production Cost and Gross Revenue in East Java Gas Pool

RDP is annual gross revenue from gas selling in East Java Gas Pool with specified DP. RDP1 is gross revenue at DP1, RDP2 is gross revenue at DP2, etc. Figure 5 show that δ as net back value or government interest. When the DP going up, government will get more from tax, levy, and production sharing contract. While the DP going down, government will get less and if the DP pressed until below 9 USD/MMBTU it will make government and/or gas companies suffer losses. Finally, it will need a kind of incentive from government to keep the pipeline gas business running attractively.

6. Conclution

The optimal pricing zone in East Java should be a gas pool price due to have minimum effect for consumers and easy implementation for trading gas companies and government. The optimum downstream gas selling price in the East Java gas pool is between 10.36 USD/MMBTU to 13.08 USD/MMBTU as the ceiling price. The method of calculating gas prices from the Minister of Energy and Mineral Resources Regulation No. 58 of 2017 founds the value is on the optimal price range. If gas prices need to be lowered, the upstream production and distribution pipeline (infrastructure) costs need to be reduced. A kind of incentive from government also necessary to keep the pipeline gas business running attractively for investors.

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