FINAL PROJECT – TI 141501

DETERMINATION FOR SYNTHESIS GAS AND ELECTRICITY PRICING POLICY IN DUAL BUYER CASE (PLN AND PRIVATE COMPANY)

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TUGAS AKHIR– TI 141501

PENENTUAN KEBIJAKAN HARGA GAS SINTETIS DAN PENJUALAN LISTRIK PADA KASUS *DUAL-BUYER* (PLN DAN PERUSAHAAN SWASTA)

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ABSTRACT

Nowadays, almost all countries encourage development in their regions for improving their quality of life. An Indonesian Smelter Company that runs a mining and mineral processing takes the opportunity and plans to build an iron processing plant located in Lampung province and expected to start the operation in 2020. The main concern for Smelter Company is the supply of electricity with net requirement of 133 MWel. Currently, the electricity supplied by PLN for Lampung province remains inadequate. Those, there are 2 options available for the company to source the electricity. First option is to outsource from PLN. Second option is to build a power plant through a subsidiary company to generate the required electricity. In addition to the options, Smelter Company has a secondary product, which is synthesis gas that can be used to generate as much as 283 MW_{el}. If the management of Smelter Company prefers to choose the second option, the excess electricity can be sold to PLN. However there is an uncertainty whether PLN will buy the excess or not. In the other hand, the pricing policy for both electricity and synthesis gas has not been reviewed yet. Hence, this research aims to design the pricing scheme for synthesis gas and electricity that are beneficial for all relevant parties under review. The pricing policy is constructed using multi-regression method and it is used as a reference to calculate the future electricity price that accommodate a possibility of several changes, such as gas price and electricity sales volume. The result has shown that the best price for synthesis gas is $2.752/mmBtu and the pricing policy for electricity can be determined using the following equation: *Electricity Price= 0.10091 + (0.03139 x Gas Price) – (0.000476 x Electricity Sales Volume)*. The equation also ensures that PLN will not violate the standard method using A-B-C-D components. By comparing both alternatives, the analysis has shown that the second option is outperform the first option.

Keyword: electricity price, PLN tariff, multiregression, synthesis gas, pricing policy

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PENENTUAN KEBIJAKAN HARGA GAS SINTETIS DAN PENJUALAN LISTRIK PADA KASUS *DUAL-BUYER* (PLN DAN PERUSAHAAN SWASTA)

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ABSTRAK

Pada saat ini, hampir semua negara di dunia berlomba-lomba untuk mengembangkan dan membangun negaranya untuk meningkatkan mutu hidup masyarakat. Sebuah perusahaan di Indonesia yang bekerja di bidang pertambangan dan pengolahan mineral menangkap kesempatan tersebut dan berencana untuk membangun pabrik pengolahan besi yang berlokasi di provinsi Lampung dan direncanakan mulai beroperasi pada 2020. Aspek yang menjadi perhatian utama adalah suplai listrik, di mana jumlah yang dibutuhkan adalah 133 MW_{el}. Ketersediaan listrik di provinsi Lampung masih di bawah jumlah permintaan. Untuk memenuhi kebutuhan listrik tersebut, terdapat 2 opsi. Pertama adalah membeli dari PLN, di mana persamaan untuk melakukan peramalan tarif PLN dibangun menggunakan metode *multi-regression*. Opsi kedua adalah membeli dari pembangkit listrik yang akan dibangun oleh anak perusahaannya. Manajemen perusahaan cenderung memilih untuk membeli dari pembangkit listrik. Perusahaan tersebut memiliki produk sampingan yaitu gas sintetis yang dapat digunakan untuk menghasilkan 283 MW_{el}. Sisa listrik dapat dijual kepada PLN, namun keputusan PLN untuk membelinya masih tidak diketahui. Penelitian ini bertujuan untuk merancang skema harga gas sintetis dan tenaga listrik sehingga tujuan semua pihak dapat tercapai, merancang model penentuan harga tenaga listrik, dan menguji keputusan manajemen mengenai sumber tenaga listrik. Kebijakan harga penjualan tenaga listrik ini dibangun menggunakan metode *multi-regression* dan menjadi dasar untuk menghitung harga listrik dengan mengakomodasi berbagai kemungkinan perubahan yang dapat terjadi. Berdasarkan hasil penelitian, skema terbaik untuk harga gas sintetis adalah $2.752/mmBtu, dan kebijakan penentuan harga listrik untuk perusahaan adalah *Harga Listrik = 0.10091 + (0.03139 x Harga Gas – (0.000476 x Volume Penjualan Listrik),* sedangkan untuk PLN mengikuti perhitungan standar yaitu dengan komponen A-B-C-D. Berdasarkan hasil *incremental analysis*, keputusan manajemen untuk membeli dari pembangkit listrik adalah tepat karena mendominasi keputusan untuk membeli dari PLN.

Kata kunci: harga listrik, tariff PLN, *multi-regression*, gas sintetis, kebijakan penentuan harga tenaga listrik

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I realize that this research is not perfect and there is some mistakes . Therefore, I am welcome for any contructive advices and critics for further self –improvement. By completing this research, I hope it becomes one steps closer to the successful career and useful for society. I hope that this research can be useful and beneficial for society.

Surabaya, January 2017

Josafat Eliezer Sucahyo

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CHAPTER 1
INTRODUCTION

This chapter explains the background of the research, problem formulation, objectives, benefits, scope of research, and writing methodology in this report. Each part will be delivered in each sub chapter thoroughly.

1.1 Background

In the globalization era, development and innovation are required in order to support and increase the standard of living in society. Nowadays, almost all countries encourage development in their regions. It is driven by the population rate that is increasing rapidly and demand for improvement in quality of life. Development itself covers many sectors, from infrastructure, technology, communication, industrial, etc. In order to conduct those development, there are several basic things/requirement that are needed to support and realize the development's planning. One of them is steel, because in every construction and development, it is needed as the frame/basic foundation. Therefore, steel as one of basic requirement's materials/products, the availability is very critical/crucial for continuity and sustainability of the development that already planned since previous years.

Indonesia is one of several countries that have abundant natural resources as raw material to produce steel, such as iron ore, coal, limestone, etc. A company that has business in mining and mineral processing in Indonesia takes the opportunity and plans to contribute in domestic steel sector by set up iron processing plant (Pelletizing and Smelting Plant) with the production capacity are: 1.5 MTPA (Million Ton Per Annum) Pig Iron and 2.28 MTPA (Million Ton Per Annum) Iron Pellet.

This plant is planned to set up in Lampung province. The reason for the selection are caused of the location of owned iron ore's concessions near with Lampung. In addition, it is also according with the Long-Term Planning from Indonesia's government, which is by assigning Lampung as one of Strategic

Development Regions by General Affair Ministry of Indonesia (Badan Pengembangan Infrastruktur Wilayah, 2016). The main concern for Smelter Company is the supply of electricity.

Based on Business Plan of Electrical Supply Perusahaan Listrik Negara (RUPTL PLN) 2016-2025, the peak load of Lampung province is 854 MW, while the total power capacity from the installed power plants is 593.5 MW, or 69.5% from the demand. Therefore, PLN as Electrical State Company conducted Blackout Rolling program. While in steel industry, continuity and consistency of supplied power are very important and have significant role for the plant's operation, especially for smelting and pelletizing plant which are implementing continuous processes. If the supplied power is stopped/not provided, the operation will be automatically shut down, and it brings big impact, whether financial, equipment's performance, and fulfillment of buyer's order. Therefore, the management of Smelter Company must consider the option for the supplied power, whether they want to buy for PLN or they want to ask the subsidiary company to build power plant and buy the power that being generated directly. Both options have pro and cons.

The advantage of supplied power from PLN are the guarantee of availability of supplied power and the price is fixed from the government. But there are also disadvantages, which are the continuity and consistency of the supplied power cannot be guaranteed caused of the lack of supplied power's capacity. The other option, supplied power from power plant, it has advantages as the guarantee of continuity and consistency of the supplied power. But it also has hesitation, which is the electricity's price assurance because the total cost may be charged entirely to Smelter Company as exclusive owner of the rights to buy the power generated if there is only a single buyer. There is another condition of this option, which is the excess power sold to PLN by Power Purchase Agreement (PPA).

In addition, the smelting plant has a secondary product, which is synthesis gas. It is the result from combustion in the furnace that is the part of smelting process. It can be used for the power plant as the fuel to generate power. The management of the company and the foreign investor also very concern about environment aspect, therefore they want the secondary product can be utilized and

bring advantages for the company. If it is not utilized and just discharged to the environment away, the project will be not environment friendly and it will bring impact for the financing, because foreign investors and financial institutions put environment aspect as one of the requirement for their approval.

Based on those facts, Smelter Company prefers to choose the option of build power plant as the source of supplied power, which is built subsidiary company. It is related with the requirement of stable continuity of supplied power and the availability of synthesis gas as the fuel for the power plant. As the information from the iron making plant's vendor, the total gas that able to be produced is 675 MW_{th} (Megawatt thermal), which can be converted to electrical energy with the net amount 283 MW. The electricity requirement for the captive usage of Smelter Company is around 133 MW, which used for the operation and production process of Iron Making plants and the operational usage in site plant office. Therefore, there is excess power that being generated, around 150 MW.

The main reason of deciding to produce electrical energy over the required amount is to maximize the usage of the available resources, synthesis gas, as the secondary product from the iron making plants and in order to maintain the environment aspect as the requirement from the investors. The excess power itself is planned to be sold to PLN by Power Purchase Agreement (PPA) to support the fulfillment of electrical demand for Lampung province. Due to operation of this project will be start after the construction period, which is around 3 years, PLN cannot conduct agreement in advance, included to buying price in PPA. They must consider various factors to take the decision, such as the total demand and available supply in the related region, commitment of the power producer to build the power plant, source of fuel, financial factor, etc.

As the second option if PLN decides to not buy the excess power, all cost from generate power is covered by Smelter Company. It can be allocated for the development planning in the future, such as steel mills. But prior the further development process planning is realized, the excess power will be useless for Smelter Company and as the consequences, the electricity price per kWh (kilowatt hour) will increase. All of those conditions and scenario must be considered by the

management in making the decision. Below is the brief illustration of basic scenarios and options in order to explain the existing problem.

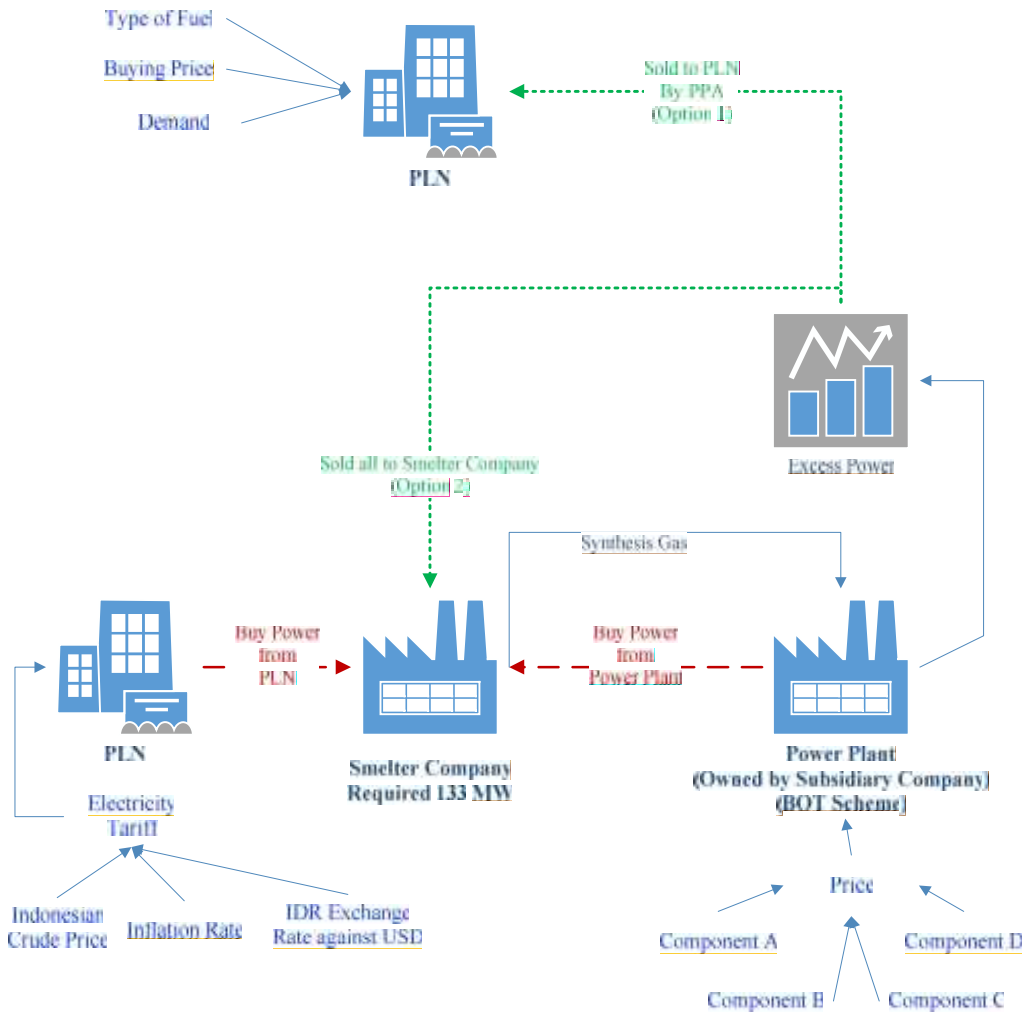

Figure 1. 1 Basic Scenario and Option of Power Supply Fulfillment in Smelter Company

In the condition when the generated power is bought exclusively by Smelter Company, the synthesis gas price as the fuel for power plant actually does not have impact to the financial aspect of Smelter Company and Power Plant. It caused of Smelter Company and Power Plant actually are one entity as the owner of power plant is subsidiary company of Smelter Company so there is transfer

pricing between them. The revenue from selling synthesis gas is the same amount of the cost for buying fuel.

The synthesis gas price will be significant factor that able to influence the feasibility of Power Plant's business when PLN decides to take over the excess power, whether in whole amount or just some of it. As PLN will buy the excess power, it means their buying price will cover the cost for generating power as much as the amount of the purchase power. So there is not transfer pricing again between Smelter Company and Power Plant because some portion of the cost is handled by PLN. In PLN side, they also want to know the detail component of the electricity price, included the fuel cost which is synthesis gas price. In this condition, it is very important to know the best synthesis gas price to maintain the consistency of electricity price and make sure that Power Plant still earns profit and Smelter Company gets the best supplied power option. In addition, it also needs to construct the pricing policy of electricity price for Smelter Company as the reference for calculating the electricity price with possibility of various changes that may happen.

1.2 Problem Formulation

The problem formulation of this final project is how to design the scheme of synthesis gas price and electricity price that is generated by Power Plant as the source of supplied power for iron making plant's operations, so it gives beneficial for the company and Power Plant.

1.3 Objectives

This final project aims:

1. To give recommendation for the selling price of synthesis gas so Smelter Company and Power Plant can have beneficial for both of them.
2. To construct pricing policy of electricity price that covers various conditions for Smelter Company, includes gas price and total purchased power.
3. To prove the management's decision to insource the supplied power from Power Plant is better than oursource from PLN supply.

1.4 Benefits

In this final project, there are several benefits that are:

1. Able to inform and give recommendation for the best option to be chosen and the influenced conditions for the selection of decision.
2. Able to give recommendation of selling price for synthesis gas price that leads to mutual benefit for Smelter Company and Power Plant in each scenario.
3. Able to contruct pricing policy of electricity price for Smelter Company as the reference to calculate the electricity price from Power Plant.
4. Able to develop observer's abilities in validating and processing data, analyzing and evaluating the situation in the company, and making decision for the best option to be chosen.

1.5 Scope of Research

There are several boundaries and assumption that being applied in the final project, as follows:

1.5.1 Boundaries

Below the several limitations used on conducting observation and final project report:

Study and analysis that being conducted for problem solving only concern on financial aspect.

1.5.2 Assumptions

Below the assumption that being used along the observation and in the final project report:

1. The exchange rate Indonesian Rupiah (IDR) currency against US Dollar (USD) uses Draft of State Budget of Indonesia (Rancangan Anggaran Pendapatan dan Belanja Negara) 2017 assumption USD = Rp 13.300,00
2. The inflation rate for Indonesian Rupiah (IDR) uses Draft of State Budget of Indonesia (Rancangan Anggaran Pendapatan dan Belanja Negara) 2017 assumption = 4.0% per annum, and for US Dollar (USD) uses the projection

from World Economic Outlook 20016 from International Monetary Fund = 1.5% per annum.

3. The distance between Power Plant location and PLN grid is assumed 0, so Component E / Transmission Cost = 0.
4. The power plant that will be built is Integrated Gasification Combined Cyle (IGCC).

1.6 Writing Methodology

There is methodology of writing in conducting the final project report, so it can be understood easily and explain the activities in detail. Below is the general information of each chapter that will be explained in the final project report:

- **Chapter 1: Introduction**

  In this chapter, there will be explanation about the background of problem, which is the object of final project, problem formulation, objectives that will be achieved, benefits that planned to be earned, scope of research that consists of boundaries and assumptions, and the writing methodology of the final project report.

- **Chapter 2: Literature Review**

  Chapter 2 gives information about related with the topic of research. It consists of the basic information about IGCC (Integrated Gasification Combined Cycle), explanation about the synchronization scheme between Power Plant and Iron Making Plants, and EPC transaction scheme. In addition, there are also detail information that also support the study and analysis of research, which are Theory of Decision Analysis and Components for Cost of Power Generation.

- **Chapter 3: Research Methodology**

  In this chapter, there will be thorough explanation about the research methodology, which consists of stages that are needed to conduct research so the report can be done structured and systematically.

- **Chapter 4: Analysis and Calculation of Synthesis Gas Price**

  Chapter 4 provides the data calculation of synthesis gas price in order to find the best price of synthesis gas so it can lead to mutual solution for

Smelter Company and Power Plant for each scenarios. There is also a detail analysis for the scheme of synthesis gas pricing. In parralel, there are also forecasting of Electricity Tariff from PLN as for test the decision of to insource from Power Plant against outsource from PLN.

- **Chapter 5: Analysis and Construction of Pricing Policy**

  This chapter construct the pricing policy of electricity price for Smelter Company, which will be used as the policy for calculating the electricity price in the next period with various possible changes and conditions, included gas price and total purchased price, so each parties able to reach their objectives. In addition, there is also calculation of minimum PLN buying price. The result from pricing policy and the minimum buying price from PLN also will be analyzed thoroughly.

- **Chapter 6: Conclusion and Suggestion**

  In this chapter, it contains of the conclusion of the final project which be the answer/solution from the issued problem and the final project's objectives. In addition, it also gives suggestion which can be good feedback for company.

CHAPTER 2
LITERATURE REVIEW

This chapter provides literatures that being used to support research. It contains of explanatory about the basic theory for research that consists of the general information about the related objects and the applied methods for support decision analysis.

2.1 Theory of Decision Analysis

Based on Keeney, 1982, Decision Analysis (DA) in simple definition is a formalization of common sense for decision problems which are too complex for informal use of common sense; or in technical definition, a philosophy, articulated by a set of logical axioms, and methodology and collection of systematic procedures, based upon those axioms, for responsibly analyzing the complexities inherent in decision problems. DA approach is important, because decisions that must be made nowadays is more complex than before. Therefore, it is needed a scientific approach for decision making. Kind of problems that required the understanding and application of DA are the problems, which contain several aspects:

a. Needs to accomplish multiple objectives;
b. Consists of multiple alternatives to be chosen;
c. The consequences associated with alternatives are different;
d. Contains uncertainty

By Decision Analysis approach, it can help organize the situation/ problem, identify the source of uncertainty, and also become a framework in solving the multiple objective's problem. The methodology itself provides the framework to combine traditional techniques of operations research, management science, and system analysis with professional judgments and values in a unified analysis to support decision-making (Keeney, 1982). It consists of 4 steps, as follows:

1. Structure the decision problem

   Figures the alternatives and specification of objectives.

2. Assess possible impacts of each alternative

   Determine the impact of each alternative as precise as possible and associate each consequences with each alternative.

3. Determine preferences (values) of decision makers

   Evaluate the objectives in order to get an objective function, which aggregates all the individual objectives and an attitude toward risk.

4. Evaluate and compare alternatives

   All related information need to be synthesized in a logical manner to evaluate the alternatives. It also conducts sensitivity analysis to accommodate the uncertainties that are associated with the various consequences and to different value structures.

Figure 2.1 shows the sequential processes/steps for the methodology of decision analysis.

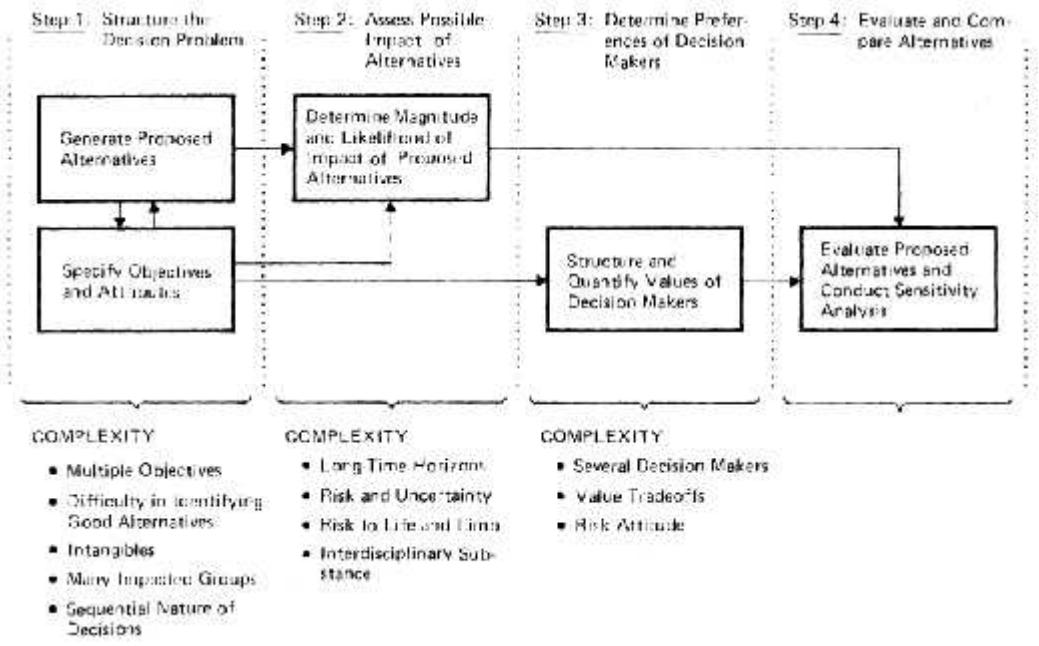

Figure 2. 1 Schematic Representation of the Steps of Decision Analysis (Keeney, 1982)

2.2 Influenced Factors of Indonesia Electricity Tariff's Growth

Based on Regulation Minister of Energy and Mineral Resources of Indonesia no. 31 year 2014, the electricity tariff from PLN is being adjusted periodically by Ministry of Energy and Mineral Resources and headquarter of PLN. It is classified based on the usage, which are:

- social service;
- household;
- business;
- industrial;
- government's office and public road lighting;
- traction;
- bulk sales; and
- specialized service

In industrial's usage, it is divided again into 4 categories, which are:

- I-1/TR

  Tariff's category for small industry / home industry in low voltage, with the power in the range of 450 VA – 14 kVA.
- I-2/TR (Low Voltage)

  Tariff's category for intermediate industry in low voltage, with the power in the range of 14 kVA – 200 kVA.
- I-3/TM (Intermediate Voltage)

  Tariff's category for intermediate industry in medium voltage, with the power above 200 kVA.
- I-4/TT (High Voltage)

  Tariff's category for major industry in high voltage, with the power above 30,000 kVA.

Tariff adjustment is being conducted whenever there are changes of the factors that able to influence the main cost of electricity's supply, whether it is increasing or decreasing. Those influencing factors are:

a. Inflation rate;
b. Indonesian Crude Price (ICP); and/or

c. Exchange rate of Indonesia rupiah (IDR) against United States of America dollar (USD).

Based on PLN (Persero), 2014, the implementation of tariff adjustment is following the equations below,

$$TB = TL\ x\ (1 + \%TA) \tag{2.1}$$

with:

TB = Implemented electricity tariff after tariff adjustment

TL = Electricity tariff in the previous period

%TA = Percentage of electricity tariff's adjustment

The formula for the percentage of tariff adjustment of electricity pricing itself is:

$$\%TA = \%\left(K_{exchange\ rate}\ x\ \Delta\ Exchange\ Rate\right) + \%(K_{ICP}\ x\ \Delta\ ICP) + \%(K_{inflation}\ x\ \Delta\ Inflation) \tag{2.2}$$

with:

TA = Tariff Adjustment

$K_{\text{exchange rate}}$ = Coefficient for changes of exchange rate

Δ Exchange rate = Difference between the new exchange rate with the reference based on State Budget of Indonesia (APBN) in previous following year

K_{ICP} = Coefficient for changes of ICP

Δ ICP = Difference between the new ICP with the reference based on State Budget of Indonesia (APBN) in previous following year

$K_{\text{inflation}}$ = Coefficient for changes of inflation

Δ Inflation = Difference between the new inflation with the reference based on State Budget of Indonesia (APBN) in previous following year

There is a mechanism for determination of Tariff Adjustment, which is:

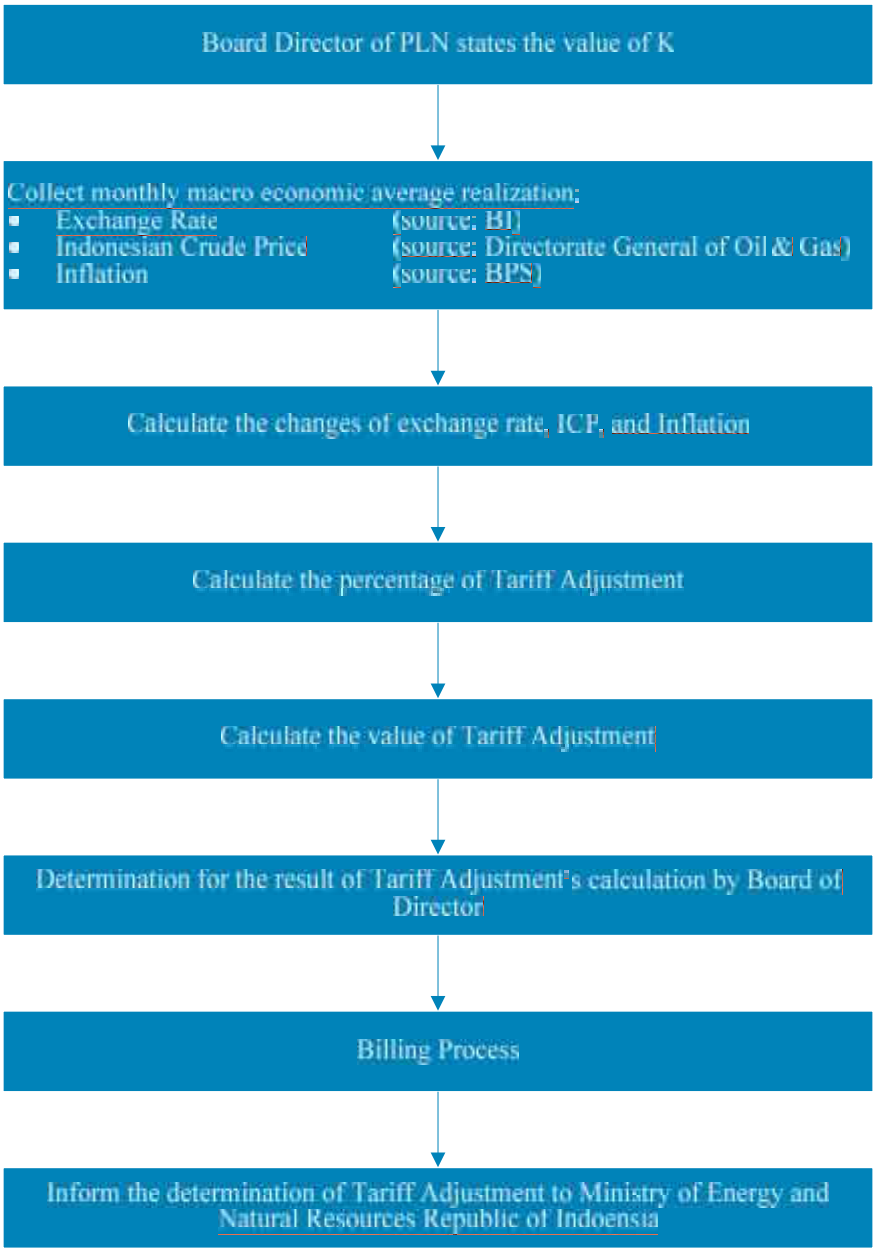

Figure 2. 2 Mechanism of Determination for Tariff Adjustment (PT. PLN-Persero, 2014)

2.3 IGCC

IGCC as the acronym of Integrated Gasification Combined Cycle is included of Combine Cycle Power Plant (CCPP). The innovation of this technology is driven by the necessity for higher efficient use of primary energies in combination with more stringent environmental regulations for fossil-fueled power plants, so it needs to develop a concept of increased efficiencies and reduced CO_2 emissions.

The preservation of resources and minimization of pollution are goals that decisively dictate the current development of fossil-fired power plants. IGCC itself is an environmentally-friendly system which improves the net plant efficiency and reduces the CO_2 emissions compared to conventional pulverized coal-fired power plants (Mitsubishi Hitachi Power Systems, 2014). IGCC itself uses a coal gasification system to convert coal into a synthesis gas (syngas) and produce steam. It is processed in order to remove sulfur compounds, mercury, and particulate matter before it is used to fuel a combustion turbine generator, which produces electricity (Duke Energy Corporation, 2013).

As mentioned that it is combined cycle, which means there are more than 1 kind of cycle. In generating power, it is produced by 2 kind of cycles, gas turbine cycle and steam turbine cycle. Below is the general scheme of the process inside IGCC:

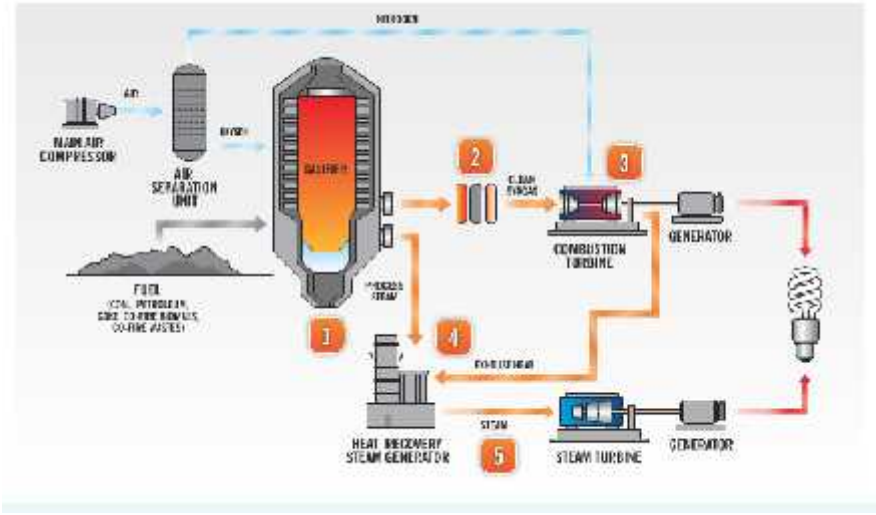

Figure 2. 3 Process in IGCC (Duke Energy Corporation, 2013)

The hot syngas that is produced by gasifier is processed first to eliminate sulfur compounds, mercury, and other slag, it becomes clean syngas that enters combustion turbine/gas turbine, continued to generator to generate electricity. The exhaust heat and process steam enter Heat Recovery Steam Generator (HRSG) in order to generate multi-pressure steam by utilizing energy from process steam for gasifier and exhaust gas, for maximizing energy recovery. The steam enters steam

turbine and continued to generator to generate electricity. Based on V. Ganapathy, 1996, the combination between gasifier, gas turbine, HRSG system, and steam turbine can reach 55-60% for the efficiency of power generated. Based on Siemens AG, 2012, there is flexibility for the kind of fuel to be handled, including coal, biomass, waste, petroleum coke, refinery residues as well as a blend of those fuels. Moreover, it also able to use secondary fuels to be burned during the maintenance of the main fuel supply equipment (example: gasifier). Below is the comparison between the regular multi fuel burner and syngas burner:

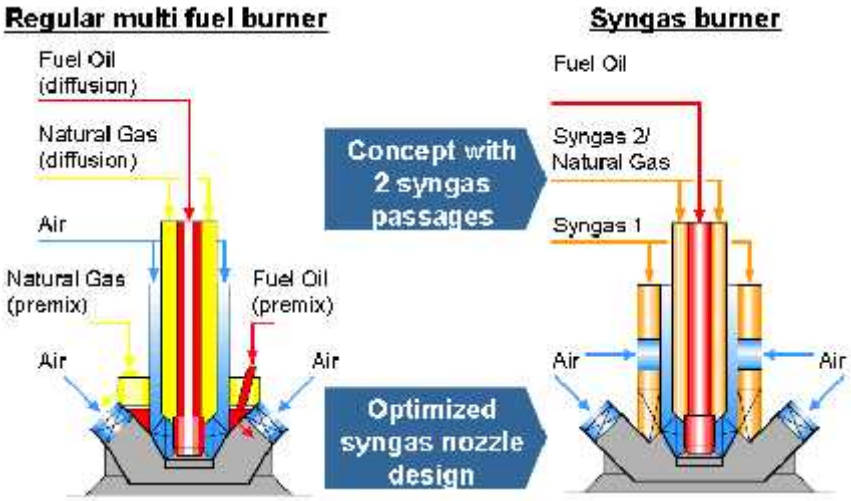

Figure 2. 4 Comparison between Regular Multi Fuel Burner and Syngas Burner (Siemens AG, 2015)

Heat Recovery Steam Generator (HRSG) as the part of IGCC, is also known as waste heat boiler, which used to cool hot gas, generate steam and re-gain energy. It is the critical link between the gas turbine and steam turbine in combine cycle and cogeneration plants (Industrial Application of Gas Turbine Committee, 2009). The basic component of HRSG are:

- Evaporator

  Used to convert the water into saturated steam from the steam drum.
- Economizer

  Used to heat the water before enters steam drum and evaporator.
- Superheater / Reheater

Used to raise the temperature of saturated stem to be superheated steam (dry steam), which is required for steam turbine.

- Preheater

  Used to raise the temperature of the water before enter feed water tanks, that continued by economizer.

2.4 Synchronization between Power Plant and Iron Making Plants

As mentioned before, there is flexibility for the kind of fuel to be handled by CCPP, one of them is syngas (synthesis gas). Syngas itself can be produced by the integration process between the power plant and the manufacturing plant. Based on that concept, the integration between Combine Cycle Power Plant (CCPP) and Iron Making Plants is being conducted. The Iron Making Plants substitutes gasifier's role in the basic process of IGCC. The integration scheme based on Siemens AG, 2015, is provided below:

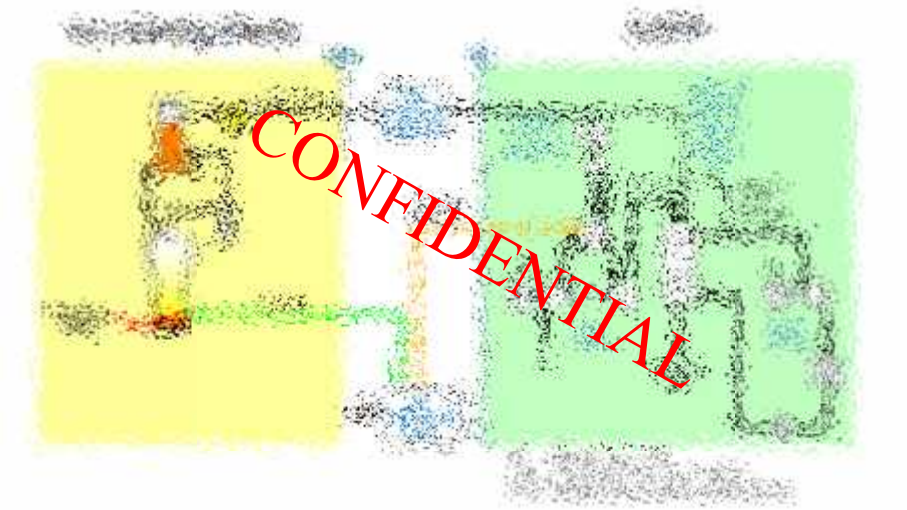

Figure 2. 5 Integration Scheme of CCPP and Iron Making Plants (Siemens AG, 2015)

Coal, as the fuel for combustion process in the furnace, is put in the furnace in order to burn and melt the other ingredients (iron ore, iron pellet, limestone, dolomite, quartz, etc.) to form pig iron (Fe purity ≥ 95%). The specification of accepted coal is below:

Table 2. 1 Accepted Coal Specification

	Tolerable	Preferred
Fix Carbon	Min. 55% (water free)	55-65% (water free)
Volatile Matter	Max. 35% (water free)	25-35% (water free)
Ash	Max. 15% (water free)	5-12% (water free)
Moisture	Max 6% after drier Max 12% before drier	Max 5% after drier Max 8% before drier
Sulphur	Max 1 %	Max 0.5%
Grain size	5-50 mm +15 mm: min 50% -5 mm: max 10% -1 mm: max 5%	8-40 mm 20-30 mm: min 50% -8mm: max 5%

Source: Siemens VAI, 2014

In addition, there is also high-purity oxygen that supplied by Air Separation Unit (ASU) to the furnace for smelting process. By the chemical process that occurs in the furnace, it produces hot metal pig iron with purity ≥ 95%, slag, and by-product as export gas.

In the environment point of view, it will be harmful to release the export gas to the nature directly, because it contains of carbon, which is very dangerous and able to damaging the environment. In other hand, the export gas can be used as the fuel for CCPP as syngas. Therefore, it is the integration point between CPP and Iron Making Plants. The export gas as syngas, will be transferred to CCPP as the fuel for the combustion. The specification of the export gas itself is:

Table 2. 2 Specification of Export Gas

Pressure	Approx. 150 kPa g
Temperature	Approx. 40 °C
CO	Approx. 45%
CO_2	Approx. 32%
H_2	Approx. 16%
H_2O	Approx. 3%
CH_4	Approx. 2%
N_2/Ar	Approx. 2%
H_2S	Approx. < 100 ppmv
Dust	Approx. < 5 mg/Nm^3 (STP)
Calorific Value	Approx. 8,000 kJ/m^3 (STP)

Source: Siemens VAI, 2014

The export gas will enter CCPP and be processed as the normal process of Integrated Gasification Combined Cycle (IGCC), which is processed firstly to be clean syngas. The further process, it flows to gas turbine and converted into electricity. The exhaust heat and gas from the gas turbine will be continued to Heat Recovery Steam Generator (HRSG) to generate multi-pressure steam by utilizing energy from exhaust heat and gas, for maximizing energy recovery. The steam enters steam turbine and continued to generator to generate electricity. In addition, high-purity of nitrogen as the result from Air Separation Unit (ASU) also will be flown for cooling system on combustor so the NO_x emission can be controlled.

The generated power from CCPP can be used for the needs of Iron Making Plants. If there is still excess power, it can be sold/offered to power distribution companies, such as PLN.

2.5 EPC Scheme

EPC stands for *Engineering-Procurement-Construction*, and is a particular form of contracting arrangement used in some industries where the contractor is made responsible for all the activities from design, procurement, construction, to commissioning and handover of the project to the End-User/Owner (Yandri, 2008). It is the most common form of contract for the construction of private sector on large-scale and complex infrastructure projects, such as power plant project. EPC also known as *Turnkey Construction Contract* because the contractor is obliged to deliver a complete facility to the end-user/owner who only need to 'turn a key' to start operate the facility. Based Picha, et al., 2015, the end-user/owner/client from the contractor has responsibilities to prepare the plant permit, electrical interconnection, fuel supply arrangement, and site preparation (land clearing, leveling, etc.). In general, the contractor has to execute and deliver the project based on the agreed time and budget, which known as *Lump Sum Turn Key (LSTK) Contract,* the other term of EPC contract. The owners want to transfer all the risks to the contractor and decrease the project price at the same time. The cost overrun will be bear by the contractor. Contrarily, the contractor prefers to carry the least risk and gain most profit, regarding the inevitable complexities of large power projects. As EPC contract is a 'tailored-made' contract, it needs understanding from

the both side in order to reach deal so it will bring mutual benefit for both side. But the basic concept of EPC contract is the contractor has responsible to develop the project from its inception to the final completion, while the owner provides the some specifications for the project, then the contractor will design, build, and handover it in an operational state. Therefore, it is important for the contractor to enumerate and consider the risk of any cost overruns and the overschedule, and also strive to get the benefit from any savings that can be made. It caused of the requirement for them to fulfill the *Performance Guarantee,* related with the agree liability capabilities. The connection and interaction between all of those phases (Engineering-Procurement-Construction) in the project cycle is provided in Figure 2.6:

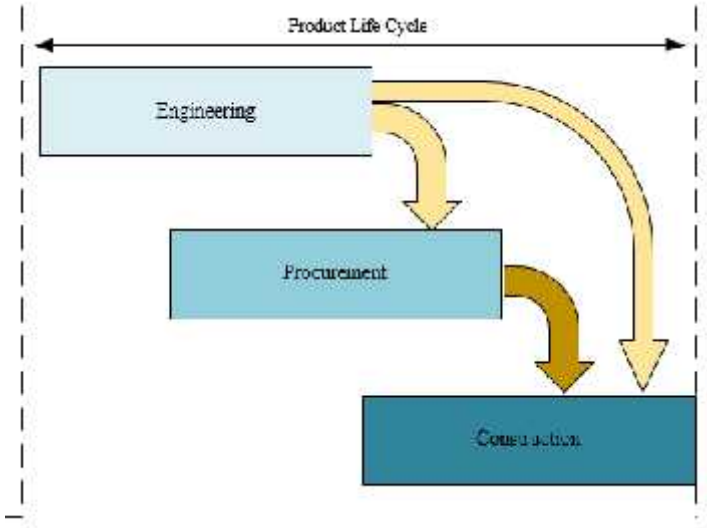

Figure 2. 6 Relation between Engineering, Procurement, and Construction in Project Cycle (Yandri, 2008)

Refers to Figure 2.6, those phases are interconnected each other's. EPC itself is described as a management system that able to manage various elements and related each other's in order to reach the objectives. Those elements consist of multi-disciplinary subjects, such as engineering, financial, human resources, etc.

Diagram below will illustrate the basic contractual structure of a project-financed power plant project using EPC Contract. In this diagram, it shows the relation of related parties, start from government as the policy makers, the project

company/owner, the sponsors/investors, the lender that can be bank or other financial institutions, suppliers, various contractors with different responsibilities, until the off taker of the power generated.

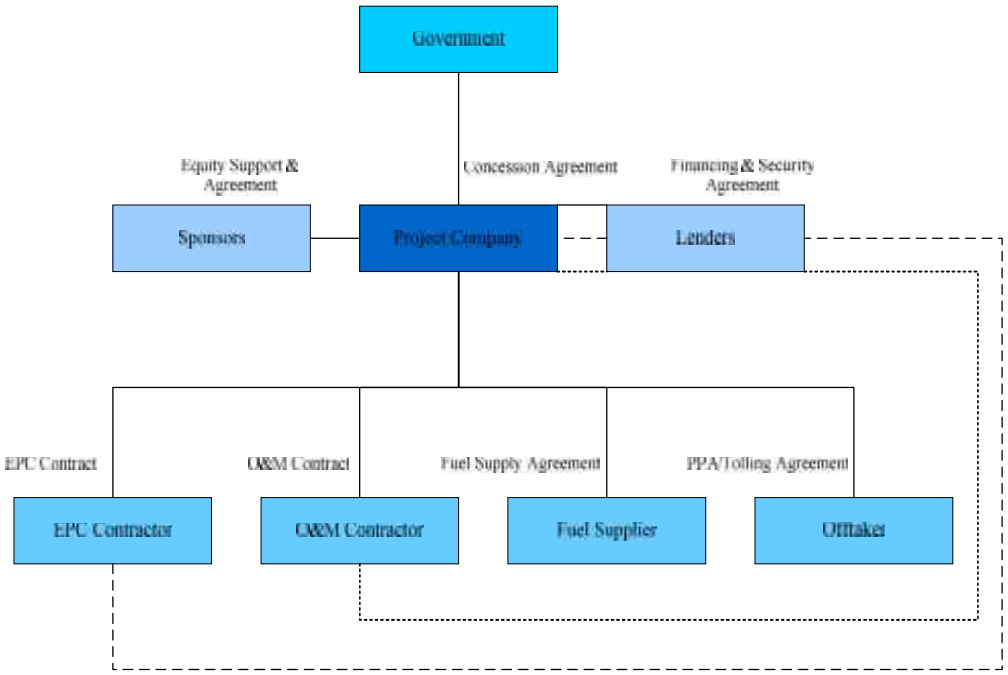

Figure 2. 7 Basic Contractual Structure of EPC Contract (DLA Piper, 2011)

There is a similar term of EPC contract that is also common in project's sector, which is EPCM, the abbreviation of *Engineering-Procurement-Construction Management*. Although the acronym and the term are similar, but the understanding and basic concept are different. EPCM contract is a professional services contract, which the provided services are typically: engineering/design; procurement of necessary materials and equipment; and management and administration of construction contracts (Henchie, 2008). The contractor acts as the owner/end-user's agent and take responsible on behalf of the owner to direct the relationship between the owner and the suppliers and trade contractors. The main difference is that in the EPCM, the contractor is providing professional services (including design) and is not a principal (i.e. is not a party to a contract in respect of the construction of the project) (Loots & Henchie, 2007). EPCM contractor has responsibility for:

- Design (producing the basic engineering and developing the detailed design);
- Procurement of necessary materials and equipment;
- Management and administration of the construction contracts.

Therefore, the contractor usually does not take full responsibility to deliver the completed project by an overall completion date, nor responsibility for care of the works or for the total cost to the owner. In fact, there are clauses in EPCM contract about incentives regarding with total cost and duration. Therefore, the main potential liabilities of EPCM contractor relate to any default or breach in:

- Performance of the design work;
- Preparation of the budget cost estimate;
- Preparation of the estimated duration of the work;
- Managing the procurement and administration of the trade contracts;
- Coordination of the design and construction between the trade contractors

Although those points above are included as the responsibilities of EPCM contractor, it is mostly rare and difficult for the owner proves any breach of those responsibilities.

Based on Henchie, 2008, the advantages from owner's perspective related with EPC contract is the contractor takes whole responsibilities for:

- Cost of Completion as a lump sum (subject to limited adjustments);
- The time for completion (subject to extensions of time); and
- The quality of the design, work, and achievement of performance guarantees (subject to any exclusion).

However, there is a disadvantage for the owner, compared with EPCM contract, which is the detail design will be the contractor's prerogative.

As the comparison between EPC contract and EPCM contract, the contractual relationship in the typical EPCM and EPC contract are provided below:

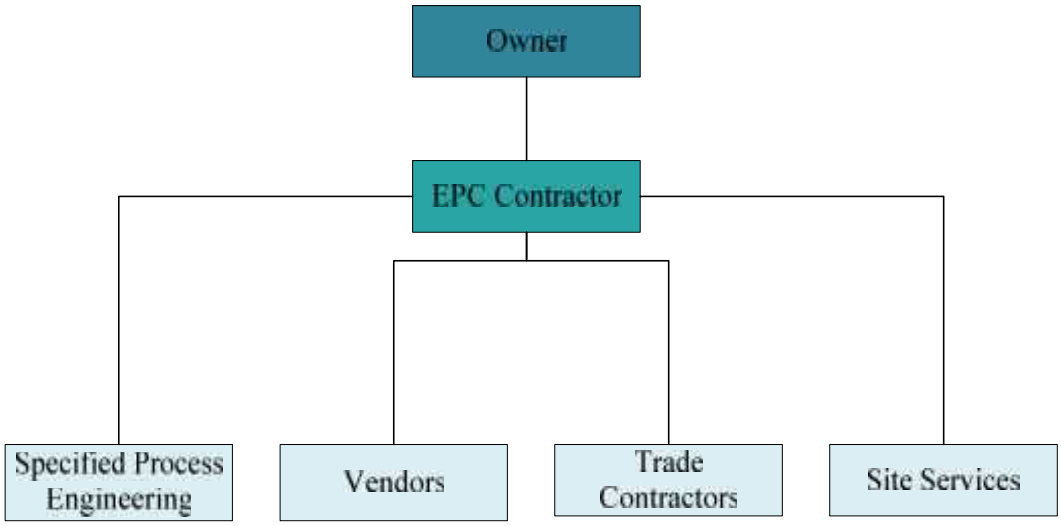

Figure 2. 8 EPC Arrangement (LootsandHenchie, 2007)

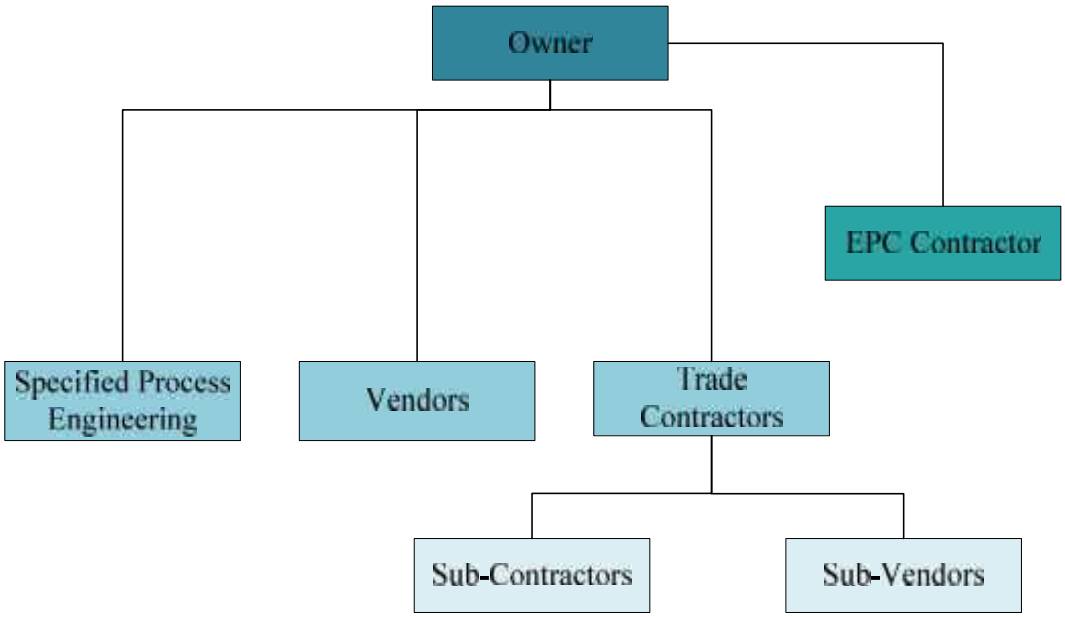

Figure 2. 9 EPCM Arrangement (LootsandHenchie, 2007)

2.6 Components for Selling Price of Power Generation

In considering the basic cost for power generation, there are several cost components. Based on Kresnaningtyas, 2011, the selling price for power generation basically consists of investment cost/capital cost and generation cost (operation). It can be seen more detail in Figure 2.10 below:

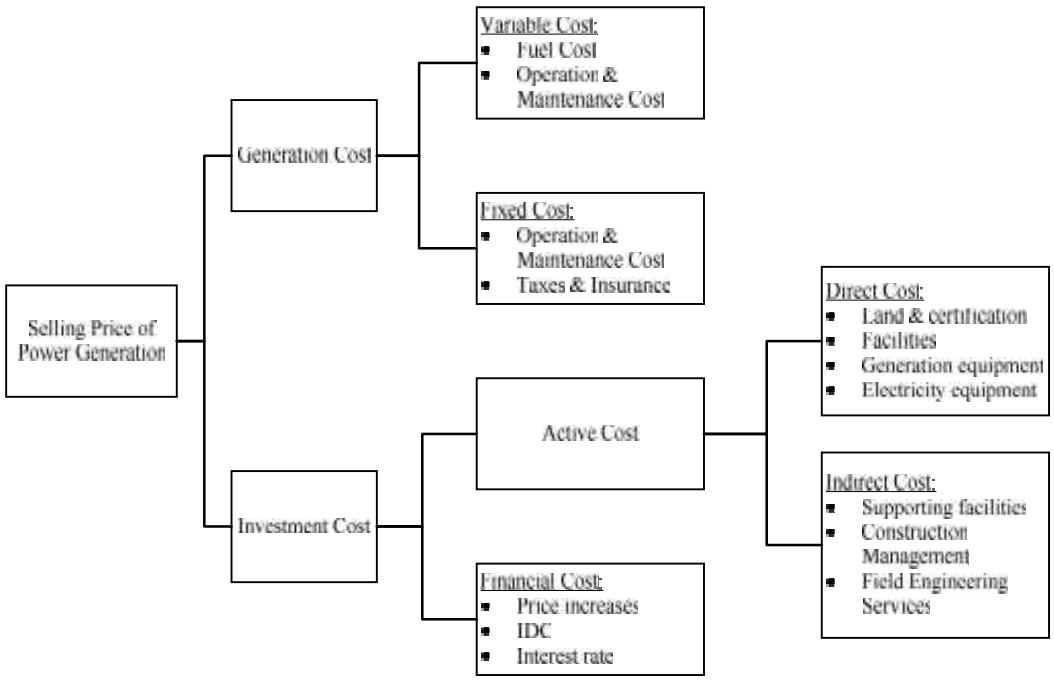

Figure 2. 10 Classification for Selling Price of Power Generation (Kresnaningtyas, 2011)

In addition, based on Maksum and Rivai, 2012, the cost components for construct the selling price of power generation principally are consist of:

a. Capital Cost (Component A)
b. Fixed Cost for Operation and Maintenance (Component B)
c. Fuel Cost (Component C)
d. Variable Cost for Operation and Maintenance (Component D)

$$Selling\ Price\ of\ Power\ Generation = Comp.A + Comp.B + Comp.C + Comp.D \quad (2.1)$$

- *Capital Cost (Component A)*

Capital Cost is the total investment cost for the power plant, starts from planning until the construction. It consists of construction cost, procurement cost from the machineries (such as turbine, boiler, etc.), and Balance of Plant (BOP). Moreover, the engineering cost since the planning phase and also Interest during Construction (IDC) are included in the component A. Below is the general equation to determine capital cost (component A):

$$Construction\ Cost = \frac{Total\ Investment\ Cost\ (USD)}{Installed\ Capacity\ (kW)} \quad (2.2)$$

In calculation of Capital Cost, there are several factors that affect the calculation, which are the economic life time and Capital Recovery Factor (CRF). CRF itself is determined by interest rate (i) and depreciation factor (d). Below is the equation for CRF, interest rate factor (f_s), and depreciation factor (f_d):

$$CRF = f_s + f_d \quad (2.3)$$

$$f_s = \frac{i(1+i)^n}{(1+i)^n - 1} \quad (2.4)$$

$$f_d = \frac{d}{(1+d)^n - 1} \quad (2.5)$$

While Capital Cost will be calculated by:

$$Capital\ Cost\ (Component\ A) = \frac{CRF\ x\ Construction\ Cost}{Netto\ Operation\ Time} \quad (2.6)$$

In supplied power project, the source of financing usually from the paid-up capital and loan. It will cause additional cost for the loan, which are interest and IDC. Those cost also need to be considered and included in capital cost's calculation.

- *Fixed Cost for Operation and Maintenance (Component B)*

Based on Figure 2.10, Operation and Maintenance (O and M) cost consists of Fixed Cost and Variable Cost. Fixed Cost itself is all Operation and Maintenance cost that are not related with the electrical output. Those cost will be fixed, no matter how much power being generated. It depends on the type of fuel, capacity of power plant, and the applied technology. O and M Cost that included as fixed cost are:

- Employee salary
- Administration cost

- Management cost
- Maintenance cost

Maintenance cost can be fixed and variable cost. It will be fixed cost if the calculation is based on the machinery's components, the equipment's life time, or operation hour. As the part of basic cost for power generation, the total of Fixed Cost for Operation and Maintenance (USD) needs to be divided with the annual amount of power generated (kWh), so the basic cost for power generation (USD/kWh) can be known.

• *Fuel Cost (Component C)*

Fuel Cost is categorized as variable cost, which related with total amount of power generated. The influence factors to consider the fuel cost are the consumption rate, kind of fuel, and price/unit for fuel. Those factors influence the amount of annual fuel cost. Each kind of fuel has different calorific value and heat rate, which affect the consumption rate to produce 1 kWh. When the consumption rate is higher, it means the cost to generate 1 kWh is getting higher. It also related with the price per unit for the fuel. The combination of those factors will be generated the final fuel cost.

• *Variable Cost for Operation and Maintenance (Component D)*

As mentioned before, Operation and Maintenance cost consists of fixed and variable cost. Variable Cost for Operation and Maintenance is production-related costs which vary with electrical generation (U.S. Energy Information Administration, 2013). As the example of O and M cost that included as variable cost are:

- Raw water
- Industrial water
- Lubricants
- Consumable materials and supplies

The increases and decreases of this cost are following the total generated power. Same as the other cost components, Variable cost for Operation and Maintenance needs to be converted into USD/kWh for the total calculation of basic cost of power generation.

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CHAPTER 3
RESEARCH METHODOLOGY

Research methodology is required as basic framework for conducting any research so it can be done structured and systematically. This chapter consists of preliminary phase, literature review phase, data collection and processing phase, data analysis and interpretation phase, conclusion and suggestion phase, and the research flowchart that informs guideline and stages in conducting the research.

3.1 Preliminary Phase

In Preliminary Phase, it will concern on problem identification and formulation. The problem will be assessed and formulated in order to find the solution, which being the objectives of the research.

3.1.1 Problem Identification

Problem that is being the observed object is the needs of supplied power for support the operation of iron making plants in Lampung province. The available power's capacity from installed power plants in Lampung province reaches 593.5 MW, while the current actual demand reaches 854 MW. It means Lampung province encounters deficit power, and must conduct blackout rolling program. It can influence the performance and financial condition of iron making plants. Besides, Smelter Company has secondary product, synthesis gas, which can be the fuel for power plant that is equivalent with 283 MW_{el}. Therefore, in order to fulfill the captive demand, the company's management prefer to asks subsidiary company to build power plant and buy the supplied power. The problem is the scheme of synthesis gas pricing and electricity price that can lead mutual benefit for Power Plant and Smelter Company in various condition, so the decision to insource supplied power from Power Plant that owned by subsidiary company is the right decision. Therefore, it needs to conduct study to analyze and examine in detail that accommodates several conditions that may happen to contruct the best pricing scheme of synthesis gas and electricity.

3.1.2 Problem Formulation and Objective Setting

The next step is formulating problem and setting the objectives of research. The problem formulation for this research is to construct the pricing scheme of synthesis gas and electricity so it can bring win-win solution between Smelter Company and Power Plant. Recommendation of synthesis gas price, electricity pricing policy and proving the best decision for the option of supplied power's source become the objectives from this research.

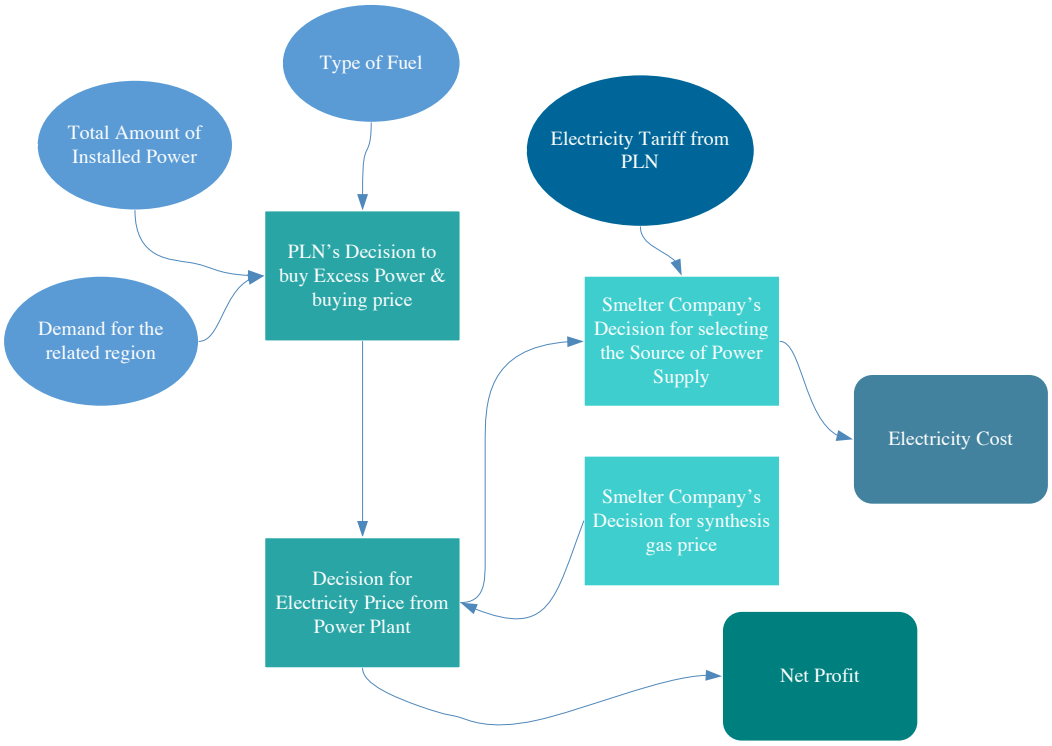

Figure 3. 1 Influence Diagram of Existing Problem in Smelter Company

3.2 Literature Review

In this research, literature has critical role as the basic theory to solve the problem and conduct decision analysis. Literature that is being reviewed are theory about decision analysis, general information about influenced factor of Indonesia electricity tariff's growth, IGCC, Synchronization Scheme between Power Plant and Iron Making Plants, and EPC scheme. In addition, it also contains about the applied methods, which is Component for Cost of Power Generation. The sources are from text book, thesis, journals, government and company's reports.

3.3 Data Collection and Processing Phase

Data Collection and Processing Phase have important roles as the basic information and data to be observed and analyzed. This phase gives an impact to the decision and result from the research.

3.3.1 Data Collection

In this stage, various data that are correlating and supporting the observed problems are gathered. Those data itself collected from various sources, which can be divided into 2 classification as primary data and secondary data. Primary data is obtained from company's data, while the secondary data that are being obtained from government's report, journal, and books. The collected data itself related with the both options, as the supporting data in analyzing and observing each options. The collected data to support forecasting process of PLN Tariff are historical data of PLN tariff in previous years, historical data of influenced factors, and reference data from State Budget of Indonesia (APBN) in previous years related with Indonesia Crude Price (ICP), inflation rate, and exchange rate. The data collection for calculating electricity price is the primary data from company.

3.3.2 Data Processing

The collected data needs to be processed in order to conduct analysis and observation. Data processing stage is divided into 2 sub processes that provided in Chapter 4 for calculate the synthesis gas price and Chapter 5 for construct the pricing policy.

In the first sub process, it calculates the selling price of synthesis gas that can be feasible for all scenarios and the lowest PLN buying price that still can be accepted. Besides, it also conduct forecasting of PLN's electricity tariff in parallel as the comparison for supplied power's option and test the decision of Smelter Company. The applied method that is being used for forecasting PLN's electricity tariff by multi-regression method. In addition, the calculation power plant's electricity price also being conducted for each scenarios and it is being elaborated based on the components for Cost of Power Plant, which consists of Investment

Cost/Capital Cost, Fuel Cost, Variable Cost for Operation and Maintenance, and Fixed Cost for Operation and Maintenance.

After the first sub process is done, it is continued to Chapter 5 for contructing the pricing policy of electricity price for Smelter Company. It is constructed based on the calculated electricity price in Chapter 4 for all scenarios.

3.4 Data Analysis

At this phase, the processed data will be analyzed in thoroughly for constructing the pricing scheme of synthesis gas and generated power. Each data will be analyzed on each chapter.

Chapter 4 will analyze the synthesis gas price that gives mutual benefit for both sides and the minimum buying price from PLN that still acceptable for Power Plant. In addition, there is incremental analysis to compare the option of supplied power's source between to insource from power plant or outsource from PLN supply.

In Chapter 5, the pricing policy will be analyzed in detail in order to know the influence factors of electricity price and the correlation of PLN decision to buy with the electricity price.

3.5 Conclusion and Suggestion Phase

In the last phase of the research, there is conclusion as the answer of the objectives of research based on the analysis from previous phase, which is including the recommendation of the pricing scheme of synthesis gas and generated power, the pricing policy of electricity price, and give evidence that insource from power plant is the best decision. In addition, it also gives suggestion for the company and further researches.

3.6 Flowchart of Research

The big picture for the flow of conducting research, it will be informed by flowchart from the beginning until the end in Figure 3. 2.

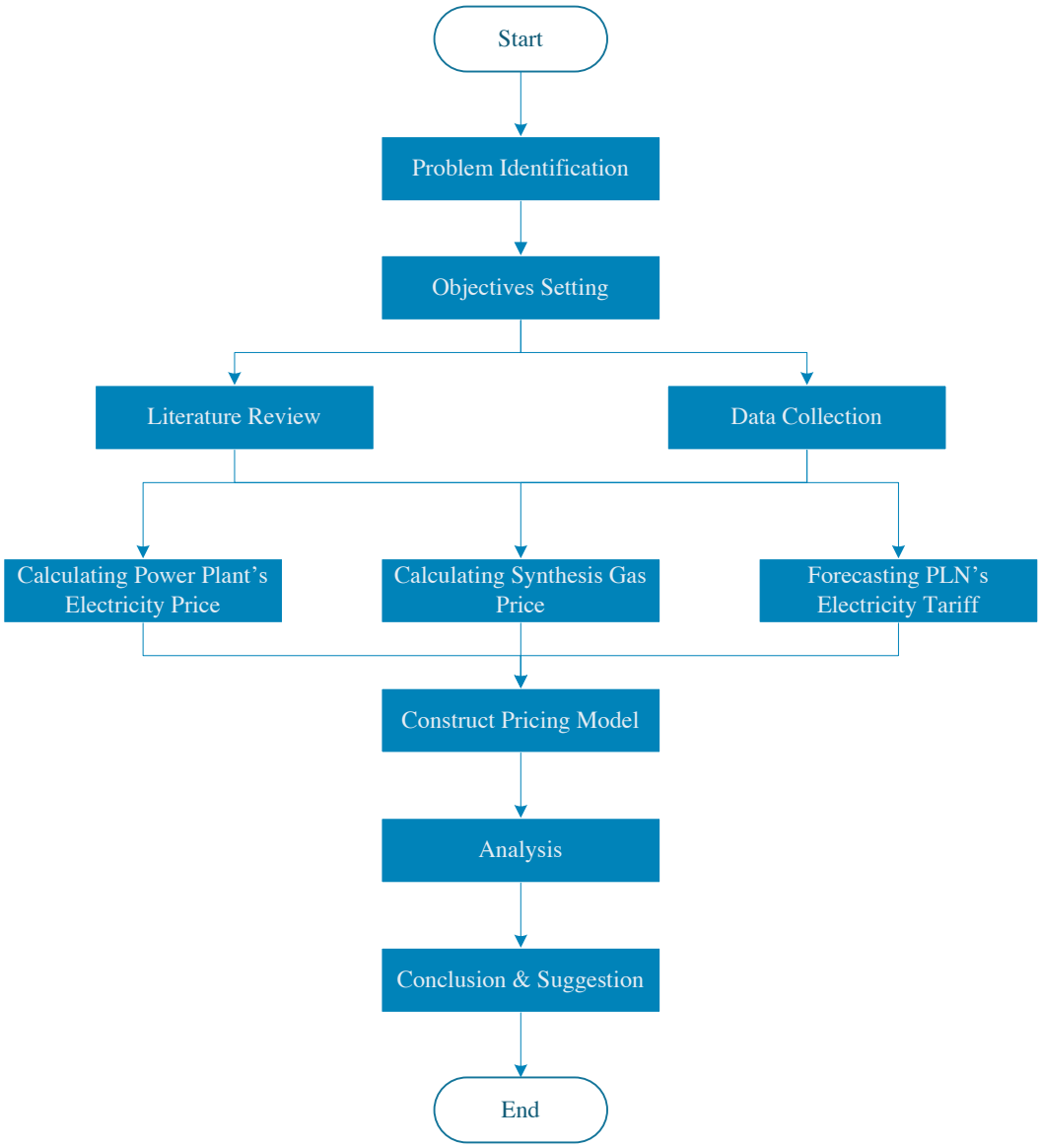

Figure 3. 2 Flowchart of Research

As the detail of the data processing, below is the flowchart for forecasting PLN's electricity tariff and calculation of power plant electricity's price:

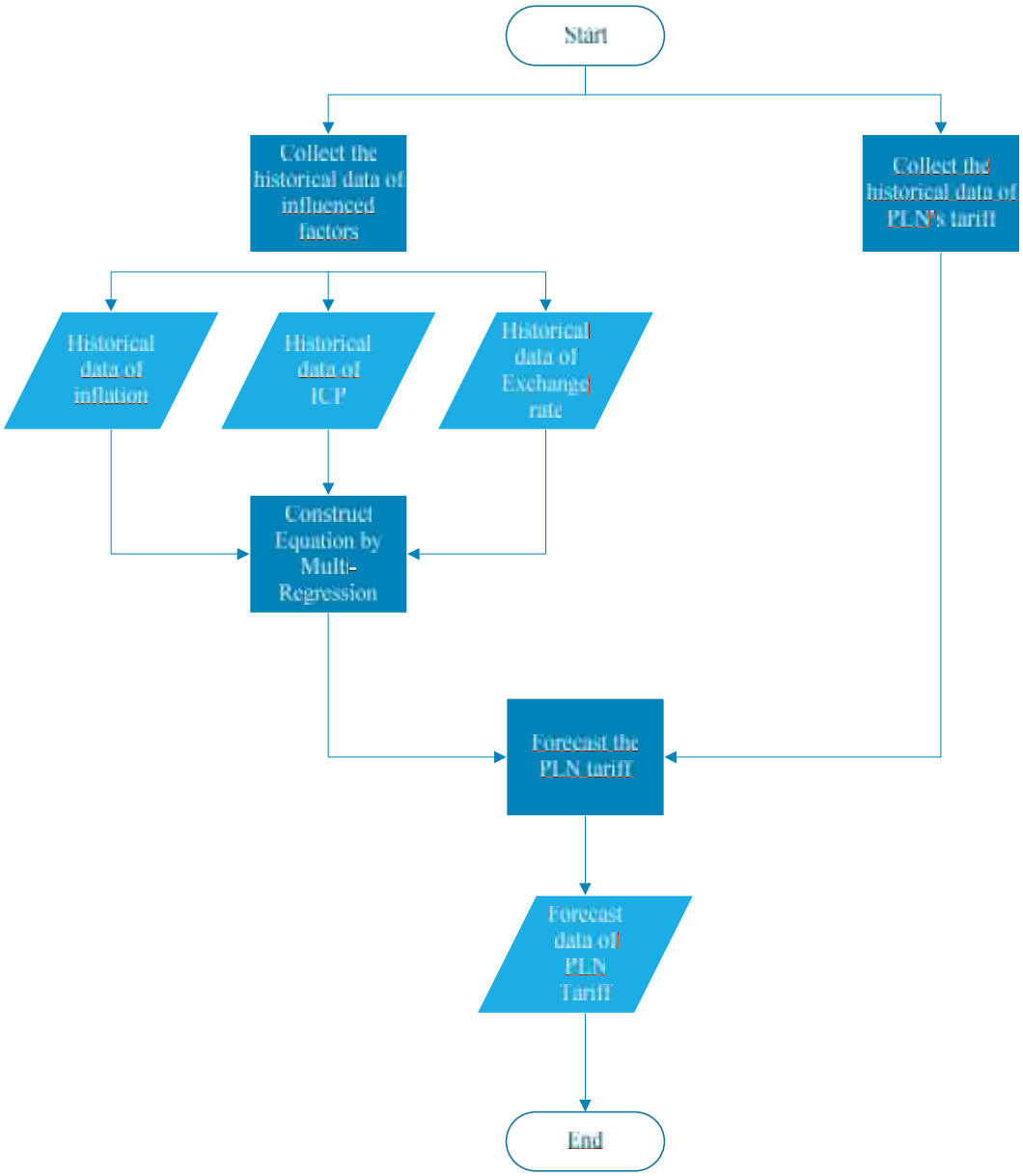

Figure 3. 3 Flowchart of Forecasting PLN's Electricity Tariff
**ICP: Indonesia Crude Price*

In forecasting PLN Tariff, it needs the historical data of influenced factors, which are inflation rate, Indonesia Crude Price, and exchange rate IDR against USD from the previous years in order to construct the equation of Tariff Adjustment. Besides, it also needs the historical data of PLN Tariff and the basic assumption that used State Budget of Indonesia (APBN) for the influenced factors. The deviation between the historical data and the basic assumption of the same year for

each factors become the input for multi-regression method as the independence variable, and the historical data of PLN Tariff becomes the response / dependent variable. The regression's model / equation will be used to calculate the forecasted data of PLN Tariff.

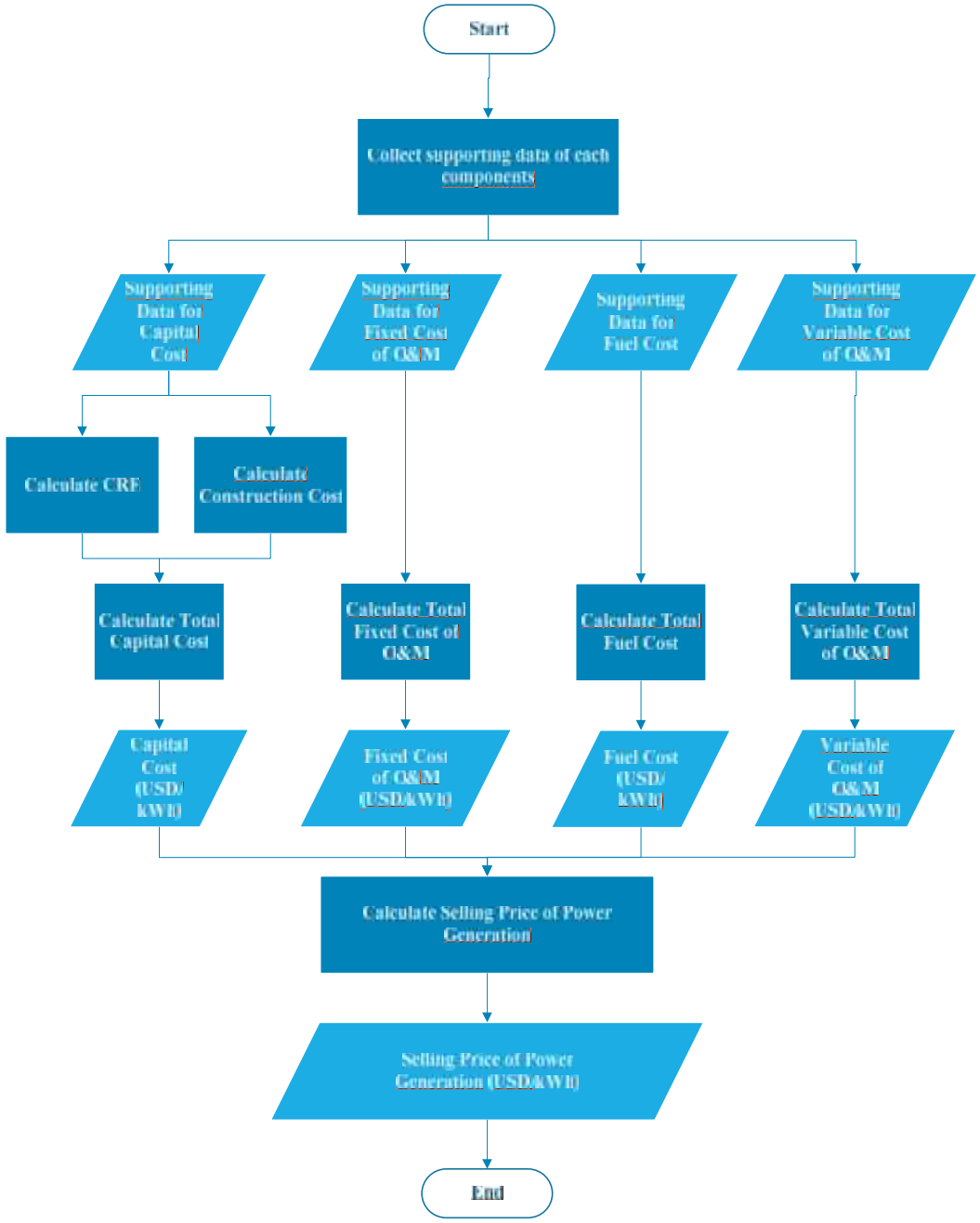

Figure 3. 4 Flowchart of Calculation of Power Plant's Electricity Price

As mentioned in sub chapter 2.6, Electricity Price of Power Generation by Power Plant consists of 4 component, which are Capital Cost (Component A), Fixed Cost of Operation and Maintenance (Component B), Fuel Cost (Component C), and Variable Cost of Operation and Maintenance (Component D). All of the investment cost for build and operate the power plant is included in Capital Cost. Besides, the depreciation factor and the expected return, which consists of bank loan interest rate, Export Credit Agency (ECA) interest rate, and the expected return from the management of the power plant are also considered in Capital Cost (Component A) as Capital Recovery Factor (CRF). While in Fixed Cost of Operation and Maintenance, it covers the human resources cost (salary), maintenance cost, and other costs that is not depended on the amount of power generated. Fuel cost is cost that occurs for procuring the fuel, which is synthesis gas from Smelter Company. While Component D, Variable Cost of Operation and Maintenance is cost that occurs depend on the amount of generated power.

CHAPTER 4
ANALYSIS and CALCULATION OF SYNTHESIS GAS PRICE

This chapter consists of 3 sub chapters, which are Data Collection, Calculation of Synthesis Gas Price and Analysis of Synthesis Gas Price. All of the related and supporting data are gathered for further processing in the research. Chapter 4 answers the first and third research objectives, which are give recommendation of synthesis gas price so there will bring beneficial for Smelter Company and Power Plant, and test the the decision of insource supplied power from power plant by comparing with outsource option from PLN.

It is important to know the price of synthesis gas because this price will be fixed however the total power is being purchased. It is used to maintain and give consistent price for PLN. Therefore, the final synthesis gas price must be able to fulfill and support each related parties reach their objectives. PLN gets the best price, which is not over the limit of buying price that already regulated by government, and Smelter Company get consistent supplied power that is better than outsource from PLN. While Power Plant still earns profit and make sure that it is feasible to conduct the scheme of business with dual-buyer.

As mentioned before, there are 2 buyers, which each of them needs pricing policy. PLN follows the standard calculation policy with the other power plants using Component A-B-C-D. In order to accommodate the changes of gas price and total purchased power, Power Plant needs to construct the other pricing policy for electricity price that is sold to Smelter Company. Based on that facts, it needs to construct a new pricing policy for Smelter Company that is constructed in Chapter 5. The results from the calculation of selling price of generated power to Smelter Company in Chapter 4 becomes the input of multiple regression that is used to construct the pricing policy. Figure 4.1 is the framework of the workflow in Chapter 4.

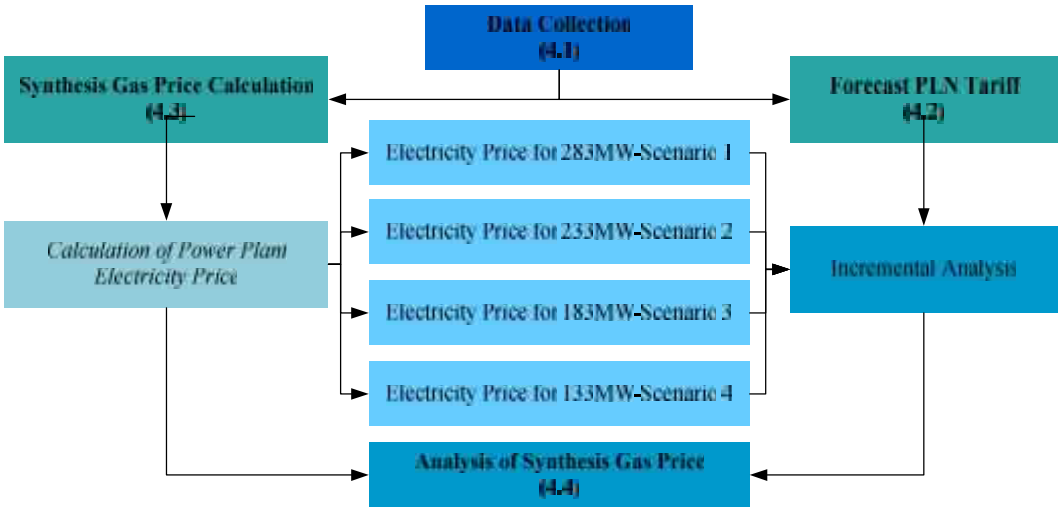

Figure 4. 1 Framework of Chapter 4 Workflow

4.1 Data Collection

As mentioned above and in previous chapters, there are several data that are gathered as the input for data processing and calculation in further processes. These data consist of history data of PLN Electricity Tariff, influenced factors, basic assumption of State Budget of Indonesia (APBN), and the basic information for pricing calculation of Smelter Company and Power Plant.

4.1.1 History Data of PLN Electricity Tariff

These data are the recapitulation of the PLN electricity tariff that are implemented since 2010 until 2016. Each electricity tariff policies that being issued is signed by Minister of Energy and Mineral Resources for Indonesia, because PLN is state-owned company and electricity tariff affects the livelihood of the entire people of Indonesia. These data will be used as the input in data processing to construct the equation model that is used to forecast the PLN electricity tariff in the next several period. The historical data is listed in Appendix 1.

4.1.2 History Data of Influence Factors

Based on PLN, the changes of electricity tariff are influenced by 3 factors.All of the gathered influence factor's data are started from 2005 until 2016. In order to ensure the accuracy and validity data, each factor's data are collected

from the related parties. Inflation rate is collected from BPS-Statistics Indonesia (Badan Pusat Statistik) in *month-to-month* (mtm) type data. It is calculated based on the changes of Consumer Price Index (CPI) in Indonesia. The second factor, Indonesia Crude Price (ICP), the data is gathered from the official website of Indonesia's Directorate General of Oil and Gas, one of the bureaus that are under Ministry of Energy and Mineral Resources of Indonesia. They publish the table of price for Indonesia's crude oil monthly. The last factor is exchange rate IDR (Indonesia Rupiah) against USD (U.S. Dollar). The historical data is obtained from the official website of Bank Indonesia as the responsible party that handles monetary of Indonesia. They record foreign exchange transaction rate in daily. Same with the historical data of PLN electricity tariff, these data are being used as the input for construct an equation model that is used to forecast the electricity tariff in the next few years. All of the historical data for influence factor are listed in Appendix 2 until 4.

4.1.3 History Data of Basic Assumption of State Budget (APBN) of Indonesia

Based on Tariff Adjustment policy in Regulation Minister of Energy and Mineral Resources of Indonesia no. 31 year 2014, the changes of electricity tariff is determined based on the difference between the actual values of each influence factors in the last period of time and the reference values for each influence factors (inflation rate, Indonesia Crude Price, and Exchange Rate). The reference values are taken from basic assumption for each factors in State Budget of Indonesia (Anggaran Pendapatan dan Belanja Negara) in the previous following year. Therefore, it is needed to collect Basic Assumption of State Budget of Indonesia that listed in Appendix 5.

4.1.4 Basic Information of Smelter Company and Power Plant

In order to calculate the selling price of the power generated from the power plant, there are a lot of information required from Power Plant and Smelter Company. The basic information that are required from Power Plant are the net capacity of the power plant, availability, consumption rate, investment cost for the power plant, estimation of salary expense for power plant's employees,

maintenance cost, variable cost, and the other costs, also the estimated PLN Buying Price for the excess power. Table 4.1 is the list of basic information of the power plant that are required:

Table 4. 1 Table of Basic Information of Power Plant (Integrated Gasification Combine Cycle – IGCC)

Description	Amount	Information
Net capacity of Power Plant	283 MW	
Efficiency Rate of Fuel	48%	From MW th (Megawatt thermal) into MW
Availability	94.2%	Decrease ±1% / year (related with reliability of the equipment)
Consumption rate of Synthesis Gas	7.053 MMBtu / MWh	Equal with 2.083 MWh th / MWh
Consumption rate of Liquid Natural Gas	0.0565 MMBtu/ MWh	Used for initial heating process of the excess steam from smelter
Investment Cost/Capital Cost		
Integrated Gasification Combined Cycle	$268,400,000	Included in EPC Contract
Construction Cost	$103,600,000	
Permit	$ 2,000,000	Import permit, etc.
Working Capital	$ 80,000,000	(include to cover IDC)
ECA Interest rate	1.57%	
Loan interest rate	4.98%	Based on metadata of BI-Commercial Bank for Investment Loans
Risk Free	6.75%	(Indonesia Government Bond-RI0144)
Estimated Annual Salary Expense of Power Plant's Employees		
Director's Salary	$ 84,000	For each person and include compensation (2 times of monthly salary)
Number of Director	3 person	
Commissioner's Salary	$ 84,000	For each person and include compensation (2 times of monthly salary)
Number of Commissioner	3 person	
General Manager's Salary	$ 56,000	For each person and include compensation (2 times of monthly salary)
Number of General Manager	4 person	
Senior Manager's Salary	$42,000	For each person and include compensation (2 times of monthly salary)
Number of Senior Manager	5 person	

Table 4. 1 Table of Basic Information of Power Plant (Integrated Gasification Combine Cycle – IGCC) (*Continued*)

Description	Amount	Information
Manager's Salary	$ 35,000	For each person and include compensation (2 times of monthly salary)
Number of Manager	8 person	
Supervisor's Salary	$ 21,000	For each person and include compensation (2 times of monthly salary)
Number of Supervisor	8 person	
Administrative Staff's Salary	$ 8,400	For each person and include compensation (2 times of monthly salary)
Number of Administrative Staff	8 person	
Operator's Salary	$ 8,400	For each person and include compensation (2 times of monthly salary)
Number of Operator	24 person	
Supporting Staff's Salary	$ 7,000	For each person and include compensation (2 times of monthly salary)
Number of Supporting Staff	40 person	
Technician's Salary	$ 7,000	For each person and include compensation (2 times of monthly salary)
Number of Technician	18 person	
Security's Salary	$ 4,900	For each person and include compensation (2 times of monthly salary)
Number of Security	40 person	
Maintenance Cost	4%	From total investment cost
Other Fixed Cost	7%	From total maintenance cost and salary expense
Price of LNG	$ 7.5	Per MMBtu
Industrial Water Requirement	4.15	m^3/ MWh
Industrial Water Cost	$ 0.5	Per m^3
Softened Water / Demineralize Water Requirement	0.024	m^3/ MWh
Softened Water / Demineralize Water Cost	$ 2	Per m^3
Estimated PLN Buying Price for Excess Power	$ 0.0784	Per kWh Based on Regulation Minister of Energy and Mineral Resources of Indonesia no. 3 year 2015

The information that are required from Smelter Company are the total electricity requirement and the total amount of synthesis gas produced. Below is the list of basic information that are required:

Table 4. 2 Table of Basic Information of Smelter Company

Description	Amount	Information
Electricity Requirement		
Smelting Plant	15 MW	
Pelletizing Plant	76 MW	
Air Separation Unit	42 MW	
Total Synthesis Gas Produced	675 MW th	Equal with 2,303.1 MMBtu 1 MW th = 3.412 MMBtu
Synthesis Gas Requirement		Used for maintain the heat in the furnace of Smelting and Pelletizing
Smelting Plant	20 MW th	Equal with 68.24 MMBtu
Pelletizing	70 MW th	Equal with 237.39 MMBtu
Net Synthesis Gas	585 MW th	Equal with 1,997.47 MMBtu

All of these data are gathered for calculate the selling price for the power generated that is processed in the next sub chapter.

4.2 Forecast PLN Tariff

As mentioned before in sub chapter 2.2, PLN was implementing Tariff Adjustment policy for determine the PLN's electricity tariff since 2013-2014. Below is Tariff Adjustment equation based on Regulation Minister of Energy and Mineral Resources of Indonesia no. 31 year 2014:

$$TB = TL\ x\ (1 + \%TA) \quad (4.1)$$

with:

TB = Implemented electricity tariff after tariff adjustment

TL = Electricity tariff in the previous period

%TA = Percentage of electricity tariff's adjustment

The formula for the percentage of tariff adjustment of electricity pricing itself is:

$$\%TA = \%\left(K_{exchange\,rate}\ x\ \Delta\ Exchange\ Rate\right) + \%(K_{ICP}\ x\ \Delta\ ICP) + \%(K_{inflation}\ x\ \Delta\ Inflation) \quad (4.2)$$

with:

TA = Tariff Adjustment

$K_{exchange\ rate}$ = Coefficient for changes of exchange rate

Δ Exchange rate = Difference between the new exchange rate with the reference based on State Budget of Indonesia (APBN) in previous following year

K_{ICP} = Coefficient for changes of ICP

Δ ICP = Difference between the new ICP with the reference based on State Budget of Indonesia (APBN) in previous following year

$K_{inflation}$ = Coefficient for changes of inflation

Δ Inflation = Difference between the new inflation with the reference based on State Budget of Indonesia (APBN) in previous following year

In order to forecast PLN tariff for 2017-2044, it needs to know the complete equation of Tariff Adjustment, so the first step to forecast PLN tariff is constructing complete Tariff Adjustment equation accordance with the equation that already stated in Regulation Minister of Energy and Mineral Resources of Indonesia no. 31 year 2014. The calculation result of % Tariff Adjustment, Δ Exchange Rate, ΔICP, and ΔInflation from 2013-2016 can be seen in Appendix 6. Since the coefficient of each factors (inflation, ICP, and exchange rate) are not published, it needs to conduct Multiple Regression as the method that able to consider more than 1 influence factor in order to have complete equation for forecast the PLN's tariff in the next few years. The result from Minitab for multiple regression method is provided below:

Regression Analysis: TA versus Inflation, ICP, Exchange Rate

```
Analysis of Variance

Source           DF   Adj SS  Adj MS  F-Value  P-Value
Regression        3   78.577  26.192     1.61    0.219
  Inflation       1   56.452  56.452     3.47    0.077
  ICP             1    4.576   4.576     0.28    0.602
  Exchange Rate   1    3.596   3.596     0.22    0.643
Error            20  325.504  16.275
Total            23  404.080


Model Summary

      S    R-sq  R-sq(adj)  R-sq(pred)
4.03425  19.45%      7.36%       0.00%


Coefficients

Term              Coef    SE Coef  T-Value  P-Value   VIF
Inflation         4.23       2.27     1.86    0.077  1.18
ICP             0.0175     0.0329     0.53    0.602  5.69
Exchange Rate  0.000388   0.000826     0.47    0.643  5.49


Regression Equation

TA = 4.23 Inflation + 0.0175 ICP + 0.000388 Exchange Rate
```

Based on the result above, the complete equation for %Tariff Adjustment is:

$$\%TA = \%(4.23\ x\ \Delta\ inflation) + \%(0.0175\ x\ \Delta\ ICP) + \%(0.000388\ x\ \Delta\ Exchange\ Rate) \quad (4.3)$$

The testing result of the complete Tariff Adjustment's equation with Equation 4.3 for calculate %Tariff Adjustment is provided in Appendix 7. In order to forecast PLN's tariff, it also need to predict the value of ΔExchange Rate, ΔICP, and ΔInflation for those next few years. In this research, those value is taken from the historical data calculation for influenced factors. The average value of the difference between the basic assumption for each factor and the annual value of each factor. Below is the formula:

$$\Delta inflation = \frac{\sum_{2005}^{t}\left[APBN\ Assumption_{t-1} - \left(\frac{\sum_{1}^{i} inflation_i}{12}\right)\right]}{12} \quad (4.4)$$

With:

ΔInflation	= average value of the difference between APBN assumption for inflation rate in t-1 (previous following year) and the annual inflation rate's value
APBN Assumption$_{t-1}$	= the basic assumption for inflation rate in year t-1 (previous following year)
i	= following month (January, February, until December)
inflation$_i$	= inflation rate in month i
t	= following year (2005, 2006, until 2016)

$$\Delta iICP = \frac{\sum_{2005}^{t}\left[APBN\ Assumption_{t-1} - \left(\frac{\sum_{1}^{i} ICP_i}{12}\right)\right]}{12} \quad (4.5)$$

With:

ΔICP	= average value of the difference between APBN assumption for ICP in t-1 (previous following year) and the annual ICP's value
APBN Assumption$_{t-1}$	= the basic assumption for ICP in year t-1 (previous following year)
i	= following month (January, February, until December)
ICP$_i$	= inflation rate in month i
t	= following year (2005, 2006, until 2016)

$$\Delta exchange\ rate = \frac{\sum_{2005}^{t}\left[APBN\ Assumption_{t-1} - \left(\frac{\sum_{1}^{i} exchange\ rate_i}{12}\right)\right]}{12} \quad (4.6)$$

With :

ΔInflation	= average value of the difference between APBN assumption for exchange rate in t-1 (previous following year) and the annual exchange rate's value
APBN Assumption$_{t-1}$	= the basic assumption for exchange rate in year t-1 (previous following year)
i	= following month (January, February, until December)
inflation$_i$	= inflation rate in month i
t	= following year (2005, 2006, until 2016)

Based on those calculation, it can be found that % Tariff Adjustment for each month from 2017-2044 (3 years construction and 25 years operation) is 0.48%. Table 4.4 is the forecast PLN's tariff in 2017-2014 with the detail calculation table is provided in Appendix 8 and 9.

Table 4. 3 Forecast PLN Tariff in 2017-2044

Year	Amount			
	IDR		USD	
2017	Rp	1,040.57	$	0.078
2018	Rp	1,101.90	$	0.083
2019	Rp	1,166.84	$	0.088
2020	Rp	1,235.62	$	0.093
2021	Rp	1,308.44	$	0.098
2022	Rp	1,385.56	$	0.104
2023	Rp	1,467.22	$	0.110
2024	Rp	1,553.69	$	0.117
2025	Rp	1,645.27	$	0.124
2026	Rp	1,742.23	$	0.131
2027	Rp	1,844.92	$	0.139
2028	Rp	1,953.65	$	0.147
2029	Rp	2,022.00	$	0.152
2030	Rp	2,190.73	$	0.165
2031	Rp	2,319.85	$	0.174
2032	Rp	2,456.57	$	0.185
2033	Rp	2,601.36	$	0.196
2034	Rp	2,754.68	$	0.207
2035	Rp	2,917.03	$	0.219
2036	Rp	3,088.96	$	0.232
2037	Rp	3,271.01	$	0.246
2038	Rp	3,463.80	$	0.260

Table 4. 3 Forecast PLN Tariff in 2017-2044 (*Continued*)

Year	Amount			
	IDR		USD	
2039	Rp	3,667.95	$	0.276
2040	Rp	3,884.13	$	0.292
2041	Rp	4,113.06	$	0.309
2042	Rp	4,355.47	$	0.327
2043	Rp	4,612.17	$	0.347
2044	Rp	4,884.01	$	0.367

If Smelter Company chooses the supplied power from PLN, their Net Present Value (NPV) for the supplied power matter is **-$1,331,342,799.49**, with the detail calculation in Appendix 10.

4.3 Calculation of Synthesis Gas Price

The business relationship between Smelter Company and Power Plant is 'take-and-give' that each of them get benefit from the others. Smelter Company gets supplied power from Power Plant and the synthesis gas as their secondary product is bought by Power Plant so Smelter Company does not get any environment issues. Besides, they also get revenue on supplied power matter as the selling of synthesis gas to Power Plant. Contrarily, Power Plant gets benefit as the regular supply of fuel, which is synthesis gas from Smelter Company and fix buyer for 133 MW.

In this business scheme, one of the key point / connection point between both of them is the synthesis gas as the secondary product from Smelter Company and fuel for Power Plant. Moreover, the fuel cost has a big affect in contructing electricity price when PLN decides to join for take over the excess power. Thereof, it needs good selling price of synthesis gas so both parties still get benefit. In order to maintain the consistency of electricity price's components, the selling price of synthesis gas itself is same for all scenarios, whether PLN buys the excess power or not. As the objectives from Smelter Company is minimizing cost, includes utilities cost (power). While the objectives from Power Plant is earning profit as big as possible so the business process is feasible in financial aspect. The selling price must able to accommodates both objectives, so the business scheme can be accepted in the all conditions.

There is also a contraint from PLN's side, which is the buying price from PLN has a limit that is regulated by Regulation Ministry of Energy and Mineral Resources of Indonesia No.3 Year 2015. The limit of PLN buying price for 150 MW (total amount of the excess power) is $7.31 cents / kWh (in Annual Worth of PLN buying price in 25 years). Consequently, the selling price of generated power cannot above that amount.

As additional information, Power Plant cannot sell power to Smelter Company under PLN Buying Price. It will bring affect to the PLN buying price if the electricity price of Smelter Company below PLN Buying Price, which is PLN will ask and re-negotiate for the selling price from Power Plant to PLN to be decreased. Therefore, Power Plant must sell power to Smelter Company at least same or above PLN Buying Price.

The calculation the selling price of synthesis gas is based on the scenario, when the generated power is bought in total amount. In this scenario, the selling price for Smelter Company is in the cheapest price because it only covers the costs for generating power as 133 MW and the costs for generating the excess power is covered by PLN as the buyer of those total amount. While the buying price from PLN also in the same price because PLN always targeted their buying price is at least the same value of the cheapest price for Smelter Company. Therefore, the buying price of both of them is in the same value. As mentioned before that PLN buying price has a limit, $7.31/kWh, so the Annual Worth (AW) of the electricity price must be in that amount. This electricity price for PLN is fix for all scenarios, so however the total generated power that is bought by PLN, the electricity price is same. While the electricity price for Smelter as mentioned before, it cannot be sold under PLN Buying Price, so it will be locked for minimum selling price to Smelter Company is at least $7.31 cents/kWh. The electricity price will increase when PLN reduces the amount of power that they purchased. Below is the calculation's result for the synthesis gas price with PLN Buying Price assumed equivalent in Annual Worth (AW) is $7.31 cents/kWh, while the detail calculation is provided in Appendix 15.

Table 4. 4 Calculation Result of Synthesis Gas Price

Year	Component A	Component B	Component C	Component D	Electricity Price	Present Value of El. Price
2020	$0.0212	$0.0094	$0.0199	$0.0021	$0.0526	($0.0526)
2021	$0.0215	$0.0096	$0.0201	$0.0022	$0.0534	($0.0531)
2022	$0.0217	$0.0098	$0.0205	$0.0022	$0.0542	($0.0536)
2023	$0.0219	$0.0101	$0.0208	$0.0022	$0.0550	($0.0542)
2024	$0.0222	$0.0104	$0.0211	$0.0023	$0.0559	($0.0547)
2025	$0.0224	$0.0106	$0.0214	$0.0023	$0.0568	($0.0553)
2026	$0.0227	$0.0109	$0.0217	$0.0023	$0.0576	($0.0559)
2027	$0.0230	$0.0112	$0.0220	$0.0024	$0.0586	($0.0565)
2028	$0.0232	$0.0115	$0.0224	$0.0024	$0.0595	($0.0572)
2029	$0.0235	$0.0118	$0.0227	$0.0024	$0.0604	($0.0578)
2030	$0.0238	$0.0121	$0.0230	$0.0025	$0.0614	($0.0585)
2031	$0.0241	$0.0125	$0.0234	$0.0025	$0.0624	($0.0592)
2032	$0.0243	$0.0128	$0.0237	$0.0025	$0.0634	($0.0599)
2033	$0.0246	$0.0132	$0.0241	$0.0026	$0.0645	($0.0607)
2034	$0.0250	$0.0135	$0.0245	$0.0026	$0.0656	($0.0615)
2035	$0.0253	$0.0139	$0.0248	$0.0027	$0.0667	($0.0623)
2036	$0.0256	$0.0143	$0.0252	$0.0027	a$0.0678	($0.0631)
2037	$0.0259	$0.0147	$0.0256	$0.0027	$0.0689	($0.0640)
2038	$0.0263	$0.0151	$0.0260	$0.0028	$0.0701	($0.0648)
2039	$0.0266	$0.0156	$0.0263	$0.0028	$0.0713	($0.0658)
2040	$0.0270	$0.0160	$0.0267	$0.0029	$0.0726	($0.0667)
2041	$0.0273	$0.0165	$0.0271	$0.0029	$0.0738	($0.0677)
2042	$0.0277	$0.0169	$0.0275	$0.0029	$0.0752	($0.0687)
2043	$0.0281	$0.0174	$0.0280	$0.0030	$0.0765	($0.0698)
2044	$0.0285	$0.0179	$0.0284	$0.0030	$0.0779	($0.0709)
Total Present Value of Electricity Price (per kWh)						($1.5146)
Annual Worth of Electricity Price (per kWh)						$0.0731
Synthesis Gas Price (per mmBtu)						**$2.752**

Based on the result above, the final price of synthesis gas is $2.752/mmBtu for PLN Buying Price is $7.31 cents/kWh (Annual Worth). But it still needs to be tested in other scenarios because PLN may buy the power not in the full amount (150 MW).

In order to accommodate that possibility, it will be tested in 4 scenarios.

Table 4. 5 List of Scenario

Scenario	Take Over by Smelter Company	Take Over by PLN	Total
1	133 MW	150 MW	283 MW
2	133 MW	100 MW	233 MW
3	133 MW	50 MW	183 MW
4	133 MW	0 MW	133 MW

In scenario 1 until 3, PLN and Smelter Company is sharing responsibilities to cover the cost for generating power. In scenario 4, the excess power is assumed

not purchased by PLN, so the generated power is bought only 133 MW as the requirement of Smelter Company. So all costs for Power Plant's operation is covered by Smelter Company. In each scenario, the feasibility of Power Plant is being tested. Besides, Net Present Value (NPV) of joined cash flow between Smelter Company and Power Plant also being calculated as one entity to examine the management's decision for insource supplied power from power plant compared with the outsource option for PLN.

4.3.1 Calculation of Power Plant's Electricity Price

The electricity price consists of 4 components, which are Capital Cost as Component A, Fixed Cost of Operations and Maintenance as Component B, Fuel Cost as Component C, and Variable Cost of Operations and Maintenance as Component D. Each components has different contribution in constructing the electricity price. Below is the calculation of each components in the optimum condition (generate power in the maximum capacity, 283 MW).

- Component A

  Capital Cost accommodates all investment cost for the power plant, starts from planning until the construction, payment of loan and its interests, and the expected return and profit for the company. The interests and the expected return accommodate in Capital Recovery Factor that consists of depreciation factor (f_d) and interest / return factor (f_s). Below is the equation:

$$CRF = f_s + f_d \tag{4.7}$$

$$f_s = \frac{i(1+i)^n}{(1+i)^n - 1} \tag{4.8}$$

  i in interest / return factor is Minimum Attractive Rate of Return (MARR) for the power plant that consists of Weighted Average Cost of Capital (WACC) and additional expected profit. Below is the detail equation:

$$i = MARR = WACC + Additional\ Expected\ Profit \tag{4.9}$$

$$WACC = (\%\,ECA\ x\ ECA\ interest\ rate) + (\%Loan\ x\ Loan\ interest\ rate) + (\%equity\ x\ Risk\ free) \quad (4.10)$$

With:

ECA interest rate = 1.57%

Loan interest rate = 4.98%

Risk free = 6.75%

(Indonesia Government Bond-RI0144)

ECA = $316,200,000 ➔ 69.6%

Loan = $55,800,000 ➔ 12.3%

Equity = $82,000,000 ➔ 18.1%

Expected Profit = 4%

n = 25 years

$$WACC = (69.6\%\ x\ 1.57\%) + (12.3\%\ x\ 4.98\%) + (18.1\%\ x\ 6.75\%)$$

$$WACC = 2.9\%$$

$$i = MARR = 2.93\% + 5\% = 6.9\%$$

$$f_s = \frac{6.93\%(1+6.93\%)^{25}}{(1+6.93\%)^{25}-1} = 8.53\%$$

While depreciation factor equation is

$$f_d = \frac{d}{(1+d)^n - 1} \quad (4.11)$$

With:

d = 4%

$$f_d = \frac{4\%}{(1+4\%)^{25}-1} = 2.40\%$$

So Capital Recovery Factor (CRF) is

$$CRF = 8.52\% + 2.40\% = 10.93\%$$

All investment cost, such as construction cost, machinery cost (IGCC, and installation), working capital, permit, etc., are accommodated in Construction Cost equation, which is:

$$Construction\ Cost = \frac{Total\ Investment\ Cost\ (USD)}{Installed\ Capacity\ (kW)} \quad (4.12)$$

With:

Total investment cost = $454,000,000

Installed Capacity = 283,000 kW = 283 MW (maximum)

So the construction cost:

$$Construction\ Cost = \frac{\$454,000,000}{283,000\ kW} = \$1,604.24/kW$$

The capital cost (component A) itself calculated by equation below:

$$Capital\ Cost\ (Component\ A) = \frac{CRF\ x\ Construction\ Cost}{Netto\ Operation\ Time} \quad (4.13)$$

So component A / capital cost is:

$$\textbf{Capital Cost (Component A)} = \frac{0.1093\ x\ \$1,604.24/kW}{8250\ hours} = \$0.0212/kWh$$

- Component B

  Fixed Cost of Operations and Maintenance as Component B covers all Operation and Maintenance cost that are not related with the amount of electrical output. Therefore, the amount of this component will not be affected with the amount of generated power, but it will increase in line with the inflation rate. Operations and Maintenance expenses that are covered by Component B as follows:

  - Annual Salary Expense

- Administration cost
- Management cost
- Maintenance cost

The annual estimated salary expense is $2,256,800, including the operation and management employees. The detail calculation for the salary expense is provided in List of Cost in Appendix 9. While the Maintenance cost is estimated 4% from total investment cost, which is $18,160,000 and it also budget for other fixed cost budget, which is 7% from total annual maintenance cost and salary expense. Administration cost and Management cost are covered in this budget. The amount of other cost for Fixed Cost of Operations and Maintenance is $1,429,176. Below is the equation to construct component B.

$$Maintenance\ Cost = 4\%\ x\ Total\ Investment\ Cost \quad (4.14)$$

$$Other\ Fixed\ Cost = 7\%x(Annual\ Salary\ Expense + Maintenance\ Cost) \quad (4.15)$$

$$Fixed\ Cost\ of\ OandM = \frac{(Annual\ Salary\ Expense + Maintenance\ Cost + Other)}{Power\ Generated\ (kWh)} \quad (4.16)$$

So,

$$Maintenance\ Cost = 4\%\ x\ \$454{,}000{,}000 = \$18{,}160{,}000$$

$$Other\ Fixed\ Cost = 7\%x(\$2{,}256{,}800 + \$18{,}160{,}000) = 1{,}429{,}176$$

$$\textbf{Fixed Cost of OandM} = \frac{(\$2{,}256{,}800 + \$18{,}160{,}000 + \$1{,}429{,}176)}{2{,}334{,}750{,}000\ (kWh)}$$

$$= \$0.0094/kWh$$

- Component C

Fuel Cost relates with total amount of power generated. Higher amount of power that being generated, the cost also will get higher. Fuel cost accommodates the cost for buying fuel that is used in combustion process. In

this research, the fuel is the synthesis gas from Smelter Company, so the buying price of fuel is same with the selling price of synthesis gas from Smelter Company. Hence, when the selling price of synthesis gas is getting lower, the selling price of electricity also getting lower as the consequence of amount of component C is getting lower. In addition, there is also additional fuel cost for buying Liquid Natural Gas (LNG) that used to reheat the excess steam before it enters HRSG, although in the small amount. As the result from sub chapter 4.2 that the final price of synthesis gas is $3.089/mmBtu. Below is the equation to construct Component C.

$$Fuel\ Cost = \frac{LNG\ Price\ x\ Consumption\ Rate\ x\ Power\ Generated\ (MWh)}{Power\ Generated\ (kWh)} + \frac{Gas\ Price\ x\ Gas\ Supply}{Power\ Generated\ (kWh)} \quad (4.17)$$

With:

LNG Price = $ 7.5/mmBtu

Gas Price = $ 2.752/mmBtu

Consumption Rate = 0.05652 mmBtu / MWh (for LNG)

Power Generated = 2,334,750 MWh = 2,334,750,000 kWh

Gas Supply = 16,479,107 mmBtu

So the amount of Fuel Cost / Component C is

$$\textbf{Fuel Cost} = \frac{\$7.5\ x\ 0.05652\ x\ 2{,}334{,}750}{2{,}334{,}750{,}000} + \frac{2.752\ x\ 16{,}479{,}107}{2{,}334{,}750{,}000} = \$\ 0.0199/kWh$$

- Component D

Component D or Variable Cost of Operations and Maintenance is influenced by the amount of power generated. It will increase and decrease in line with the total power generated. Component D covers water consumption cost that constis of industrial water and softened / demineralized water. Based on the data that already collected and listed in Table 4.1, below is the equation to construct Component D.

$$Water\ Consumption\ Cost\ (MWh) = (Consumption\ of\ Softened/Demineralized\ Water\ x\ Softened\ Water\ Price + (Consumption\ Rate\ of\ Industrial\ Water\ x\ Industrial\ Water\ Price) \quad (4.18)$$

$$Variable\ Cost\ of\ OandM = \frac{Water\ Consumption\ Cost\ x\ Power\ Generated\ (MWh)}{Power\ Generated\ (kWh)} \quad (4.19)$$

So, the amount of Variable Cost of Operation and Maintenance / Component D is

$$Water\ Consumption\ Cost(MWh) = \left(0.024\frac{m^3}{MWh} x\ 2/M\quad h\right) + \left(4.15\frac{m^3}{MWh} x\ 0.5/M\quad h\right)$$
$$= \$2.12/M\quad h$$

$$\textbf{Variable Cost of OandM} = \frac{\$2.12\ x\ 2{,}334{,}750}{2{,}334{,}750{,}000} = 0.00212/kWh$$

The electricity price is the sum of those 4 components, so the equation to construct electricity price of power plant is

$$Electricity\ Price\ of\ Power\ Plant = Comp.A + Comp.B + Comp.C + Comp.D \quad (4.20)$$

$$Electricity\ Price\ of\ Power\ Plant = \$0.0212 + \$0.0094 + \$0.0199 + \$0.00212$$
$$= \$0.0526/kWh \text{ or } \$5.26 \text{ cents / kWh}$$

The calculation above is the calculation for optimum condition, which is the generated power is in the maximum amount, 283 MW. In order to anticipate the possibility that PLN will take over the excess power, the calculation of Power Plant's electricity price will be divided into 2 conditions. The first condition is the supplied power bought by Smelter Company and PLN (second buyer). The second condition is exclusively bought by Smelter Company (no other buyer). The second condition is used as the consideration to anticipate and check the feasibility in the

worst condition, which is PLN will not buy the excess power from the power plant so all power plant's cost will be charged to Smelter Company.

Each condition has different electricity price, because the calculation of electricity price must guarantee that the power plant still able to earn profit and feasible for them to operate the business. While the selling price of generated power for PLN is fix. Therefore, it needs to provide further calculation based on those conditions.

4.3.1.1 Calculation of Electricity Price with Multi Buyers

In this calculation, it accomodates the possibility that PLN will take over the excess power. It means there are 2 buyers for the generated power, which are Smelter Company and PLN. Smelter Company will buy in fix amount, 133 MW as the net requirement from the iron making plants. Contrarily, PLN's decision to buy the excess power still has unknown, whether about the amount of generated power that will be bought by them and the buying price. They can buy whole amount of the excess power, 150 MW, or just some of them. There are a lot of considerations to decide the total amount that will be bought, such as the selling price from Power Plant, demand from Lampung province or Sumatra region as the area, where the power plant established, etc. The projection of the demand and supply for Lampung province from Business Plan of Electrical Supply Perusahaan Listrik Negara (RUPTL PLN) 2016-2025 is provided below with the detail calculation in Appendix 16.

Table 4. 6 Projection of Demand and Supply for Lampung Province in 2015-2025

Year	Peak Load (MW)	Installed Power (MW)	Additional Power (MW)	Total Power (MW)
2015	854	593.5	-	593.5
2016	893	593.5	200	793.5
2017	972	593.5	110	903.5
2018	1059	593.5	56	959.5
2019	1153	593.5	27	986.5
2020	1257	593.5	-	986.5
2021	1370	593.5	200	1186.5
2022	1493	593.5	15	1201.5
2023	1628	593.5	275	1476.5
2024	1776	593.5	-	1476.5
2025	1937	593.5	252	1728.5

Source: PLN, 2016

Based on Table 4.6, the electricity status of Lampung province is still deficit, so the possibility that PLN will take over the excess power is high. But in order to accommodate that uncertainty, the calculation of electricity price with multi buyers will be conducted in 3 parts, based on the amount of excess power that PLN may buy.

4.3.1.1.1 Calculation of Electricity Price-PLN 150 MW (Scenario 1)

The first scenario is all amount of excess power from the power plant is bought by PLN, 150 MW. It means Smelter Company only cover the expenses and costs for generating power as much as they bought, 133 MW. The remaining power, 150 MW, is covered by PLN that bought all of those amount. Table 4.7 shows the calculation result of electricity price for Smelter Company in Scenario 1, while the detail calculation for electricity price in Scenario 1 is provided in Appendix 17.

Table 4.7 Calculation Result of Electricity Price for Smelter Company (Scenario 1)

Year	Component A	Component B	Component C	Component D	Electricity Price
2020	$0.0212	$0.0094	$0.0199	$0.0021	$0.0526
2021	$0.0215	$0.0096	$0.0201	$0.0022	$0.0534
2022	$0.0217	$0.0098	$0.0205	$0.0022	$0.0542
2023	$0.0219	$0.0101	$0.0208	$0.0022	$0.0550
2024	$0.0222	$0.0104	$0.0211	$0.0023	$0.0559
2025	$0.0224	$0.0106	$0.0214	$0.0023	$0.0568
2026	$0.0227	$0.0109	$0.0217	$0.0023	$0.0576
2027	$0.0230	$0.0112	$0.0220	$0.0024	$0.0586
2028	$0.0232	$0.0115	$0.0224	$0.0024	$0.0595
2029	$0.0235	$0.0118	$0.0227	$0.0024	$0.0604
2030	$0.0238	$0.0121	$0.0230	$0.0025	$0.0614
2031	$0.0241	$0.0125	$0.0234	$0.0025	$0.0624
2032	$0.0243	$0.0128	$0.0237	$0.0025	$0.0634
2033	$0.0246	$0.0132	$0.0241	$0.0026	$0.0645
2034	$0.0250	$0.0135	$0.0245	$0.0026	$0.0656
2035	$0.0253	$0.0139	$0.0248	$0.0027	$0.0667
2036	$0.0256	$0.0143	$0.0252	$0.0027	$0.0678
2037	$0.0259	$0.0147	$0.0256	$0.0027	$0.0689
2038	$0.0263	$0.0151	$0.0260	$0.0028	$0.0701
2039	$0.0266	$0.0156	$0.0263	$0.0028	$0.0713
2040	$0.0270	$0.0160	$0.0267	$0.0029	$0.0726
2041	$0.0273	$0.0165	$0.0271	$0.0029	$0.0738
2042	$0.0277	$0.0169	$0.0275	$0.0029	$0.0752
2043	$0.0281	$0.0174	$0.0280	$0.0030	$0.0765
2044	$0.0285	$0.0179	$0.0284	$0.0030	$0.0779

In this scenario, all of the generated power is bought, 150 MW by PLN and 133 MW by Smelter Company. The electricity price between both of them is the same because each buyers covers the costs and expenses as the amount of purchased power. Besides, Smelter Company also get income, as revenue from selling synthesis gas to Power Plant. Hence, Net Present Value (NPV) of Smelter Company for Scenario 1 gets **-$126,388,447.87**. The detail financial calculation of Smelter Company for scenario 1 is listed in Appendix 18.

Furthermore, in order to have mutual benefit for both side, which are Smelter Company and Power Plant, it needs to show this scheme with the synthesis gas price $2.752/mmBtu, it still gives profit and feasible for Power Plant. Consequently, it needs to calculate the indicators that show the feasibility and profitability for Power Plant that in this research shown by Net Present Value (NPV) and Internal Rate of Return (IRR). Based on Free Cash Flow Report for Power Plant that is provided in Appendix 19, below is Total Free Cash Flow of Power Plant, includes NPV and IRR of Power Plant.

Table 4. 8 Cash Flow of Power Plant in Scenario 1

Year	Cash Flow
2017	($73,237,100)
2018	($145,311,300)
2019	($142,985,501)
2020	$40,922,138
2021	$40,922,138
2022	$40,922,138
2023	$40,922,138
2024	$40,922,138
2025	$40,922,138
2026	$40,922,138
2027	$40,922,138
2028	$40,922,138
2029	$40,922,138
2030	$40,922,138
2031	$40,922,138
2032	$40,922,138
2033	$40,922,138
2034	$40,922,138
2035	$40,922,138
2036	$40,922,138

Table 4. 8 Cash Flow of Power Plant in Scenario 1 (*Continued*)

Year	Cash Flow
2037	$40,922,138
2038	$40,922,138
2039	$40,922,138
2040	$40,922,138
2041	$40,922,138
2042	$40,922,138
2043	$40,922,138
2044	$40,922,138
NPV	**$319,418,721.91**
IRR	**9.4%**

Based on NPV and IRR for Power Plant, it shows that the business scheme with synthesis gas price $2.752/mmBtu is still working for Power Plant as NPV in positive value and IRR above MARR, which is 6.93%.

As the power plant is owned by subsidiary company of Smelter Company, it needs to calculate the joined cash flow between Power Plant and Smelter Company in supplied power matter as one entity in order to compare with outsource option. Below is the calculation result of joined cash flow between both of them.

Table 4. 9 Calculation Result of Joined Cash Flow in Scenario 1

Year	Cash Flow		
	Smelter Company	Power Plant	Total
2017	$0	($73,237,100)	($73,237,100)
2018	$0	($145,311,300)	($145,311,300)
2019	$0	($142,985,501)	($142,985,501)
2020	($12,332,420)	$40,922,138	$28,589,718
2021	($12,396,710)	$40,922,138	$28,525,428
2022	($12,465,399)	$40,922,138	$28,456,738
2023	($12,538,605)	$40,922,138	$28,383,533
2024	($12,616,448)	$40,922,138	$28,305,690
2025	($12,699,049)	$40,922,138	$28,223,088
2026	($12,786,535)	$40,922,138	$28,135,602
2027	($12,879,034)	$40,922,138	$28,043,104
2028	($12,976,676)	$40,922,138	$27,945,462
2029	($13,079,594)	$40,922,138	$27,842,544
2030	($13,187,925)	$40,922,138	$27,734,213
2031	($13,301,808)	$40,922,138	$27,620,330
2032	($13,421,385)	$40,922,138	$27,500,752

Table 4. 9 Calculation Result of Joined Cash Flow in Scenario 1 (*Continued*)

Year	Cash Flow		
	Smelter Company	Power Plant	Total
2033	($13,546,803)	$40,922,138	$27,375,335
2034	($13,678,207)	$40,922,138	$27,243,930
2035	($13,815,751)	$40,922,138	$27,106,386
2036	($13,959,589)	$40,922,138	$26,962,548
2037	($14,109,879)	$40,922,138	$26,812,259
2038	($14,266,781)	$40,922,138	$26,655,356
2039	($14,430,461)	$40,922,138	$26,491,676
2040	($14,601,087)	$40,922,138	$26,321,051
2041	($14,778,829)	$40,922,138	$26,143,308
2042	($14,963,864)	$40,922,138	$25,958,274
2043	($15,156,369)	$40,922,138	$25,765,768
2044	($15,356,528)	$40,922,138	$25,565,609
NPV (Joined)			**($46,264,315)**

In order to compare the insource decision with outsource from PLN, it is conducted incremental analysis between both of them. It compares the cash flow of Smelter Company in outsource option from PLN and the cash flow of Smelter Company and Power Plant (joined) as one entity in insource option. Below is the result of incremental analysis for scenario 1.

Table 4. 10 Incremental Analysis Outsource Option-Insource Option (Scenario 1)

Year	Outsource Option (A)	Insource Option (B)	Difference (B-A)
2017	$0	($73,237,100)	($73,237,100)
2018	$0	($145,311,300)	($145,311,300)
2019	$0	($142,985,501)	($142,985,501)
2020	($101,938,298)	$28,589,718	$130,528,016
2021	($106,800,143)	$28,525,428	$135,325,571
2022	($111,880,981)	$28,456,738	$140,337,719
2023	($117,189,737)	$28,383,533	$145,573,270
2024	($122,735,629)	$28,305,690	$151,041,320
2025	($128,528,169)	$28,223,088	$156,751,257
2026	($134,577,164)	$28,135,602	$162,712,766
2027	($140,892,723)	$28,043,104	$168,935,827
2028	($147,485,257)	$27,945,462	$175,430,719
2029	($150,873,552)	$27,842,544	$178,716,096
2030	($161,544,387)	$27,734,213	$189,278,600
2031	($169,033,304)	$27,620,330	$196,653,634
2032	($176,843,829)	$27,500,752	$204,344,582
2033	($184,987,859)	$27,375,335	$212,363,195
2034	($193,477,575)	$27,243,930	$220,721,505
2035	($202,325,434)	$27,106,386	$229,431,820
2036	($211,544,162)	$26,962,548	$238,506,711

Table 4. 10 Incremental Analysis Outsource Option-Insource Option (Scenario 1) (*Continued*)

Year	Outsource Option (A)	Insource Option (B)	Difference (B-A)
2037	($221,146,743)	$26,812,259	$247,959,001
2038	($231,146,398)	$26,655,356	$257,801,754
2039	($241,556,578)	$26,491,676	$268,048,255
2040	($252,390,939)	$26,321,051	$278,711,989
2041	($263,663,318)	$26,143,308	$289,806,626
2042	($275,387,712)	$25,958,274	$301,345,986
2043	($287,578,248)	$25,765,768	$313,344,016
2044	($300,249,144)	$25,565,609	$325,814,754
NPV (Incremental)			**$1,479,366,847**

Based on thos results above, it proves that insource option from the power plant in scenario 1 is the right decision, compared with outsource option from PLN supply. It is indicated based on NPV (incremental) is in positive value.

4.3.1.1.2 Calculation of Electricity Price-PLN 100 MW (Scenario 2)

This calculation is similar with previous section that also accommodates the possibility of PLN for buying the excess power from Power Plant. The difference is the amount of generated power that is allocated to be bought by PLN. In this sub chapter, the generated power that is allocated to be bought by PLN is reduced, 100 MW. It affects Cost of Goods Sold (COGS) in generating power increases. It brings impact to the electricity price for Smelter Company in Scenario 2, which is shown in Table 4.11 and the detail calculation in Appendix 20.

Table 4.11 Calculation Result of Electricity Price for Smelter Company (Scenario 2)

Year	Component A	Component B	Component C	Component D	Electricity Price
2020	0.0258	0.0114	0.0241	0.0026	0.0639
2021	0.0261	0.0117	0.0245	0.0026	0.0648
2022	0.0264	0.0120	0.0248	0.0027	0.0658
2023	0.0267	0.0123	0.0252	0.0027	0.0668
2024	0.0269	0.0126	0.0256	0.0027	0.0679
2025	0.0273	0.0129	0.0260	0.0028	0.0689
2026	0.0276	0.0133	0.0264	0.0028	0.07
2027	0.0279	0.0136	0.0268	0.0029	0.0711
2028	0.0282	0.0140	0.0272	0.0029	0.0723
2029	0.0285	0.0144	0.0276	0.0029	0.0734
2030	0.0289	0.0148	0.0280	0.0030	0.0746
2031	0.0292	0.0152	0.0284	0.0030	0.0758
2032	0.0296	0.0156	0.0288	0.0031	0.0771
2033	0.0299	0.0160	0.0293	0.0031	0.0783
2034	0.0303	0.0164	0.0297	0.0032	0.0796
2035	0.0307	0.0169	0.0301	0.0032	0.081

Table 4.11 Calculation Result of Electricity Price for Smelter Company (Scenario 2) (*Continued*)

Year	Component A	Component B	Component C	Component D	Electricity Price
2036	0.0311	0.0174	0.0306	0.0033	0.0823
2037	0.0315	0.0179	0.0311	0.0033	0.0837
2038	0.0319	0.0184	0.0315	0.0034	0.0852
2039	0.0323	0.0189	0.0320	0.0034	0.0866
2040	0.0328	0.0194	0.0325	0.0035	0.0881
2041	0.0332	0.0200	0.0330	0.0035	0.0897
2042	0.0337	0.0206	0.0335	0.0036	0.0913
2043	0.0341	0.0212	0.0340	0.0036	0.0929
2044	0.0346	0.0218	0.0345	0.0037	0.0946

Based on table above, it can be seen that the electricity price for Smelter Company is getting higher, compared with Scenario 1. It is the impact from the increasing of COGS for generating power. The generated power is not fully-utilized, so COGS increases because the unutilized power cost is occurred. Consequently, Net Present Value (NPV) of Smelter Company for Scenario 2 decreases to **-$249,699,289.10**. The detail financial calculation of Smelter Company for scenario 2 is listed in Appendix 21.

In order to make sure that this scenario still gives profit for Power Plant and feasible for them, it needs to check NPV and IRR of Power Plant that are calculated on Free Cash Flow Report for Power Plant that is provided in Appendix 22. Table 4.12 shows Free Cash Flow of Power Plant, includes NPV and IRR of Power Plant .

Table 4. 12 Cash Flow of Power Plant in Scenario 2

Year	Cash Flow
2017	($73,237,100)
2018	($145,311,300)
2019	($142,985,501)
2020	$33,941,153
2021	$34,224,269
2022	$34,516,612
2023	$34,818,478
2024	$35,130,174
2025	$35,452,016
2026	$35,784,335
2027	$36,127,474
2028	$36,481,789
2029	$36,847,649

Table 4. 12 Cash Flow of Power Plant in Scenario 2 (*Continued*)

Year	Cash Flow
2030	$37,225,440
2031	$37,615,562
2032	$38,018,432
2033	$38,434,484
2034	$38,864,169
2035	$39,307,959
2036	$39,766,345
2037	$40,239,840
2038	$40,728,979
2039	$41,234,321
2040	$41,756,449
2041	$42,295,976
2042	$42,853,539
2043	$43,429,809
2044	$44,025,487
NPV	**$268,369,699.94**
IRR	**8.2%**

Based on that result on Table 4.12, the business scheme is still feasible for Power Plant, which is indicated by NPV in positive value, although it is getting smaller than NPV in Scenario 1 and IRR still above MARR, which 6.93%

Same with Scenario 1, it needs to calculate the joined cash flow between Power Plant and Smelter Company in supplied power matter for scenario 2 in order to observe the cash flow of both of them as 1 entity. Table below is the calculation result of joined cash flow between Smelter Company and Power Plant.

Table 4. 13 Calculation Result of Joined Cash Flow in Scenario 2

Year	Cash Flow		
	Smelter Company	Power Plant	Total
2017	$0	($73,237,100)	($73,237,100)
2018	$0	($145,311,300)	($145,311,300)
2019	$0	($142,985,501)	($142,985,501)
2020	($24,712,033)	$33,941,153	$9,229,119
2021	($24,831,219)	$34,224,269	$9,393,050
2022	($24,954,790)	$34,516,612	$9,561,822
2023	($25,082,852)	$34,818,478	$9,735,626
2024	($25,215,512)	$35,130,174	$9,914,662
2025	($25,352,878)	$35,452,016	$10,099,137
2026	($25,495,063)	$35,784,335	$10,289,272

Table 4.1314 Calculation Result of Joined Cash Flow in Scenario 2 (*Continued*)

Year	Cash Flow		
	Smelter Company	Power Plant	Total
2027	($25,642,180)	$36,127,474	$10,485,294
2028	($25,794,344)	$36,481,789	$10,687,444
2029	($25,951,675)	$36,847,649	$10,895,974
2030	($26,114,292)	$37,225,440	$11,111,148
2031	($26,282,319)	$37,615,562	$11,333,243
2032	($26,455,883)	$38,018,432	$11,562,550
2033	($26,635,110)	$38,434,484	$11,799,374
2034	($26,820,132)	$38,864,169	$12,044,037
2035	($27,011,083)	$39,307,959	$12,296,877
2036	($27,208,098)	$39,766,345	$12,558,248
2037	($27,411,317)	$40,239,840	$12,828,524
2038	($27,620,881)	$40,728,979	$13,108,098
2039	($27,836,935)	$41,234,321	$13,397,386
2040	($28,059,627)	$41,756,449	$13,696,822
2041	($28,289,107)	$42,295,976	$14,006,869
2042	($28,525,529)	$42,853,539	$14,328,011
2043	($28,769,049)	$43,429,809	$14,660,761
2044	($29,019,827)	$44,025,487	$15,005,660
NPV (Joined)			**($207,129,551.08)**

Same with Scenario 1, incremental analysis is needed to prove that the decision to insource from power plant is better than outsource option. It compares the cash flow of Smelter Company in outsource option from PLN and the cash flow of Smelter Company and Power Plant (joined) as one entity. Below is the result of incremental analysis.

Table 4. 15 Incremental Analysis Outsource Option-Insource Option (Scenario 2)

Year	Outsource Option (A)	Insource Option (B)	Difference (B-A)
2017	$0	($73,237,100)	($73,237,100)
2018	$0	($145,311,300)	($145,311,300)
2019	$0	($142,985,501)	($142,985,501)
2020	($101,938,298)	$9,229,119	$111,167,417
2021	($106,800,143)	$9,393,050	$116,193,193
2022	($111,880,981)	$9,561,822	$121,442,803
2023	($117,189,737)	$9,735,626	$126,925,364
2024	($122,735,629)	$9,914,662	$132,650,291
2025	($128,528,169)	$10,099,137	$138,627,306
2026	($134,577,164)	$10,289,272	$144,866,436
2027	($140,892,723)	$10,485,294	$151,378,018
2028	($147,485,257)	$10,687,444	$158,172,701

Table 4. 14 Incremental Analysis Outsource Option-Insource Option (Scenario 2) (*Continued*)

Year	Outsource Option (A)	Insource Option (B)	Difference (B-A)
2029	($150,873,552)	$10,895,974	$161,769,526
2030	($161,544,387)	$11,111,148	$172,655,535
2031	($169,033,304)	$11,333,243	$180,366,547
2032	($176,843,829)	$11,562,550	$188,406,379
2033	($184,987,859)	$11,799,374	$196,787,233
2034	($193,477,575)	$12,044,037	$205,521,612
2035	($202,325,434)	$12,296,877	$214,622,310
2036	($211,544,162)	$12,558,248	$224,102,410
2037	($221,146,743)	$12,828,524	$233,975,266
2038	($231,146,398)	$13,108,098	$244,254,496
2039	($241,556,578)	$13,397,386	$254,953,964
2040	($252,390,939)	$13,696,822	$266,087,761
2041	($263,663,318)	$14,006,869	$277,670,186
2042	($275,387,712)	$14,328,011	$289,715,723
2043	($287,578,248)	$14,660,761	$302,239,008
2044	($300,249,144)	$15,005,660	$315,254,804
NPV (Incremental)			**$1,318,501,610.64**

Based on the result of Table 4.14, it shows that the decision to insource option from the power plant with total purchased power 233 MW is right one. It is proven by NPV (incremental) is in positive value.

4.3.1.1.3 Calculation of Electricity Price-PLN 50 MW (Scenario 3)

As mentioned before that there is a possibility for PLN to buy the excess power. One of the critical points is the amount of excess power that is bought by PLN. In this stage, it assumes PLN only take over 50 MW. While the allocation for Smelter Company is fix, 133 MW, so the total purchased power is 183 MW. It still below the capacity of the power plant. Nevertheless, the expenses and costs for power plant in generating power are shared between PLN and Smelter Company. However, the selling price from Power Plant to PLN is fix as stated before. But Cost of Goods Sold (COGS) is increasing because the occurrence of unutilized power cost.

As the calculation result, Table 4.15 shows the electricity price for Smelter Company in Scenario 3 with the detail calculation for electricity price in Scenario 3 is provided in Appendix 23.

Table 4.16 Calculation Result of Electricity Price for Smelter Company (Scenario 3)

Year	Component A	Component B	Component C	Component D	Electricity Price
2020	$0.0329	$0.0145	$0.0307	$0.0033	$0.0813
2021	$0.0332	$0.0148	$0.0312	$0.0033	$0.0825
2022	$0.0336	$0.0152	$0.0316	$0.0034	$0.0838
2023	$0.0339	$0.0156	$0.0321	$0.0034	$0.0851
2024	$0.0343	$0.0160	$0.0326	$0.0035	$0.0864
2025	$0.0347	$0.0165	$0.0331	$0.0035	$0.0878
2026	$0.0351	$0.0169	$0.0336	$0.0036	$0.0891
2027	$0.0355	$0.0173	$0.0341	$0.0036	$0.0906
2028	$0.0359	$0.0178	$0.0346	$0.0037	$0.0920
2029	$0.0363	$0.0183	$0.0351	$0.0038	$0.0935
2030	$0.0368	$0.0188	$0.0356	$0.0038	$0.0950
2031	$0.0372	$0.0193	$0.0362	$0.0039	$0.0965
2032	$0.0377	$0.0198	$0.0367	$0.0039	$0.0981
2033	$0.0381	$0.0204	$0.0373	$0.0040	$0.0997
2034	$0.0386	$0.0209	$0.0378	$0.0040	$0.1014
2035	$0.0391	$0.0215	$0.0384	$0.0041	$0.1031
2036	$0.0396	$0.0221	$0.0390	$0.0042	$0.1048
2037	$0.0401	$0.0227	$0.0395	$0.0042	$0.1066
2038	$0.0406	$0.0234	$0.0401	$0.0043	$0.1084
2039	$0.0412	$0.0241	$0.0407	$0.0044	$0.1103
2040	$0.0417	$0.0247	$0.0413	$0.0044	$0.1122
2041	$0.0423	$0.0255	$0.0420	$0.0045	$0.1142
2042	$0.0429	$0.0262	$0.0426	$0.0046	$0.1162
2043	$0.0435	$0.0270	$0.0432	$0.0046	$0.1183
2044	$0.0441	$0.0278	$0.0439	$0.0047	$0.1204

Same with the previous scenarios that the decision of the source of supplied power is insource from Power Plant, so there is income for Smelter Company in supplied power matter as revenue from selling synthesis gas to Power Plant. The costs and expenses for generating power are not fully charged to Smelter Company. But COGS is getting higher portion because PLN only takeover in smaller amount, 50 MW, hence, the electricity price for Smelter Company getting more expensive in order to covers the costs and expenses from generating power that includes unutilized power cost. Consequently, Net Present Value (NPV) of Smelter Company for Scenario 3 gets **-$440,393,103.67**. The detail financial calculation of Smelter Company for scenario 3 is listed in Appendix 24.

Similar with the other scenarios, it also needs to prove that this scheme still gives profit for Power Plant and feasible for them. Based on Free Cash Flow Report for Power Plant that is provided in Appendix 25, below is Free Cash Flow of Power Plant, includes NPV and IRR of Power Plant for scenario 3.

Table 4. 17 Cash Flow of Power Plant in Scenario 3

Year	Cash Flow
2017	($73,237,100)
2018	($145,311,300)
2019	($142,985,501)
2020	$32,033,780
2021	$32,151,402
2022	$32,273,643
2023	$32,400,658
2024	$32,532,603
2025	$32,669,646
2026	$32,811,955
2027	$32,959,709
2028	$33,113,093
2029	$33,272,298
2030	$33,437,523
2031	$33,608,976
2032	$33,786,872
2033	$33,971,435
2034	$34,162,899
2035	$34,361,507
2036	$34,567,513
2037	$34,781,182
2038	$35,002,789
2039	$35,232,623
2040	$35,470,985
2041	$35,718,189
2042	$35,974,565
2043	$36,240,456
2044	$36,516,223
NPV	**$202,981,280.53**
IRR	**7.2%**

Based on that result on Table 4.16, the business scheme for scenario 3 is still feasible for Power Plant. It is shown by positive value of NPV above and IRR above the value of MARR, which is 6.93%.

It needs to calculate the joined cash flow between Power Plant and Smelter Company in supplied power matter because both of them actually is 1 entity. Below is the calculation result of joined cash flow between both of them in Scenario 3.

Table 4. 18 Calculation Result of Joined Cash Flow in Scenario 3

Year	Cash Flow		
	Smelter Company	Power Plant	Total
2017	$0	($73,237,100)	($73,237,100)
2018	$0	($145,311,300)	($145,311,300)
2019	$0	($142,985,501)	($142,985,501)
2020	($43,856,463)	$32,033,780	($11,822,683)
2021	($44,060,541)	$32,151,402	($11,909,139)
2022	($44,268,984)	$32,273,643	($11,995,341)
2023	($44,481,878)	$32,400,658	($12,081,221)
2024	($44,699,310)	$32,532,603	($12,166,707)
2025	($44,921,368)	$32,669,646	($12,251,723)
2026	($45,148,142)	$32,811,955	($12,336,187)
2027	($45,379,722)	$32,959,709	($12,420,013)
2028	($45,616,204)	$33,113,093	($12,503,110)
2029	($45,857,680)	$33,272,298	($12,585,382)
2030	($46,104,248)	$33,437,523	($12,666,725)
2031	($46,356,007)	$33,608,976	($12,747,031)
2032	($46,613,056)	$33,786,872	($12,826,184)
2033	($46,875,498)	$33,971,435	($12,904,063)
2034	($47,143,436)	$34,162,899	($12,980,538)
2035	($47,416,977)	$34,361,507	($13,055,470)
2036	($47,696,228)	$34,567,513	($13,128,715)
2037	($47,981,299)	$34,781,182	($13,200,118)
2038	($48,272,302)	$35,002,789	($13,269,513)
2039	($48,569,351)	$35,232,623	($13,336,728)
2040	($48,872,561)	$35,470,985	($13,401,576)
2041	($49,182,050)	$35,718,189	($13,463,861)
2042	($49,497,939)	$35,974,565	($13,523,375)
2043	($49,820,351)	$36,240,456	($13,579,894)
2044	($50,149,408)	$36,516,223	($13,633,185)
NPV (Joined)			($432,813,221.31)

Same with previous scenarios, it needs to conduct incremental analysis to test the decision to insource from power plant compared with outsource option. It compares the cash flow of Smelter Company in outsource option from PLN and the

cash flow of Smelter Company and Power Plant (joined) as one entity. Below is the result of incremental analysis.

Table 4. 19 Incremental Analysis Outsource Option-Insource Option (Scenario 3)

Year	Outsource Option (A)	Insource Option (B)	Difference (B-A)
2017	$0	($73,237,100)	($73,237,100)
2018	$0	($145,311,300)	($145,311,300)
2019	$0	($142,985,501)	($142,985,501)
2020	($101,938,298)	($11,822,683)	$90,115,614
2021	($106,800,143)	($11,909,139)	$94,891,004
2022	($111,880,981)	($11,995,341)	$99,885,640
2023	($117,189,737)	($12,081,221)	$105,108,517
2024	($122,735,629)	($12,166,707)	$110,568,922
2025	($128,528,169)	($12,251,723)	$116,276,446
2026	($134,577,164)	($12,336,187)	$122,240,977
2027	($140,892,723)	($12,420,013)	$128,472,710
2028	($147,485,257)	($12,503,110)	$134,982,147
2029	($150,873,552)	($12,585,382)	$138,288,170
2030	($161,544,387)	($12,666,725)	$148,877,662
2031	($169,033,304)	($12,747,031)	$156,286,273
2032	($176,843,829)	($12,826,184)	$164,017,645
2033	($184,987,859)	($12,904,063)	$172,083,796
2034	($193,477,575)	($12,980,538)	$180,497,037
2035	($202,325,434)	($13,055,470)	$189,269,963
2036	($211,544,162)	($13,128,715)	$198,415,447
2037	($221,146,743)	($13,200,118)	$207,946,625
2038	($231,146,398)	($13,269,513)	$217,876,885
2039	($241,556,578)	($13,336,728)	$228,219,851
2040	($252,390,939)	($13,401,576)	$238,989,363
2041	($263,663,318)	($13,463,861)	$250,199,457
2042	($275,387,712)	($13,523,375)	$261,864,338
2043	($287,578,248)	($13,579,894)	$273,998,353
2044	($300,249,144)	($13,633,185)	$286,615,959
NPV (Incremental)			**$1,092,817,940.41**

Based on the result of Table 4.18, insource option from power plant in Scenario 3 is better than outsource option from PLN supply so the decision to insource is the best decision. It is indicated based on NPV (incremental) is in positive value.

4.3.1.2 Calculation of Electricity Price with Single Buyer (Scenario 4)

The calculated price is dedicated for single buyer that has exclusive buying agreement, so the generated power only sold to the that buyer. In this research, the single buyer is Smelter Company as the main reason of Power Plant's existence. As mentioned before, the net power requirement by Smelter Company is 133 MW,

while the capacity of the power plant is over the requirement, 283 MW. Therefore, in scenario 4, the purchased power is below the capacity of power plant. Besides, all expenses and costs of power plant for generating power will be charged to Smelter Company. Accordingly, the electricity price will change and it is getting more expensive comparing with the price when PLN decides to take over the excess power however the amount. But the synthesis gas price is same whether PLN decides to take over or not. It caused of the synthesis gas price must be fixed in order to give consistent price component. Table 4.18 shows the calculation result of the electricity price for Scenario 4 with synthesis gas price is fix 2.752/mmBtu. The detail calculation for electricity price of Scenario 1 is listed in Appendix 26.

Table 4.20 Calculation Result of Electricity Price for Smelter Company (Scenario 4)

Year	Component A	Component B	Component C	Component D	Electricity Price
2020	0.0452	0.0199	0.0422	0.0045	0.1119
2021	0.0457	0.0204	0.0429	0.0046	0.1136
2022	0.0462	0.0210	0.0435	0.0047	0.1153
2023	0.0467	0.0215	0.0442	0.0047	0.1171
2024	0.0472	0.0221	0.0448	0.0048	0.1189
2025	0.0477	0.0227	0.0455	0.0049	0.1208
2026	0.0483	0.0233	0.0462	0.0049	0.1227
2027	0.0488	0.0239	0.0469	0.0050	0.1246
2028	0.0494	0.0245	0.0476	0.0051	0.1266
2029	0.0500	0.0252	0.0483	0.0052	0.1286
2030	0.0506	0.0259	0.0490	0.0052	0.1307
2031	0.0512	0.0266	0.0498	0.0053	0.1328
2032	0.0518	0.0273	0.0505	0.0054	0.1350
2033	0.0524	0.0280	0.0513	0.0055	0.1372
2034	0.0531	0.0288	0.0520	0.0056	0.1395
2035	0.0538	0.0296	0.0528	0.0056	0.1418
2036	0.0545	0.0304	0.0536	0.0057	0.1442
2037	0.0552	0.0313	0.0544	0.0058	0.1467
2038	0.0559	0.0322	0.0552	0.0059	0.1492
2039	0.0566	0.0331	0.0560	0.0060	0.1518
2040	0.0574	0.0340	0.0569	0.0061	0.1544
2041	0.0582	0.0350	0.0577	0.0062	0.1571
2042	0.0590	0.0360	0.0586	0.0063	0.1599
2043	0.0598	0.0371	0.0595	0.0064	0.1628
2044	0.0607	0.0382	0.0604	0.0065	0.1657

Since the supplied power selection is insource from Power Plant, which the fuel is synthesis gas that bought from Smelter Company, therefore there is income for Smelter Company in supplied power matter, as revenue from selling

synthesis gas to Power Plant. In consequence, Net Present Value (NPV) of Smelter Company for Scenario 1 gets **-$688,227,001.71**.

Furthermore, in order to have beneficial for both sides, which are Smelter Company and Power Plant, it needs to show this scheme still gives profit and feasible for Power Plant. Consequently, it needs to calculate the indicators that show the feasibility and profitability for Power Plant that in this research shown by Net Present Value (NPV) and IRR. Based on Free Cash Flow Report for Power Plant that is provided in Appendix 28, below is Free Cash Flow of Power Plant, includes NPV of Power Plant.

Table 4. 21 Cash Flow of Power Plant in Scenario 4

Year	Cash Flow
2017	($73,237,100)
2018	($145,311,300)
2019	($142,985,501)
2020	$40,922,138
2021	$40,180,211
2022	$40,261,356
2023	$40,343,154
2024	$40,424,963
2025	$40,506,771
2026	$40,588,580
2027	$40,670,389
2028	$40,712,500
2029	$40,754,611
2030	$40,796,722
2031	$40,838,833
2032	$40,922,138
2033	$40,922,138
2034	$40,922,138
2035	$40,922,138
2036	$40,922,138
2037	$40,922,138
2038	$40,922,138
2039	$40,922,138
2040	$40,922,138
2041	$40,922,138
2042	$40,922,138
2043	$40,922,138
2044	$40,922,138
NPV	**$316,197,989.12**
IRR	**9.3%**

Based on that result on Table 4.20, the business scheme for scenario 4 is still feasible for Power Plant. It is shown by positive value of NPV above and IRR value which is getting higher than MARR, 6.93%.

While the joined cash flow between Power Plant and Smelter Company in supplied power matter is provided below.

Table 4. 22 Calculation Result of Joined Cash Flow in Scenario 4

Year	Cash Flow		
	Smelter Company	Power Plant	Total
2017	$0	($73,237,100)	($73,237,100)
2018	$0	($145,311,300)	($145,311,300)
2019	$0	($142,985,501)	($142,985,501)
2020	($77,395,201)	$40,922,138	($36,473,063)
2021	($77,748,000)	$40,180,211	($37,567,788)
2022	($78,105,129)	$40,261,356	($37,843,773)
2023	($78,466,639)	$40,343,154	($38,123,485)
2024	($78,832,582)	$40,424,963	($38,407,619)
2025	($79,203,008)	$40,506,771	($38,696,237)
2026	($79,577,971)	$40,588,580	($38,989,391)
2027	($79,957,523)	$40,670,389	($39,287,134)
2028	($80,341,716)	$40,712,500	($39,629,217)
2029	($80,730,606)	$40,754,611	($39,975,995)
2030	($81,124,246)	$40,796,722	($40,327,525)
2031	($81,522,692)	$40,838,833	($40,683,859)
2032	($81,925,998)	$40,922,138	($41,003,861)
2033	($82,334,222)	$40,922,138	($41,412,085)
2034	($82,747,420)	$40,922,138	($41,825,283)
2035	($83,165,650)	$40,922,138	($42,243,512)
2036	($83,588,968)	$40,922,138	($42,666,830)
2037	($84,017,435)	$40,922,138	($43,095,297)
2038	($84,451,108)	$40,922,138	($43,528,971)
2039	($84,890,049)	$40,922,138	($43,967,911)
2040	($85,334,317)	$40,922,138	($44,412,179)
2041	($85,783,973)	$40,922,138	($44,861,836)
2042	($86,239,080)	$40,922,138	($45,316,942)
2043	($86,699,699)	$40,922,138	($45,777,561)
2044	($87,165,893)	$40,922,138	($46,243,755)
NPV (Joined)			($696,729,914.45)

In order to compare the decision of supplied power's source, it needs to compare the cash flow of Smelter Company in outsource option from PLN and the

cash flow of Smelter Company and Power Plant (joined) as one entity. It used to check which option is the best one to fulfill the power requirement of Smelter Company in financial aspect. Below is the result of incremental analysis.

Table 4. 23 Incremental Analysis Outsource Option-Insource Option (Scenario 4)

Year	Outsource Option (A)	Insource Option (B)	Difference (B-A)
2017	$0	($73,237,100)	($73,237,100)
2018	$0	($145,311,300)	($145,311,300)
2019	$0	($142,985,501)	($142,985,501)
2020	($101,938,298)	($36,473,063)	$65,465,234
2021	($106,800,143)	($37,567,788)	$69,232,355
2022	($111,880,981)	($37,843,773)	$74,037,208
2023	($117,189,737)	($38,123,485)	$79,066,253
2024	($122,735,629)	($38,407,619)	$84,328,011
2025	($128,528,169)	($38,696,237)	$89,831,932
2026	($134,577,164)	($38,989,391)	$95,587,773
2027	($140,892,723)	($39,287,134)	$101,605,589
2028	($147,485,257)	($39,629,217)	$107,856,040
2029	($150,873,552)	($39,975,995)	$110,897,557
2030	($161,544,387)	($40,327,525)	$121,216,863
2031	($169,033,304)	($40,683,859)	$128,349,445
2032	($176,843,829)	($41,003,861)	$135,839,969
2033	($184,987,859)	($41,412,085)	$143,575,775
2034	($193,477,575)	($41,825,283)	$151,652,292
2035	($202,325,434)	($42,243,512)	$160,081,922
2036	($211,544,162)	($42,666,830)	$168,877,332
2037	($221,146,743)	($43,095,297)	$178,051,446
2038	($231,146,398)	($43,528,971)	$187,617,427
2039	($241,556,578)	($43,967,911)	$197,588,667
2040	($252,390,939)	($44,412,179)	$207,978,759
2041	($263,663,318)	($44,861,836)	$218,801,482
2042	($275,387,712)	($45,316,942)	$230,070,770
2043	($287,578,248)	($45,777,561)	$241,800,687
2044	($300,249,144)	($46,243,755)	$254,005,389
NPV (Incremental)			**$828,901,247.26**

Based on the result of Table 4.22, insource option from power plant with total purchased power is 133 MW, it is better than outsource option from PLN supply. It is indicated based on NPV (incremental) is in positive value.

4.4. Analysis of Synthesis Gas Price

Refers to the result for the calculation that are already conducted in sub chaper 4.3, there are two points that can be analyzed, which is the comparison between insource supplied power from Power Plant and outsource supply from

PLN, and the synthesis gas price that gives mutual benefit for Smelter Company and Power Plant.

4.4.1. Comparison Option between Insource and Outsource Power Supply

Refers to all result of incremental analysis for each scenarios, it can be seen that insource option from power plant is the better option, compared with concluded that outsource option from PLN supply, even it is dominating the outsource option. Although the electricity price for Smelter Company is higher than PLN Tariff, insource option is more preferable because Power Plant's owner is the subsidiary company from Smelter Company, so they must seen as single entity. The cost for buying electricity in insource option is not the net cost, because there is actually revenue from selling synthesis gas. Especially in Scenario 4, when there is only single buyer of generated power. There is **transfer pricing** between Smelter Company and Power Plant because all of the costs for generating power is fully charged to Smelter Company while the cost for buying synthesis gas as the fuel is the same amount for the revenue from selling synthesis gas.

Besides, Smelter Company gets other benefits by deciding insource supplied power from power plant, which is the requirement of handling process for synthesis gas is solved by sell it to Power Plant as their fuel. So Smelter Company does not face environment issues about releasing synthesis gas directly to environment. Table below is the summary of incremental analysis for all scenarios.

Table 4. 24 Summary of Incremental Analysis

Scenario	1	2	3	4
NPV (Incremental)	$1,479,366,847	$1,318,501,610	$1,092,817,940	$828,901,247

4.4.2. Synthesis Gas Price

Analysis for selling price of synthesis gas is used to interpret and provide the selling price for synthesis gas that gives beneficial for both sides in all conditions and scenarios. Based on the result in sub chapter 4.3, the final selling price of synthesis gas is $2.572/mmBtu. It is calculated based on the scenario when the total purchased power is 283 MW. In this condition, each buyers cover the costs

and expenses for generating power based on the amount they purchased, so selling price for each buyer whether PLN and Smelter Company are is in the same price. While as mentioned, the buying price from PLN has limit, which is $0.0731/kWh (Annual Value for 25 years period) so the selling price to PLN at least is $0.0731/kWh (Annual Value). Moreover, the selling price to Smelter Company cannot below the selling price to PLN because PLN wants the selling price to them is the cheapest.

In scenario 4, the excess power is not purchased, the synthesis gas price does not influence the financial ratio of Smelter Company and Power Plant because there is transfer pricing between both of them. So even the synthesis gas price sold in high price or even sold free ($0/mmBtu), the financial ratio for both of them does not change.

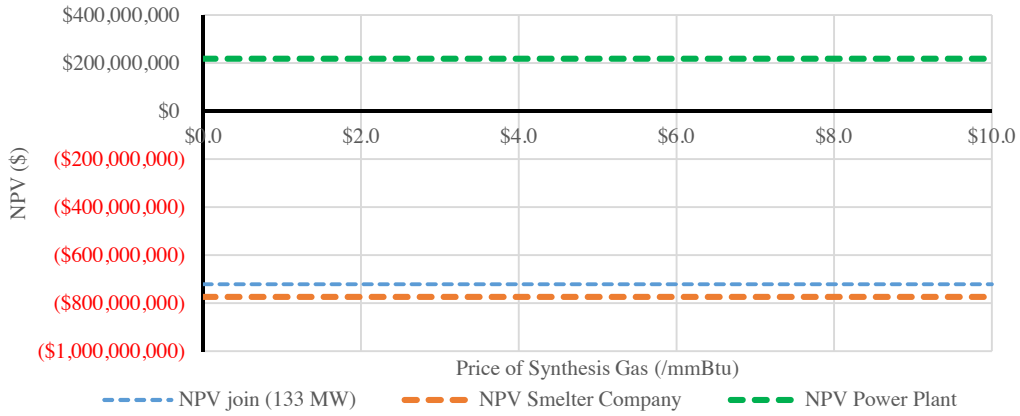

Figure 4. 2 Comparison NPV and Synthesis Gas Price in Scenario 4

They can still accept the selling price of generated power because there is transfer pricing so the decision of insource from power plant is dominating over the option to outsource from PLN as NPV of Smelter Company for outsource is far lower than the stated NPV above, which is **-$1,331,342,799.49.**

But it will be significant factor, when PLN involves and decides to buy the excess power. Synthesis gas price influences the selling price for both buyers because it is one of the components to construct the selling price. The final synthesis gas price is $2.752/mmBtu is feasible for Power Plant and gives beneficial for both sides whether Smelter Company and Power Plant. Power Plant able to gain profit

from the business and it is feasible from financial aspect, while Smelter Company able to minimize and maintain their operation cost, which including utilities cost (electricity).

This synthesis gas price is calculated based on scenario 1, which is the generated power is purchased in full amount. In this scenario, the electricity price reaches the cheapest point because each buyer covers the cost for generate power as much they purchased. While PLN just want to buy the excess power at least in the cheapest price for Smelter Company even lower than that price. This condition can be achieved only in Scenario 1, therefore the calculation for synthesis gas price is based on Scenario 1, when the generate power is purchased in whole amount.

This synthesis gas price is applicable as long as the references for PLN Buying Price is $7.31cents/kWh. It means when the limit of PLN Buying Price is changed, the result from the calculation of final synthesis gas price is not applicable. It caused of the cheapest electricity price for Smelter Company is at least same with the limit of PLN Buying Price. Therefore the calculated price is applicable as long as the reference is $7.31 cents/kWh.

In order to test whether this synthesis gas price is acceptable or not by Power Plant and Smelter Company, it needs futher analysis, which is based on Power Plant point of view and Smelter Company point of view.

Based on the result from calculation processes in sub chapter 4.3.1.1, the involvement of PLN in take over the excess power influences the selling price of generated power for Smelter Company. It can be seen from Figure 4.3 that shows the price movement against PLN involvement.

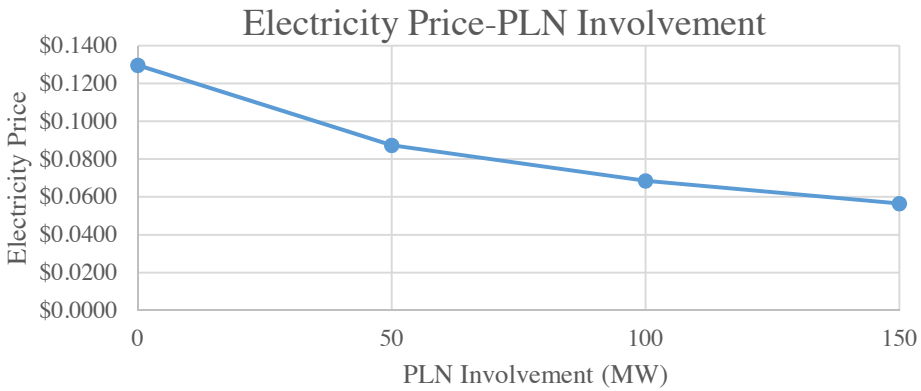

Figure 4. 3 Electricity Price for Smelter Company vs PLN Involvement

When PLN increases the amount of the excess power that they purchase, the electricity price for Smelter Company is getting cheaper. It caused of the portion for PLN to covers the power generating costs is getting higher in line with the increasing amount that they buy.

While the electricity price for PLN is fix, which means the amount of purchased power by PLN is not influencing the electricity price. But it has impact to the margin for Power Plant that earned from PLN.

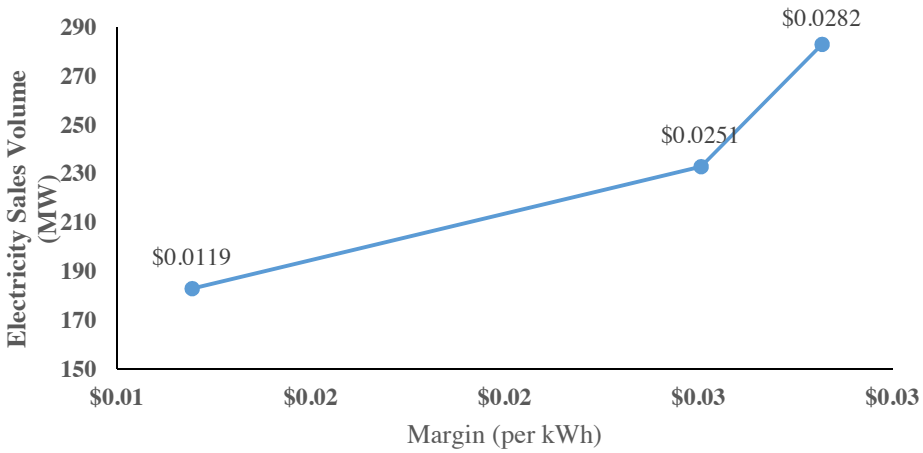

Figure 4. 4 Margin from PLN vs Electricity Sales Volume

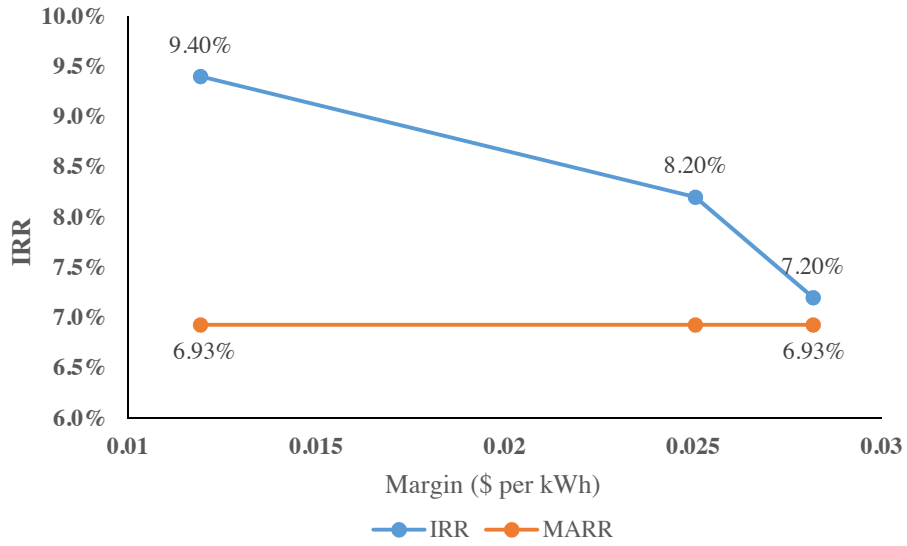

Figure 4. 5 Margin from PLN vs Internal Rate of Return of Power Plant

As shown in Figure 4.4, the margin that is earned from PLN is decreasing in line with the decreasing of the total purchased power. It caused of Cost of Goods Sold for generating power is getting more expensive as the impact to decreasing of the purchased amount by PLN, while some expenses are fixed. Consequently, Internal Rate of Return of Power Plant is following the decreasing margin that is shown in Figure 4.5. But in overall, it is still feasible for Power Plant to operate the business scheme with dual buyer and synthesis gas price is $2.752/mmBtu.

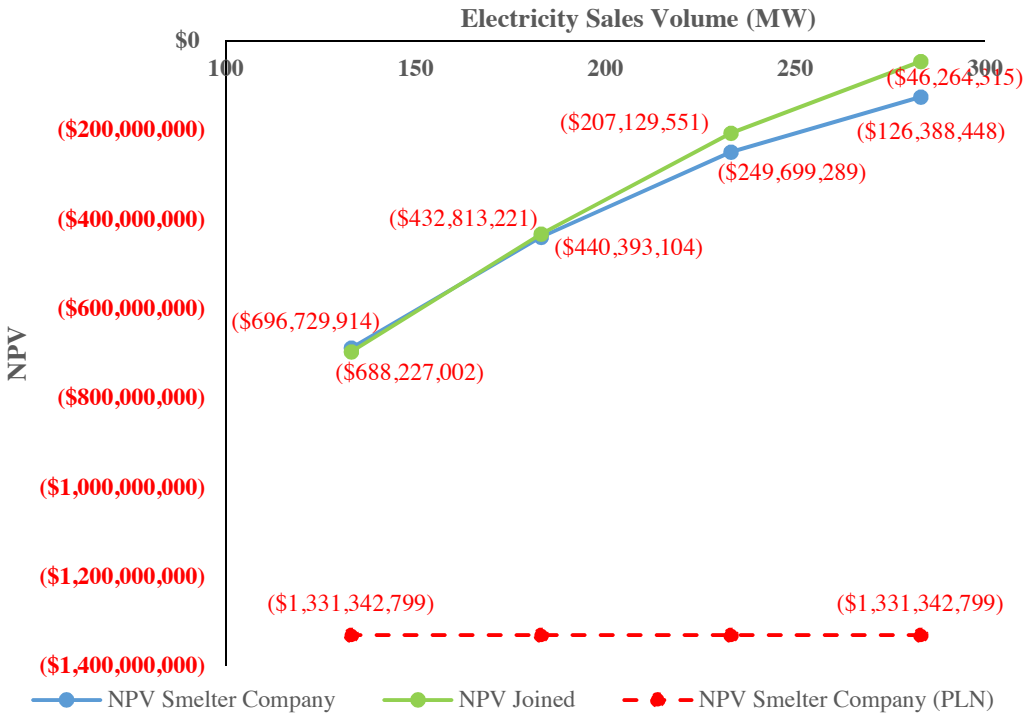

Figure 4. 6 NPV of Smelter Company vs Utilization of Power Plant's Capacity

While in Smelter Company's point of view, the decreasing of utilization also has an impact to their financial ratio in supplied power matter. NPV of Smelter Company is actually getting worse when the total purchased power decreases. It caused of the revenue from selling synthesis gas is fix in order to maintain the consistency of electricity price's components. Therefore, when PLN decision for take over the excess power is increasing, the portion of Smelter Company in order to cover costs for generating power is reduced, so NPV of Smelter Company is getting better when all generated power is purchased in full amount.

In the joined point of view, which is the joined between Smelter Company and Power Plant as one entity, it is similar with Smelter Company point of view. NPV joined is getting better when total purchased power is increasing as the impact from PLN decision in take over bigger amount of excess power. Based on the fact that is shown in Figure 4.6, it can be seen that the synthesis gas price in $2.752/mmBtu is still acceptable for both parties as one entity because all of their NPV is above NPV for outsource option from PLN.

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CHAPTER 5
ANALYSIS and CONSTRUCTION OF PRICING POLICY

This chapter contains of several parts, which is the construction of pricing mpolicy for electricity price of Smelter Company, Calculation of Minimum PLN Buying Price, and the analysis of the data calculation in sub chapter 5.1 and 5.2. It analyzes the result of pricing policy and minimum PLN Buying Price. The pricing model is constructed based on the calculation result of electricity price for each given scenarios in Chapter 4.

5.1. Construction of Pricing Policy

As one of the objectives is constructing pricing policy for calculate the electricity price in the next period. The electricity price for PLN is following the standard calculation policy that is same with the other power plants that the generated power are taken over by PLN, which is using Component A-B-C-D. While in order to accommodate the various possibility of changes, includes gas price and total purchased power, Power Plant needs another pricing policy for electricity price that is sold to Smelter Company. Moreover, the pricing policy also can be implemented if there are other private sector companies that interest/want to buy the excess power besides PLN. Pricing policy is contructed based on the calculation result of electricity price for all given scenarios in previous chapter. It will be constructed by Multiple Regression method, which is able to consider more than 1 influence factor so the Pricing Policy can accommodate various changes and influence factors in the future. Power Plant Tariff/Electricity Tariff as the dependent variable, while the independent variables are Gas Price and Electricity Sales Volume. The input for Minitab is listed in Appendix 29. The result from Minitab for multiple regression method is provided below:

Regression Analysis: Electricity Price versus Gas Price, Electricity Sales Volume

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	2	0.083272	0.041636	879.32	0.000
Gas Price	1	0.012416	0.012416	262.22	0.000

```
  Electricity Sales Volume   1  0.070856  0.070856  1496.42    0.000
Error                       97  0.004593  0.000047
Total                       99  0.087865

Model Summary

        S    R-sq  R-sq(adj)  R-sq(pred)
0.0068811  94.77%     94.66%      94.40%

Coefficients

Term                         Coef   SE Coef  T-Value  P-Value   VIF
Constant                  0.10091   0.00694    12.89    0.000
Gas Price                 0.03139   0.00194    16.19    0.000  1.00
Electricity Sales Vol  -0.000476  0.000012   -38.68    0.000  1.00

Regression Equation

Electricity Price = 0.10091 + 0.03139 Gas Price - 0.000476 Electricity
                    Sales Volume
```

Based on Minitab result, the final pricing policy of electricity price for Smelter Company is below.

$$\boldsymbol{Electricity\ Price = 0.010091 + (0.03139x\ Gas\ Price) - (0.000476x\ Electricity\ Sales\ Volume)} \quad \textbf{(5.1)}$$

The testing result of that equation is provided in Appendix 30.

Based on that pricing policy, below is the result for the selling price to Smelter Company that accommodate the synthesis gas price and total purchased power.

Table 5. 1Electricity Price for Smelter Company

Year	Scenario	Electricity Price	Gas Price	Electricity Sales Volume
2020	**Scenario 1**	$0.0526	$2.752	283
2021		$0.0539	$2.794	283
2022		$0.0552	$2.836	283
2023		$0.0565	$2.878	283
2024		$0.0579	$2.921	283
2025		$0.0593	$2.965	283
2026		$0.0607	$3.010	283
2027		$0.0621	$3.055	283
2028		$0.0635	$3.101	283
2029		$0.0650	$3.147	283
2030		$0.0665	$3.194	283
2031		$0.0680	$3.242	283

Table 5. 1 Electricity Price for Smelter Company (*Continued*)

Year	Scenario	Electricity Price	Gas Price	Electricity Sales Volume
2032		$0.0695	$3.291	283
2033		$0.0710	$3.340	283
2034		$0.0726	$3.390	283
2035		$0.0742	$3.441	283
2036		$0.0758	$3.493	283
2037		$0.0775	$3.545	283
2038		$0.0792	$3.598	283
2039		$0.0808	$3.652	283
2040		$0.0826	$3.707	283
2041		$0.0843	$3.763	283
2042		$0.0861	$3.819	283
2043		$0.0879	$3.876	283
2044		$0.0897	$3.935	283
2020	**Scenario 2**	$0.0764	$2.752	233
2021		$0.0777	$2.794	233
2022		$0.0790	$2.836	233
2023		$0.0803	$2.878	233
2024		$0.0817	$2.921	233
2025		$0.0831	$2.965	233
2026		$0.0845	$3.010	233
2027		$0.0859	$3.055	233
2028		$0.0873	$3.101	233
2029		$0.0888	$3.147	233
2030		$0.0903	$3.194	233
2031		$0.0918	$3.242	233
2032		$0.0933	$3.291	233
2033		$0.0948	$3.340	233
2034		$0.0964	$3.390	233
2035		$0.0980	$3.441	233
2036		$0.0996	$3.493	233
2037		$0.1013	$3.545	233
2038		$0.1030	$3.598	233
2039		$0.1046	$3.652	233
2040		$0.1064	$3.707	233
2041		$0.1081	$3.763	233
2042		$0.1099	$3.819	233
2043		$0.1117	$3.876	233
2044		$0.1135	$3.935	233
2020	**Scenario 3**	$0.1002	$2.752	183
2021		$0.1015	$2.794	183
2022		$0.1028	$2.836	183

Table 5. 1 Electricity Price for Smelter Company (*Continued*)

Year	Scenario	Electricity Price	Gas Price	Electricity Sales Volume
2023		$0.1041	$2.878	183
2024		$0.1055	$2.921	183
2025		$0.1069	$2.965	183
2026		$0.1083	$3.010	183
2027		$0.1097	$3.055	183
2028		$0.1111	$3.101	183
2029		$0.1126	$3.147	183
2030		$0.1141	$3.194	183
2031		$0.1156	$3.242	183
2032		$0.1171	$3.291	183
2033		$0.1186	$3.340	183
2034		$0.1202	$3.390	183
2035		$0.1218	$3.441	183
2036		$0.1234	$3.493	183
2037		$0.1251	$3.545	183
2038		$0.1268	$3.598	183
2039		$0.1284	$3.652	183
2040		$0.1302	$3.707	183
2041		$0.1319	$3.763	183
2042		$0.1337	$3.819	183
2043		$0.1355	$3.876	183
2044		$0.1373	$3.935	183
2020	**Scenario 4**	$0.1240	$2.752	133
2021		$0.1253	$2.794	133
2022		$0.1266	$2.836	133
2023		$0.1279	$2.878	133
2024		$0.1293	$2.921	133
2025		$0.1307	$2.965	133
2026		$0.1321	$3.010	133
2027		$0.1335	$3.055	133
2028		$0.1349	$3.101	133
2029		$0.1364	$3.147	133
2030		$0.1379	$3.194	133
2031		$0.1394	$3.242	133
2032		$0.1409	$3.291	133
2033		$0.1424	$3.340	133
2034		$0.1440	$3.390	133
2035		$0.1456	$3.441	133
2036		$0.1472	$3.493	133
2037		$0.1489	$3.545	133
2038		$0.1506	$3.598	133

Table 5. 1 Electricity Price for Smelter Company (*Continued*)

Year	Scenario	Electricity Price	Gas Price	Electricity Sales Volume
2039		$0.1522	$3.652	133
2040		$0.1540	$3.707	133
2041		$0.1557	$3.763	133
2042		$0.1575	$3.819	133
2043		$0.1593	$3.876	133
2044		$0.1611	$3.935	133

Below are the financial result in each scenario that is using this policy for calculate the electricity price for Smelter Company.

Table 5. 2 Financial Result for Each Scenario

Description	Electricity Sales Volume (MW)			
	283	**233**	**183**	**133**
NPV Smelter Company	($165,529,070)	($283,779,054)	($511,293,169)	($756,229,447)
NPV Power Plant	$377,983,610	$316,161,860	$289,088,434	$393,347,183
IRR Power Plant	10.1%	8.9%	8.8%	11.1%
NPV (Joined)	($56,049,471)	($215,649,492)	($450,538,238)	($715,134,069)

Based on the result above, the financial results for Smelter Company and Power Plant are quite different in each scenarios. In Power Plant point of view, the financial results are getting better, which is shown by higher value of IRR and NPV. Contrarily, the financial results for Smelter Company is getting worse, it is indicated by decreasing value of NPV Smelter Company. The financial results of the joined cashflow between Smelter Company and Power Plant as one entity also change, which is getting lower than before. But in overall, it is still acceptable for both sides because they still reach their objectives. In Power Plant side, they earn more profit and still feasible to conduct the business scheme with dual-buyer. While in Smelter Company side, they have consistent supplied power and it is still better than outsource from PLN in financial aspect, which is shown by better NPV (Joined). In addition, their synthesis gas is being utilized so they do not need to face environment issues.

5.2. Calculation of Minimum PLN Buying Price

As mentioned before that the buying price for generated power from PLN has upper limit that regulated by Regulation of Ministry of Energy and Mineral Resource, which is $7.31 cents/kWh (Annual Worth for 25 years). In fact, PLN may offer the buying price for excess power below the limit, especially if the generated power is categorized as excess power. Therefore, it is also needed to calculate the minimum PLN buying price that still can be accepted by Power Plant if the electricity price for Smelter Company still refers to upper limit of PLN Buying Price, which is $7.31cents/kWh, so the cheapest electricity price for Smelter Company is $7.31cents/kWh. Besides, this calculation is conducted with synthesis gas price $2.572/mmBtu

Based on the results that is provided in Table 5.2, it shows that there are a range between Internal Rate of Return (IRR) for Power Plant and Minimum Attractive Rate of Return (MARR). It means the buying price from PLN can be decreased until certain value. The range between minimum PLN buying price and the limit that is already regulated, $7.31cents/kWh, is the negotiation range of PLN buying price that is still accepted by Power Plant. In addition, each scenario has different IRR, which means each of them also has different minimum PLN buying price. It is decreasing, in line with the decreasing total purchased power. It caused of the increasing of Cost of Goods Sold (COGS) as the impact of the decreased total purchased power. So the margin that is earned from PLN Buying Price is decreasing. The minimum PLN buying price will be obtained when IRR of Power Plant for each scenario reaches the same value of Minimum Attractive Rate of Return (MARR).

The calculation is using What-if Analysis.. Below is the result to calculate the minimum PLN buying price that still can be accepted by Power Plant in scenario 1, which is purchased in whole amount.

Table 5. 3 Calculation Result for PLN Minimum Buying Price in Scenario 1

Year	PV	PLN Buying Price
2020	($0.0371)	$0.0371
2021	($0.0374)	$0.0380
2022	($0.0378)	$0.0389
2023	($0.0382)	$0.0399

Table 5.3 Calculation Result for PLN Minimum Buying Price in Scenario 1 (*Continued*)

Year	PV	PLN Buying Price
2024	($0.0386)	$0.0410
2025	($0.0390)	$0.0420
2026	($0.0394)	$0.0431
2027	($0.0399)	$0.0442
2028	($0.0403)	$0.0454
2029	($0.0408)	$0.0466
2030	($0.0413)	$0.0479
2031	($0.0418)	$0.0492
2032	($0.0423)	$0.0505
2033	($0.0428)	$0.0519
2034	($0.0434)	$0.0534
2035	($0.0439)	$0.0549
2036	($0.0445)	$0.0565
2037	($0.0451)	$0.0581
2038	($0.0457)	$0.0598
2039	($0.0464)	$0.0616
2040	($0.0471)	$0.0634
2041	($0.0478)	$0.0653
2042	($0.0485)	$0.0673
2043	($0.0492)	$0.0694
2044	($0.0500)	$0.0715
Total	($1.068)	
PLN Buying Price	$0.0516	

Based on the result of Table 5.3, it shows that the minimum PLN Buying Price that still can be accepted by Power Plant in scenario 1 is $5.16cents/kWh, so the negotiation price between PLN and Power Plant is $5.16cents-7.31cents/kWh. This price is still accepted by Power Plant if PLN decides to buy excess power whole amount MW. Table 5.4 shows the financial results for all scenarios if PLN final buying price is 5.16cents/kWh.

Table 5. 4 Summary of Financial Result of Each Senario with PLN Buying Price $5.16 cents/kWh

Scenario	**1**	**2**	**3**	**4**
NPV Power Plant	$206,117,873.18	$135,057,284.20	$112,428,992.49	$393,347,183
IRR Power Plant	6.9%	5.8%	5.4%	11.1%
NPV Joined	($165,514,331)	($320,607,860.02)	($556,192,470.40)	($715,134,069)

The minimum PLN Buying Price will be different if the total purchased power is changed. In scenario 2, which the purchased excess power is 100 MW, PLN Buying Price that still accepted is calculated below.

Table 5. 5 Calculation Result for PLN Minimum Buying Price in Scenario 2

Year	PV	PLN Buying Price
2020	($0.0425)	$0.0404
2021	($0.0429)	$0.0414
2022	($0.0434)	$0.0425
2023	($0.0438)	$0.0435
2024	($0.0443)	$0.0447
2025	($0.0447)	$0.0458
2026	($0.0452)	$0.0470
2027	($0.0457)	$0.0483
2028	($0.0463)	$0.0495
2029	($0.0468)	$0.0508
2030	($0.0473)	$0.0522
2031	($0.0479)	$0.0536
2032	($0.0485)	$0.0551
2033	($0.0491)	$0.0566
2034	($0.0497)	$0.0582
2035	($0.0504)	$0.0599
2036	($0.0511)	$0.0616
2037	($0.0518)	$0.0634
2038	($0.0525)	$0.0652
2039	($0.0532)	$0.0671
2040	($0.0540)	$0.0691
2041	($0.0548)	$0.0712
2042	($0.0556)	$0.0733
2043	($0.0565)	$0.0756
2044	($0.0574)	$0.0764
Total	($1.226)	
PLN Buying Price	$0.0592	

Based on the result of Table 5.5, it shows that the minimum PLN Buying Price that still can be accepted by Power Plant in scenario 2 is $5.92cents/kWh, which is higher than the minimum price for scenario 1. The range for negotiation is between $5.92cents-$7.31cents/kWh. It is narrower than previous scenario. Table below shows the financial result for each scenarios if PLN buying price is $5.92cents/kWh.

Table 5. 6 Summary of Financial Result of Each Senario with PLN Buying Price $5.92cents/kWh

Scenario	1	2	3	4
NPV Power Plant	$301,883,165.65	$198,900,812.51	$144,350,756.64	$393,347,183
IRR Power Plant	8.5%	6.9%	6.1%	11.1%
NPV Joined	($110,029,863)	($283,618,214.41)	($537,697,647.60)	($715,134,069)

Power Plant gets the lowest IRR value in Scenario 3, which PLN is assumed just purchased 50 MW. But it still above MARR, so PLN actually still can be decreased. Below is the result to calculate the minimum PLN Buying Price that still can be accepted by Power Plant in scenario 3.

Table 5. 7 Calculation Result of Minimum PLN Buying Price in Scenario 3

Year	PV	PLN Buying Price
2020	($0.0486)	$0.0462
2021	($0.0490)	$0.0470
2022	($0.0494)	$0.0479
2023	($0.0500)	$0.0489
2024	($0.0506)	$0.0500
2025	($0.0504)	$0.0504
2026	($0.0504)	$0.0508
2027	($0.0518)	$0.0528
2028	($0.0518)	$0.0533
2029	($0.0532)	$0.0553
2030	($0.0532)	$0.0559
2031	($0.0546)	$0.0579
2032	($0.0546)	$0.0584
2033	($0.0560)	$0.0606
2034	($0.0560)	$0.0612
2035	($0.0574)	$0.0634
2036	($0.0574)	$0.0639
2037	($0.0588)	$0.0662
2038	($0.0588)	$0.0669
2039	($0.0602)	$0.0691
2040	($0.0616)	$0.0714
2041	($0.0616)	$0.0721
2042	($0.0630)	$0.0745
2043	($0.0644)	$0.0753
2044	($0.0644)	$0.0768
Total	($1.388)	
PLN Buying Price	$0.0676	

Based on the result of Table 5.7, it shows that the minimum PLN Buying Price that still can be accepted by Power Plant in scenario 3 is $6.76cents/kWh. It means the safe range of selling price of electricity to PLN for negotiation with them with the total purchased power 183 MW is between $6.76cents/kWh until $7.31cents/kWh. It can guarantee the feasibility of Power Plant business. It is shown by the financial result for each scenarios with PLN Buying price is $6.76cents/kWh.

Table 5. 8 Summary of Financial Result with PLN Buying Price $6.76cents/kWh

Scenario	1	2	3	4
NPV Power Plant	$355,452,461.92	$234,613,676.69	$162,207,188.73	$393,347,183
IRR Power Plant	9.5%	7.7%	6.9%	11.1%
NPV Joined	($74,326,456)	($259,815,942.98)	($525,796,511.88)	($715,134,069)

5.3. Analysis of Pricing Policy

Refers to the result for the calculation that are already conducted in sub chaper 5.1 and 5.2, there are two points that can be analyzed, which is the result of pricing policy for electricity price of Smelter Company and minimum PLN buying price that is still acceptable by Power Plant.

5.3.1. Pricing Policy

Based on the result of Multiple Regression method by Minitab that is used for construct pricing policy for electricity price of Smelter Company, there are 2 influence factors that are accommodated in the policy, gas price and total purchased power. In statistical rules, an equation is valid if the p-value of the independent variables are at least equal or below 5% or 0.005. It indicates the independent variables influence the dependent variable partially. While the result of multiple regression in sub chapter 5.1, all of the p-value of the dependent variables are below 5%, so the pricing policy can be stated valid statistically.

Both influence factors have different impact to the electricity price for Smelter Company. Electricity Sales Volume has contrary behavior toward the electricity price. If PLN decides to increase the amount of purchased power, which means the total purchased power is increasing, the electricity price is getting cheaper.

It caused of the costs/expenses for generating power is decreasing, as the impact of the decreasing of unutilized power cost. Unutilized power cost actually does not have independent post in pricing calculation. It is contained in each pricing components as the impact of the unutilized power. If PLN takes over bigger amount of the excess power, it means the amount of unutilized power decreases and the portion of the responsibility to cover the cost for generating power for each buyer is changing. The portion of each buyer is the purchased power divided with the total

purchased power by both of them. So if PLN decides to take over bigger amount of the excess power, the portion for PLN is also getting bigger, while Smelter Company covers smaller portion that the previous condition. Below is the portion's calculation of each buyer in different scenarios.

Table 5. 9 List of Portion for Each Buyer

Scenario	Purchased Power (MW)		Total (MW)	Portion	
	PLN	Smelter Company		PLN	Smelter Company
1	0	133	133	0.0%	100.0%
2	50	133	183	27.3%	72.7%
3	100	133	233	42.9%	57.1%
4	150	133	283	53.0%	47.0%

Figure 5.1 shows the electricity price for Smelter Company in the first year of operation (2020) that accommodates different total purchased power.

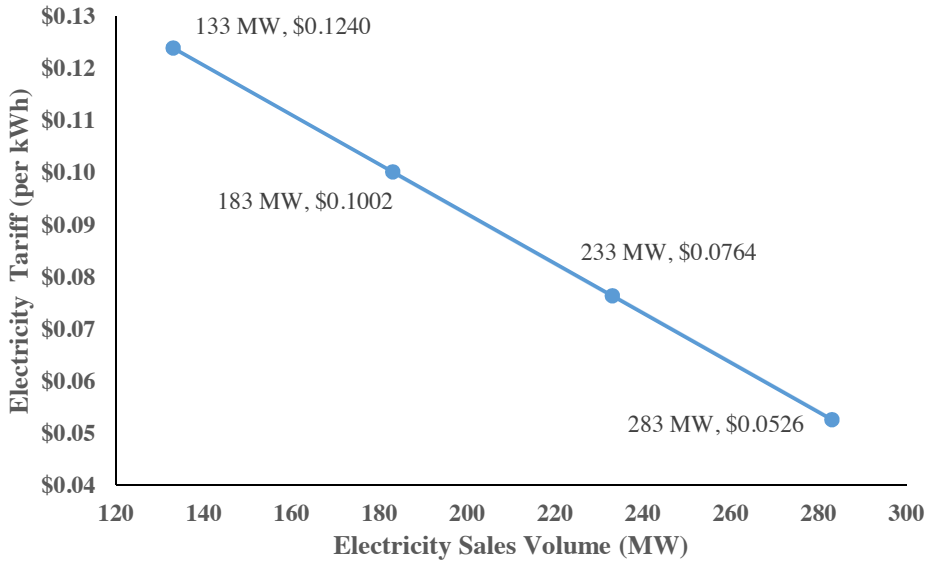

Figure 5. 1 Electricity Price for Smelter Company in 1st year of Operation (2020)

Figure above also support and in line with the explanation of total purchased power's impact. So the increasing total purchased power is deducting the electricity price for Smelter Company because decreasing the portion/responsibility to cover the generating power cost.

While the gas price has different impact to electricity price. It is in line with electricity behavior. As mentioned before in Chapter 4, the final synthesis gas price that gives beneficial for Smelter Company and Power Plant is $2.752/mmBtu. This synthesis gas price is applicable if the limit of PLN Buying Price is $7.31cents/kWh. As the synthesis gas is increasing as the impact of the inflation, the electricity price also increasing, but the cheapest price is still $7.31cents/kWh as the Annual Worth of the electricity price for 25 years. Below is the result of electricity price for Smelter Company that accommodate the inflation impact to synthesis gas price in all scenarios.

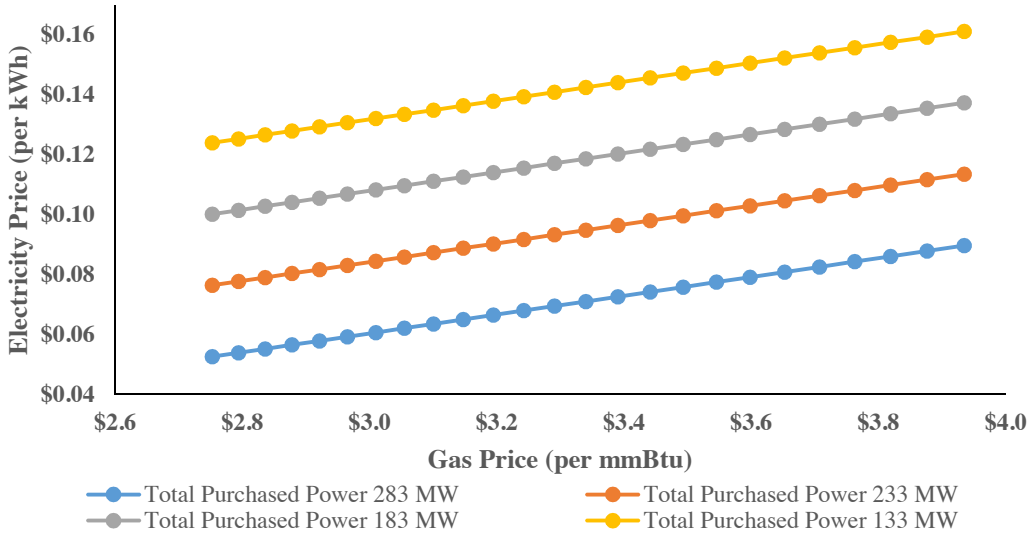

Figure 5. 2 Electricity Price for Smelter Company (accommodate inflation impact toward gas price)

Based on Figure 5.2, it shows that the increasing gas price by inflation lead to the increasing electricity price for Smelter Company. Figure above also shows impact of the interaction of both influence factors. The electricity price is increasing when the gas price increase and it is getting more expensive when total purchased power is decreasing.

If the limit that is stated by government changes, it will cause the final synthesis gas price will change in order to find other equilibrium price for both sides. When the final synthesis gas price changes, it will bring impact to the

electricity price because synthesis gas price is one of the influence factors in pricing policy.

Based on those facts, it shows that the decision from PLN to buy excess power is very critical and has big impacts to electricity price, whether about the purchased amount and the buying price. Both of them are influencing the electricity price. Therefore, it is important to negotiate and involve PLN in take over the generated power.

In conclusion, the pricing policy for electricity price of PLN is following the standard calculation policy, which is based on Component A-B-C-D, while pricing policy for electricity price for Smelter Company is **Electricity Price= 0.10091 + (0.03139 x Gas Price) – (0.000476 x Electricity Sales Volume)**. Figure 5.3 shows the result for both of them.

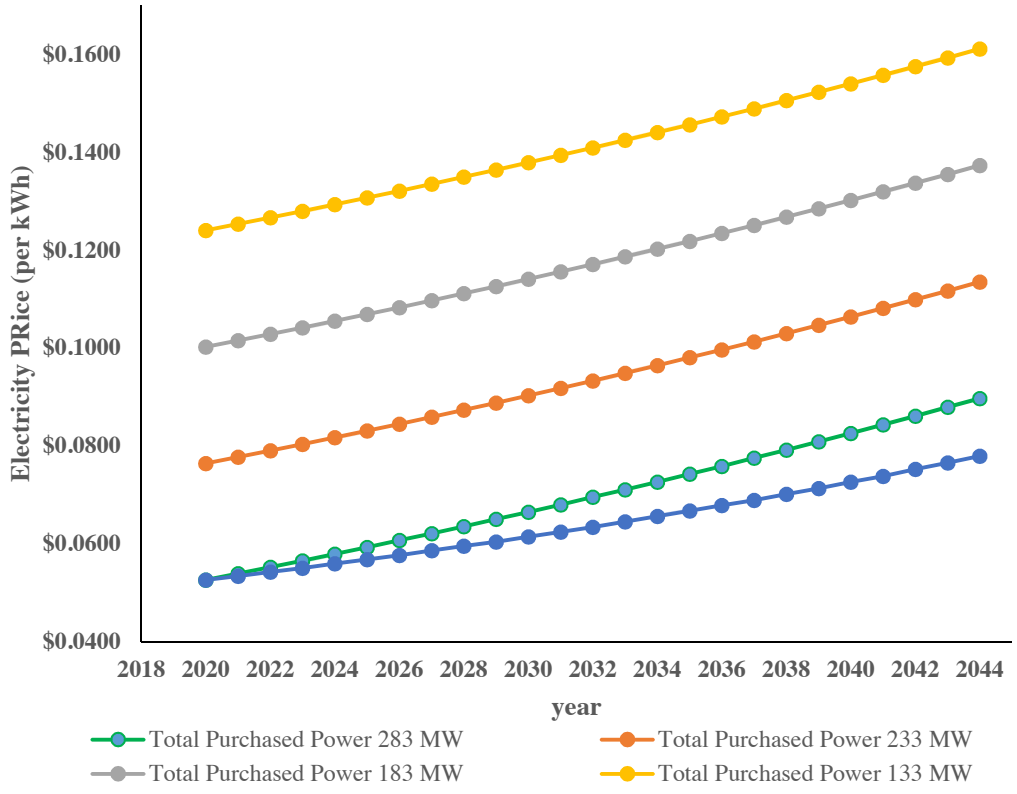

Figure 5. 3 Result of Pricing Policy for Smelter Company and Power Plant

5.3.2. Minimum PLN Buying Price

Based on the calculation result in sub chapter 5.2, the minimum PLN Buying Price that gives guarantee of the feasibility for Power Plant is different in each scenario. It is related with total purchased power. If PLN reduces the total amount that they purchase, the range for negotiation between PLN and Power Plant is narrower. While the electricity price for Smelter Company is locked for the bottom price, which is equal $7.31 cents/kWh.

Figure 5.4 shows the range of PLN buying price for scenario 1 until 3, which PLN is assumed take over the excess power in various amount.

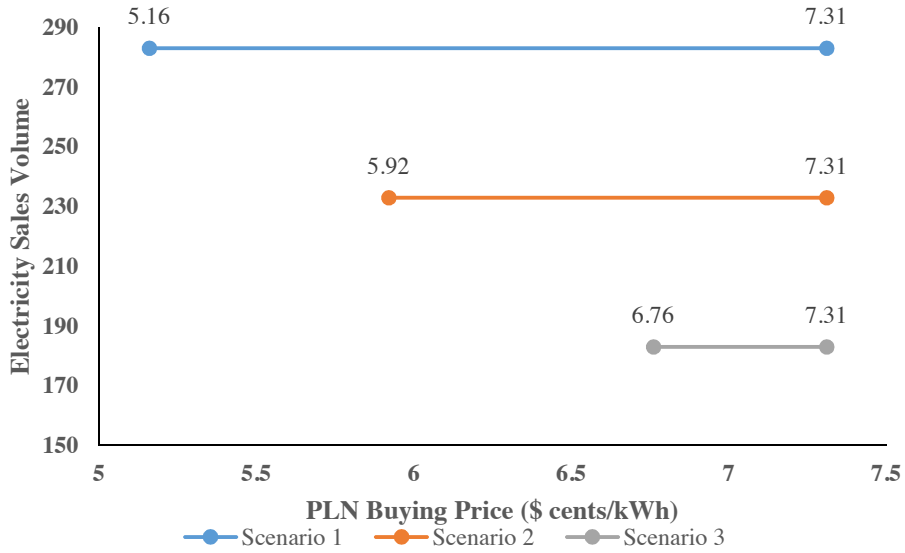

Figure 5. 4 Range of PLN Buying Price for Scenario 1-3

In figure above, it shows that the range for negotiation between PLN and Power Plant is getting wider when PLN decides to offer / buy bigger amount of the excess power. It is actually still related with the margin that is earned from PLN in chapter 4. As explained before that the margin from PLN is decreasing when PLN decides to reduce the amount of purchased power. When the initial margin is thicker, it means the range for negotiation between both of them is wider.

Below is the final pricing for scenario 1 until 3, includes the minimum buying price from PLN.

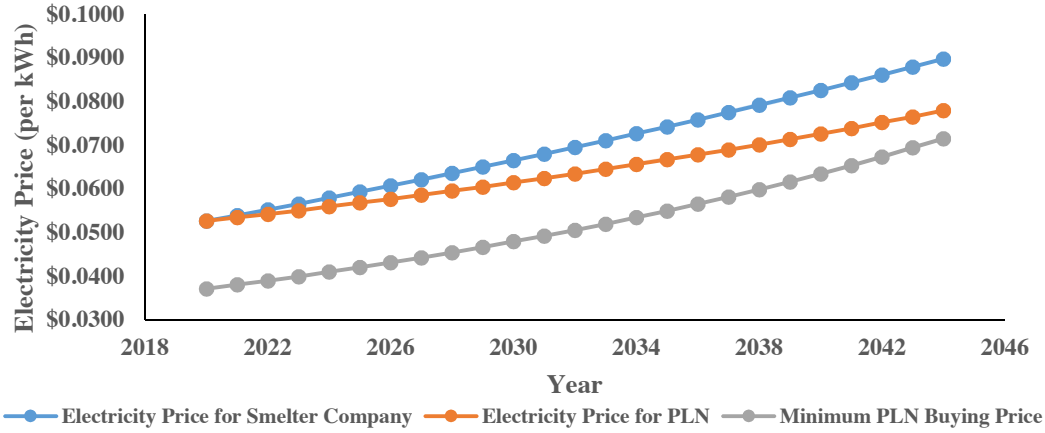

Figure 5. 5 Final Pricing for Scenario 1 (Electricity Sales Volume 283 MW)

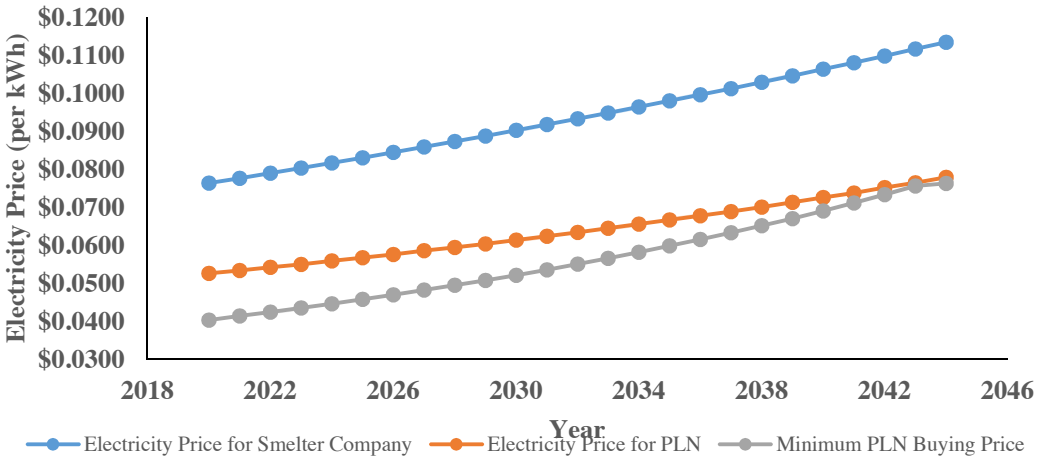

Figure 5. 6 Final Pricing for Scenario 2 (Electricity Sales Volume 233 MW)

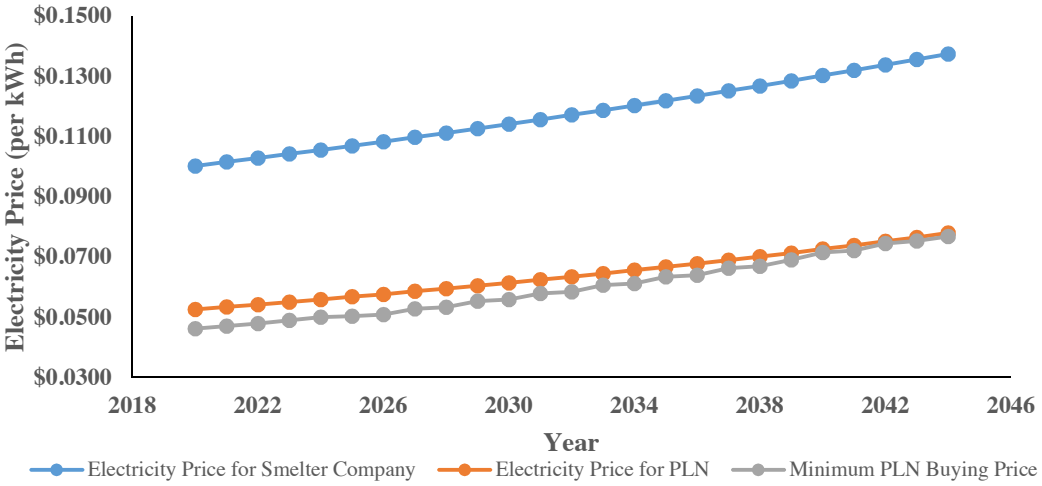

Figure 5. 7 Final Pricing for Scenario 3 (Electricity Sales Volume 183 MW)

Based on the 3 figures above, it shows that the pricing for Smelter Company is getting more expensive when the total purchased power is decreasing. Although the pricing for Smelter Company is getting more expensive, the negotiation range between PLN and Power Plant is narrower because of the decreasing margin from PLN as explained above and in chapter 4.

In Figure 5.8, it shows NPV of Power Plant in different PLN buying price, while Figure 5.9 shows NPV joined in different PLN buying price.

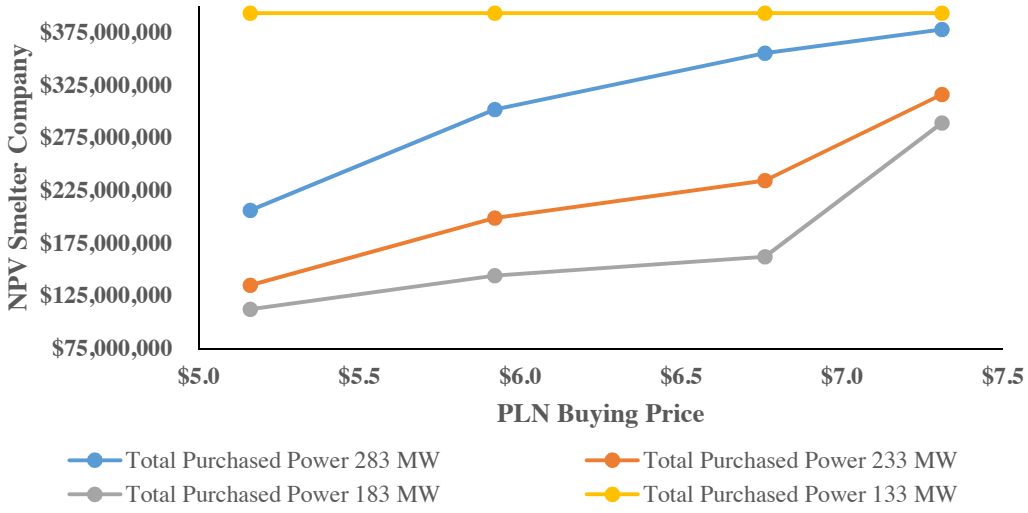

Figure 5. 8 NPV of Power Plant in Various PLN Buying Price

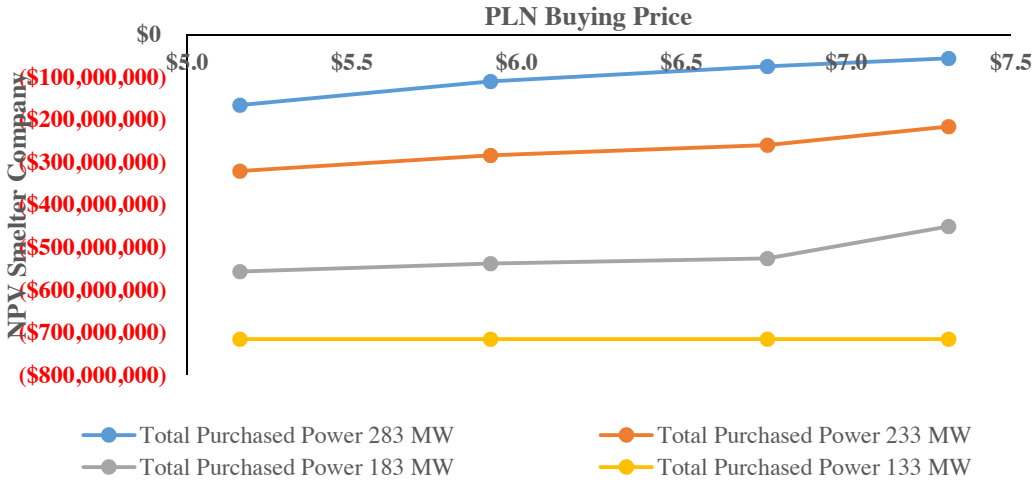

Figure 5. 9 NPV of Joined in Various PLN Buying Price

Based on the results on Figure 5.8 and Figure 5.9, it can be concluded that the best scheme for Smelter Company and Power Plant is offer the excess power in full amount, suitable with the initial idea to generate 283 MW as the full capacity. In Figure 5.8, the scenario that gives the best profit and financial aspects for Power Plant is Scenario 4, which is without PLN intervention in take over the excess power. Contrarily, it is the worst scenario for Smelter Company, because all responsibility to cover the generating power cost is entirely on Smelter Company's side, which consequently NPV of Smelter Company reach the bottom value although still above NPV of Smelter Company in outsource option from PLN. In Figure 5.9 that accommodate the objectives and cashflow of Smelter Company and Power Plant as one entity, scenario 1, which is offer the excess power in full amount to PLN, is the best scenario that can fulfill all objectives of both parties.Even the PLN buying price is below the upper limit that is already stated by the regulation, it still gives better financial result compared with other scenarios. Therefore, the business scheme with dual buyer is feasible for Power Plant and it is better to offer the excess power to PLN in full amount, with the range of negotiation price is between $5.16cents/kWh until $7.31cents/kWh.

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CHAPTER 6
CONCLUSION and SUGGESTION

Chapter 6 as the last chapter in this research provides the answer of the research objectives. In addition, there is also suggestion for related parties and further research as the development of this research.

6.1 Conclusion

Based on the research's result that is already conducted, there are several conclusions that can be emphasized, as follows:

- The synthesis gas price is needed to be determined in order to gives beneficial for both parties and fulfill the constraints from PLN that the upper limit of their buying price is $7.31cents/kWh. Therefore, the best synthesis gas price that gives beneficial for Smelter Company and Power Plant is **$2.752/mmBtu.** Power Plant still earns profit and the business scheme to generate power for Smelter Company and PLN is still feasible from financial aspect. In Smelter Company's side, they able to maintain the cost, includes utilities cost (electricity). This price is accepted and applicable as long as the reference of PLN Buying Price is $7.31cents/kWh.
- The pricing policy that can be implemented and applied for calculating the electricity price of PLN is the standard calculation policy that is already implemented in the other power plants, which is using components A-B-C-D, whule the electricitry price of Smelter Company is following another policy, which is **Electricity Price= 0.10091 + (0.03139 x Gas Price) – (0.000476 x Electricity Sales Volume)**. This policy accommodates the changes of synthesis gas price and the total purchased power, which each of them has different impact to electricity price. The increasing of synthesis gas price causes the increasing of electricity price, while the increasing total purchased power is deducting the electricity price for Smelter Company because the portion to cover the cost for generating power is reducing. Thereof, in order to have cheaper electricity price, the generated power must be purchased as much

as possible, which is bought by PLN or other private sector companies near the location.

- The range for negotiation of PLN buying price between PLN and Power Plant is different for each scenario. The range of PLN buying price that is still acceptable by Power Plant are:

Table 6. 1 Range of PLN Buying Price

Scenario	Electricity Sales Volume	Min (cents/kWh)	Max (cents/kWh)
1	283	5.16	7.31
2	233	5.92	7.31
3	183	6.76	7.31

- Based on the analysis that is already conducted in Chapter 5, the best scheme for Smelter Company and Power Plant is offering the excess power in full amount to PLN, suitable with the initial idea to generate 283 MW as the full capacity, although the final PLN buying price will be below the limit that stated in the regulation. The negotiation PLN price is following the range in table 6.1 for scenario 1. NPV joined when all generated power is purchased is better than other scenarios, even when the power is purchased with the minimum buying price by PLN. Power Plant still earns profit and it feasible for them to conduct the business scheme with dual buyer. In Smelter Company's point of view, it also gives benefit, which is reducing the cost to purchased power for iron making plant's operation and they do not have environment issues for the synthesis gas.
- Based on the comparison option between insource from power plant and outsource from PLN, it shows that the insource option is dominating over outsource option in all scenarios. The incremental analysis also support those facts. So the decision to insource supplied power from power plant is the right decision and proven by this research.

6.2 Suggestion

Below is the suggestion as the consideration for observed company in the future.

- In order to increase the utilization and reduce the dependency to PLN decision for take over the excess power, Smelter Company can offer the excess power to other companies near with their location, even offers for join venture scheme in supplied power project so it can reduce the responsibilities for investment and the risk of Smelter Company.
- Smelter Company can conduct research for power transmissing business project that is used to fulfill the electricity demand for the society /villages around the plants directly using the excess power from the power plant.

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REFERENCES

Badan Pengembangan Infrastruktur Wilayah, (2016). *PUPR Siapkan 6 Wilayah Pengembangan Strategis di Pulau Sumatera,* Jakarta: Badan Pengembangan Infrastruktur Wilayah.

Badan Pusat Statistik, (2017). *Indeks Harga Konsumen dan Inflasi Bulanan Indonesia*. [Online] Available at: https://www.bps.go.id/linkTabelStatis/view/id/907 [Accessed 5 January 2017].

Bank Indonesia, (2016). *Interest Rate of US Dollar Loans by Group of Banks*. [Online] Available at: http://www.bi.go.id/seki/tabel/TABEL1_27.pdf [Accessed 10 December 2016].

DLA Piper, (2011). *EPC Contracts in the Power Sector,* Sydney: DLA Piper.

Duke Energy Corporation, (2013). *How IGCC Works*. [Online] Available at: https://www.duke-energy.com/about-us/how-igcc-works.asp [Accessed 11 October 2016].

Ganapathy, V., (1996). Heat-Recovery Steam Generators: Understand the Basics. Dalam: *Chemical Engineering Progress*. Texas: BCO Industries, pp. 32-44.

Henchie, N., (2008). *Worlds Apart: A Comparison of EPC and EPCM Contracts,* London: Mayer Brown.

Indonesia Bond Pricing Agency, (2016). *Obligasi dan Sukuk Pemerintah*. [Online] Available at: http://www.ibpa.co.id/DataPasarSuratUtang/BondMaster/ObligasidanSukukPemerintah/tabid/79/Default.aspx [Accessed 10 December 2016].

Industrial Application of Gas Turbine Committee, (2009). *Introduction of HRSGs*. Banf, Industrial Application of Gas Turbine Committee.

International Monetary Fund, 2016. *World Economic Outlook,* Washington, DC: International Monetary Fund.

Keeney, R. L., (1982). Decision Analysis: An Overview. *Operation Research,* 30(5), pp. 803-838.

Kementerian Energi dan Sumber Daya Mineral , (2014). *Harga Minyak Mentah Indonesia (ICP)*. [Online] Available at: http://kip.esdm.go.id/pusdatin/index.php/data-informasi/data-energi/minyak-dan-gas-bumi/harga-minyak-mentah-icp [Accessed 29 November 2016].

Kementerian Energi dan Sumber Daya Mineral Republik Indonesia, (2014). *Peraturan Menteri Energi dan Sumber Daya Mineral Republik Indonesia Nomor 31 Tahun 2014,* Jakarta: Kementerian Energi dan Sumber Daya Mineral Republik Indonesia.

Kementerian Energi dan Sumber Daya Mineral, (2016). *Daftar Harga Minyak Mentah Indonesia (Indonesia Crude Price/ICP).* [Online] Available at: http://lifting.migas.esdm.go.id/lifting/informasi/icp [Accessed 4 December 2016]

Kementerian Keuangan Republik Indonesia, (2010). *Data Pokok APBN 2004-2010,* Jakarta: Kementerian Keuangan Republik Indonesia

Kementerian Keuangan Republik Indonesia, (2010). *Nota Keuangan and Anggaran Pendapatan dan Belanja Negara 2010,* Jakarta: Kementerian Keuangan Republik Indonesia.

Kementerian Keuangan Republik Indonesia, (2011). *Data Pokok APBN 2005-2011,* Jakarta: Kementerian Keuangan Republik Indonesia.

Kementerian Keuangan Republik Indonesia, (2012). *Nota Keuangan and Anggaran Pendapatan dan Belanja Negara 2012,* Jakarta: Kementerian Keuangan Republik Indonesia.

Kementerian Keuangan Republik Indonesia, (2013). *Nota Keuangan and Anggaran Pendapatan dan Belanja Negara 2013,* Jakarta: Kementerian Keuangan Republik Indonesia.

Kementerian Keuangan Republik Indonesia, (2014). *Nota Keuangan and Anggaran Pendapatan dan Belanja Negara 2014,* Jakarta: Kementerian Keuangan Republik Indonesia.

Kementerian Perindustrian Republik Indonesia, (2014). *Profil Industri Baja,* Jakarta: Kementerian Perindustrian Republik Indonesia.

Kementerian Keuangan Republik Indonesia, (2015). *Nota Keuangan dan Anggaran Pendapatan dan Belanja Negara Tahun 2015,* Jakarta: Kementerian Keuangan Republik Indonesia

Kementerian Keuangan Republik Indonesia, (2016). *Informasi APBN 2016,* Jakarta: Kementerian Keuangan Republik Indonesia.

Kementerian Keuangan Republik Indonesia, (2016). *Nota Keuangan and Rancangan APBN 2017,* Jakarta: Kementerian Keuangan Republik Indonesia.

Kresnaningtyas, B. P. (2010), *Studi Pembangunan Pembangkit Listrik Tenaga Panas Bumi (PLTP) Suwawa 110 MW di Gorontalo dan Pengaruhnya*

Terhadap Tarif Regional, Bachelor Thesis, Institut Teknologi Sepuluh Nopember, Surabaya

Loots, P. and Henchie, N., (2007). *Worlds Apart: EPC and EPCM Contracts: RIsk Issues and Allocation,* London: Mayer Brown.

Maksum, H. and Rivai, A., (2015). Komponen Penentuan Harga Jual Tenaga Listrik dari Pembangkit Listrik Tenaga Uap Batubara Skala Kecil (PLTU B-SK). *MandE,* Volume 13, pp. 76-84.

Mitsubishi Hitachi Power Systems, (2014). *IGCC (Integrated coal Gasification Combined Cycle)*. [Online] Available at: https://www.mhps.com/en/products/category/integrated_coal_gasfication_combined_cycle.html [Accessed 11 October 2016].

Pícha, J., Tomek, A. and Löwitt, H., 2015. *Application of EPC Contracts in International Power Projects*. Prague, Creative Construction Conference 2015 (CCC2015)

PT. PLN (Persero), (2010). *Rencana Usaha Penyediaan Tenaga Listrik 2010-2019,* Jakarta: PT. PLN (Persero).

PT. PLN (Persero), (2011). *Rencana Usaha Penyediaan Tenaga Listrik 2011-2020,* Jakarta: PT. PLN (Persero).

PT. PLN (Persero), (2012). *Rencana Usaha Penyediaan Tenaga Listrik 2012-2021,* Jakarta: PT. PLN (Persero).

PT. PLN (Persero), (2013). *Rencana Usaha Penyediaan Tenaga Listrik 2013-2022,* Jakarta: PT. PLN (Persero).

PT PLN (Persero), (2014). *Penerapan Tarif Listrik Tahun 2014: Tariff Adjustment bagi Golongan Tarif Non-Subsidi dan Penghapusan Subsidi Listrik bagi I3 dan I4,* Jakarta: PT PLN (Persero).

PT. PLN (Persero), (2015). *Rencana Usaha Penyediaan Tenaga Listrik 2015-2024,* Jakarta: PT. PLN (Persero).

PT PLN (Persero), (2016). *Tarif Listrik PLN*. [Online] Available at: http://www.pln.co.id/?p=49 [Accessed 22 December 2016].

PT. PLN (Persero), (2016). *Rencana Usaha Penyediaan Tenaga Listrik 2016-2025,* Jakarta: PT. PLN (Persero).

Siemens AG, (2012). *Integrated Gasification Combined Cycle*. [Online] Available at: http://www.energy.siemens.com/mx/en/fossil-power-generation/power-plants/integrated-gasification-combined-cycle/integrated-gasification-combined-cycle.htm#content=Flexibility [Accessed 11 October 2016].

U.S. Energy Information Administration, (2013). *Updated Capital Cost Estimated for Utility Scale Electricity Generating Plants,* Washington, D.C.: U.S. Department of Energy.

Yandri, Heru, (2008), *Strategi Pengadaan untuk Posisi Leverage dan Critical dalam Usaha Meningkatkan Kinerja Biaya Proyek EPC (Studi kasus pada PT. X),* Master Thesis, Universitas Indonesia, Jakarta

APPENDIX

Appendix 1 Table of Historical Data of PLN Electricity Tariff in 2010-2016

Electricity Tariff			
Period		Amount	Average
Month	Year		
2010		Rp 605.00	Rp 605.00
2011		Rp 605.00	Rp 605.00
2012		Rp 612.00	Rp 612.00
Jan	2013	Rp 629.00	Rp 673.75
Feb		Rp 629.00	
Mar		Rp 629.00	
Apr		Rp 654.00	
May		Rp 654.00	
Jun		Rp 654.00	
Jul		Rp 689.00	
Aug		Rp 689.00	
Sep		Rp 689.00	
Oct		Rp 723.00	
Nov		Rp 723.00	
Dec		Rp 723.00	
Jan	2014	Rp 723.00	Rp 905.83
Feb		Rp 723.00	
Mar		Rp 723.00	
Apr		Rp 723.00	
May		Rp 819.00	
Jun		Rp 819.00	
Jul		Rp 928.00	
Aug		Rp 928.00	
Sep		Rp 1,051.00	
Oct		Rp 1,051.00	
Nov		Rp 1,191.00	
Dec		Rp 1,191.00	
Jan	2015	Rp 1,011.99	Rp 1,042.99
Feb		Rp 993.19	
Mar		Rp 965.00	
Apr		Rp 991.60	
May		Rp 1,063.80	
Jun		Rp 1,070.42	
Jul		Rp 1,087.07	
Aug		Rp 1,086.00	
Sep		Rp 1,069.85	
Oct		Rp 1,058.00	
Nov		Rp 1,059.00	
Dec		Rp 1,059.99	
Jan	2016	Rp 970.35	Rp 965.91
Feb		Rp 958.62	
Mar		Rp 933.26	
Apr		Rp 924.78	
May		Rp 931.99	
Jun		Rp 939.85	
Jul		Rp 972.76	

Appendix 1 Table of Historical Data of PLN Electricity in Tariff 2010-2016 (*Continued*)

Electricity Tariff			
Period		Amount	Average
Month	Year		
Aug		Rp 971.01	
Sep		Rp 993.42	
Oct		Rp 994.80	
Nov		Rp 996.21	
Dec		Rp 1,003.85	

Source: PT PLN (Persero),2010-2016

Appendix 2 Table of Historical Data of Inflation Rate in 2005–2016

Inflation Rate			
Period		Monthly	Annual
2005	Jan	1.43%	1.35%
	Feb	-0.17%	
	Mar	1.91%	
	Apr	0.34%	
	May	0.21%	
	Jun	0.50%	
	Jul	0.78%	
	Aug	0.55%	
	Sep	0.69%	
	Oct	8.70%	
	Nov	1.31%	
	Dec	-0.04%	
2006	Jan	1.36%	0.53%
	Feb	0.58%	
	Mar	0.03%	
	Apr	0.05%	
	May	0.37%	
	Jun	0.45%	
	Jul	0.45%	
	Aug	0.33%	
	Sep	0.38%	
	Oct	0.86%	
	Nov	0.34%	
	Dec	1.21%	
2007	Jan	1.04%	0.53%
	Feb	0.62%	
	Mar	0.24%	
	Apr	-0.16%	
	May	0.10%	
	Jun	0.23%	
	Jul	0.72%	
	Aug	0.75%	
	Sep	0.80%	
	Oct	0.79%	
	Nov	0.18%	
	Dec	1.10%	
2008	Jan	1.77%	0.93%
	Feb	0.65%	
	Mar	0.95%	
	Apr	0.57%	
	May	1.41%	
	Jun	2.46%	
	Jul	1.37%	
	Aug	0.51%	
	Sep	0.97%	
	Oct	0.45%	
	Nov	0.12%	

Appendix 2 Table of Historical Data of Inflation Rate in 2005–2016 (*Continued*)

Inflation Rate			
Period		Monthly	Annual
2009	Jan	-0.07%	0.23%
	Feb	0.21%	
	Mar	0.22%	
	Apr	-0.31%	
	May	0.04%	
	Jun	0.11%	
	Jul	0.45%	
	Aug	0.56%	
	Sep	1.05%	
	Oct	0.19%	
	Nov	-0.03%	
	Dec	0.33%	
2010	Jan	0.84%	0.56%
	Feb	0.30%	
	Mar	-0.14%	
	Apr	0.15%	
	May	0.29%	
	Jun	0.97%	
	Jul	1.57%	
	Aug	0.76%	
	Sep	0.44%	
	Oct	0.06%	
	Nov	0.60%	
	Dec	0.92%	
2011	Jan	0.89%	0.31%
	Feb	0.13%	
	Mar	-0.32%	
	Apr	-0.31%	
	May	0.12%	
	Jun	0.55%	
	Jul	0.67%	
	Aug	0.93%	
	Sep	0.27%	
	Oct	-0.12%	
	Nov	0.34%	
	Dec	0.57%	
2012	Jan	0.76%	0.35%
	Feb	0.05%	
	Mar	0.07%	
	Apr	0.21%	
	May	0.07%	
	Jun	0.62%	
	Jul	0.70%	
	Aug	0.95%	
	Sep	0.01%	
	Oct	0.16%	
	Nov	0.07%	
	Dec	0.54%	

Appendix 2 Table of Historical Data of Inflation Rate in 2005–2016 (*Continued*)

Inflation Rate			
Period		Monthly	Annual
2013	Jan	1.03%	0.68%
	Feb	0.75%	
	Mar	0.63%	
	Apr	-0.10%	
	May	-0.03%	
	Jun	1.03%	
	Jul	3.29%	
	Aug	1.12%	
	Sep	-0.35%	
	Oct	0.09%	
	Nov	0.12%	
	Dec	0.55%	
2014	Jan	1.07%	0.67%
	Feb	0.26%	
	Mar	0.08%	
	Apr	-0.02%	
	May	0.16%	
	Jun	0.43%	
	Jul	0.93%	
	Aug	0.47%	
	Sep	0.27%	
	Oct	0.47%	
	Nov	1.50%	
	Dec	2.46%	
2015	Jan	-0.24%	0.28%
	Feb	-0.36%	
	Mar	0.17%	
	Apr	0.36%	
	May	0.50%	
	Jun	0.54%	
	Jul	0.93%	
	Aug	0.39%	
	Sep	-0.05%	
	Oct	-0.08%	
	Nov	0.21%	
	Dec	0.96%	
2016	Jan	0.51%	0.23%
	Feb	-0.09%	
	Mar	0.19%	
	Apr	-0.45%	
	May	0.24%	
	Jun	0.66%	
	Jul	0.69%	
	Aug	-0.02%	
	Sep	0.22%	
	Oct	0.14%	
	Nov	0.47%	

Source: Badan Pusat Statistik, 2017

Appendix 3 Table of Historical Data of Indonesia Crude Price in 2005–2016

Indonesia Crude Price			
Period		Monthly	Annual
2005	Jan	$42.39	$53.44
	Feb	$44.74	
	Mar	$53.00	
	Apr	$54.88	
	May	$48.72	
	Jun	$52.92	
	Jul	$55.42	
	Aug	$61.09	
	Sep	$61.36	
	Oct	$58.11	
	Nov	$53.96	
	Dec	$54.64	
2006	Jan	$62.26	$64.27
	Feb	$61.19	
	Mar	$61.72	
	Apr	$68.92	
	May	$70.01	
	Jun	$67.85	
	Jul	$71.95	
	Aug	$72.82	
	Sep	$62.49	
	Oct	$55.98	
	Nov	$55.90	
	Dec	$60.15	
2007	Jan	$52.81	$72.31
	Feb	$57.62	
	Mar	$61.49	
	Apr	$67.91	
	May	$68.60	
	Jun	$69.14	
	Jul	$75.50	
	Aug	$72.32	
	Sep	$76.10	
	Oct	$82.55	
	Nov	$92.10	
	Dec	$91.54	
2008	Jan	$92.09	$97.02
	Feb	$94.64	
	Mar	$103.11	
	Apr	$109.30	
	May	$124.67	
	Jun	$132.36	
	Jul	$134.96	
	Aug	$115.56	
	Sep	$99.06	
	Oct	$70.66	
	Nov	$49.32	
	Dec	$38.45	

Appendix 3 Table of Historical Data of Indonesia Crude Price in 2005–2016 (*Continued*)

Indonesia Crude Price			
Period		Monthly	Annual
2009	Jan	$41.89	$61.58
	Feb	$43.10	
	Mar	$46.95	
	Apr	$50.62	
	May	$57.86	
	Jun	$68.91	
	Jul	$64.85	
	Aug	$72.47	
	Sep	$67.07	
	Oct	$72.53	
	Nov	$77.08	
	Dec	$75.58	
2010	Jan	$77.29	$79.40
	Feb	$74.01	
	Mar	$78.67	
	Apr	$85.48	
	May	$76.96	
	Jun	$75.22	
	Jul	$73.74	
	Aug	$75.94	
	Sep	$76.76	
	Oct	$82.26	
	Nov	$85.07	
	Dec	$91.37	
2011	Jan	$97.09	$111.55
	Feb	$103.31	
	Mar	$113.07	
	Apr	$123.36	
	May	$115.18	
	Jun	$113.82	
	Jul	$117.15	
	Aug	$111.67	
	Sep	$111.00	
	Oct	$109.25	
	Nov	$112.94	
	Dec	$110.70	
2012	Jan	$115.91	$112.73
	Feb	$122.17	
	Mar	$128.14	
	Apr	$124.63	
	May	$113.76	
	Jun	$99.08	
	Jul	$102.88	
	Aug	$111.72	
	Sep	$111.02	
	Oct	$109.85	
	Nov	$106.68	
	Dec	$106.90	

Appendix 3 Table of Historical Data of Indonesia Crude Price in 2005–2016 (*Continued*)

Indonesia Crude Price			
Period		Monthly	Annual
2013	Jan	$111.07	$105.84
	Feb	$114.86	
	Mar	$107.42	
	Apr	$100.19	
	May	$99.01	
	Jun	$99.97	
	Jul	$103.12	
	Aug	$106.50	
	Sep	$109.69	
	Oct	$106.39	
	Nov	$104.69	
	Dec	$107.20	
2014	Jan	$105.80	$96.51
	Feb	$106.08	
	Mar	$106.90	
	Apr	$106.44	
	May	$106.20	
	Jun	$108.95	
	Jul	$104.63	
	Aug	$99.51	
	Sep	$94.97	
	Oct	$83.72	
	Nov	$75.39	
	Dec	$59.56	
2015	Jan	$45.30	$49.75
	Feb	$54.32	
	Mar	$53.66	
	Apr	$57.48	
	May	$61.86	
	Jun	$59.45	
	Jul	$51.82	
	Aug	$42.81	
	Sep	$49.67	
	Oct	$43.68	
	Nov	$41.44	
	Dec	$35.48	
2016	Jan	$ 27.49	$39.13
	Feb	$ 28.54	
	Mar	$ 34.17	
	Apr	$ 37.20	
	May	$ 44.68	
	Jun	$ 44.50	
	Jul	$ 40.70	
	Aug	$ 41.11	
	Sep	$ 42.17	
	Oct	$ 46.64	
	Nov	$ 43.25	

Source: Kementerian Energi dan Sumber Daya Mineral, 2005-2016

Appendix 4 Table of Historical Data of Exchange Rate in 2005-2016

Exchange Rate			
Period		Monthly	Annual
2005	Jan	Rp 9,250.30	$9,753.97
	Feb	Rp 9,291.00	
	Mar	Rp 9,417.43	
	Apr	Rp 9,586.95	
	May	Rp 9,526.95	
	Jun	Rp 9,664.55	
	Jul	Rp 9,848.29	
	Aug	Rp 10,037.09	
	Sep	Rp 10,283.81	
	Oct	Rp 10,143.90	
	Nov	Rp 10,090.82	
	Dec	Rp 9,906.55	
2006	Jan	Rp 9,540.40	$9,210.33
	Feb	Rp 9,299.35	
	Mar	Rp 9,217.48	
	Apr	Rp 8,981.67	
	May	Rp 9,029.86	
	Jun	Rp 9,409.64	
	Jul	Rp 9,171.00	
	Aug	Rp 9,139.65	
	Sep	Rp 9,189.10	
	Oct	Rp 9,233.12	
	Nov	Rp 9,180.59	
	Dec	Rp 9,132.15	
2007	Jan	Rp 9,111.82	$9,188.71
	Feb	Rp 9,112.85	
	Mar	Rp 9,209.95	
	Apr	Rp 9,142.90	
	May	Rp 8,888.48	
	Jun	Rp 9,072.45	
	Jul	Rp 9,112.36	
	Aug	Rp 9,413.55	
	Sep	Rp 9,356.50	
	Oct	Rp 9,152.71	
	Nov	Rp 9,310.68	
	Dec	Rp 9,380.27	
2008	Jan	Rp 9,453.30	$9,740.61
	Feb	Rp 9,226.95	
	Mar	Rp 9,230.83	

Appendix 4 Table of Historical Data of Exchange Rate in 2005-2016 (*Continued*)

Exchange Rate			
Period		Monthly	Annual
	Apr	Rp 9,254.64	
	May	Rp 9,337.30	
	Jun	Rp 9,342.29	
	Jul	Rp 9,209.45	
	Aug	Rp 9,195.10	
	Sep	Rp 9,387.40	
	Oct	Rp 10,098.65	
	Nov	Rp 11,769.85	
	Dec	Rp 11,381.53	
2009	Jan	Rp 11,223.11	$10,459.86
	Feb	Rp 11,912.15	
	Mar	Rp 11,908.80	
	Apr	Rp 11,080.25	
	May	Rp 10,444.65	
	Jun	Rp 10,257.59	
	Jul	Rp 10,161.86	
	Aug	Rp 10,027.50	
	Sep	Rp 9,950.39	
	Oct	Rp 9,530.00	
	Nov	Rp 9,517.20	
	Dec	Rp 9,504.85	
2010	Jan	Rp 9,321.95	$9,132.34
	Feb	Rp 9,395.11	
	Mar	Rp 9,219.68	
	Apr	Rp 9,072.33	
	May	Rp 9,229.16	
	Jun	Rp 9,194.00	
	Jul	Rp 9,094.45	
	Aug	Rp 9,016.76	
	Sep	Rp 9,020.84	
	Oct	Rp 8,972.90	
	Nov	Rp 8,983.29	
	Dec	Rp 9,067.62	
2011	Jan	Rp 9,082.38	$8,819.93
	Feb	Rp 8,957.11	
	Mar	Rp 8,805.48	
	Apr	Rp 8,694.30	
	May	Rp 8,598.80	
	Jun	Rp 8,607.00	

Appendix 4 Table of Historical Data of Exchange Rate in 2005-2016 (*Continued*)

Exchange Rate			
Period		Monthly	Annual
	Jul	Rp 8,576.19	
	Aug	Rp 8,574.79	
	Sep	Rp 8,809.45	
	Oct	Rp 8,939.67	
	Nov	Rp 9,060.23	
	Dec	Rp 9,133.76	
2012	Jan	Rp 9,154.76	$9,431.09
	Feb	Rp 9,070.81	
	Mar	Rp 9,211.29	
	Apr	Rp 9,221.50	
	May	Rp 9,336.57	
	Jun	Rp 9,498.14	
	Jul	Rp 9,503.59	
	Aug	Rp 9,547.16	
	Sep	Rp 9,614.25	
	Oct	Rp 9,645.14	
	Nov	Rp 9,675.95	
	Dec	Rp 9,693.94	
2013	Jan	Rp 9,735.57	$10,511.43
	Feb	Rp 9,735.05	
	Mar	Rp 9,758.11	
	Apr	Rp 9,772.95	
	May	Rp 9,809.91	
	Jun	Rp 9,931.00	
	Jul	Rp 10,123.70	
	Aug	Rp 10,625.28	
	Sep	Rp 11,402.95	
	Oct	Rp 11,423.86	
	Nov	Rp 11,671.25	
	Dec	Rp 12,147.55	
2014	Jan	Rp 12,240.55	$11,929.25
	Feb	Rp 11,994.75	
	Mar	Rp 11,484.15	
	Apr	Rp 11,492.95	
	May	Rp 11,583.72	
	Jun	Rp 11,952.10	
	Jul	Rp 11,747.50	
	Aug	Rp 11,770.95	
	Sep	Rp 11,959.00	

Appendix 4 Table of Historical Data of Exchange Rate in 2005-2016 (*Continued*)

Exchange Rate			
Period		Monthly	Annual
	Oct	Rp 12,205.57	
	Nov	Rp 12,219.25	
	Dec	Rp 12,500.48	
2015	Jan	Rp 12,641.95	$13,456.36
	Feb	Rp 12,813.53	
	Mar	Rp 13,132.09	
	Apr	Rp 13,012.62	
	May	Rp 13,206.26	
	Jun	Rp 13,379.95	
	Jul	Rp 13,441.79	
	Aug	Rp 13,850.70	
	Sep	Rp 14,468.00	
	Oct	Rp 13,864.76	
	Nov	Rp 13,740.95	
	Dec	Rp 13,923.75	
2016	Jan	Rp 13,958.35	$13,323.03
	Feb	Rp 13,583.20	
	Mar	Rp 13,259.14	
	Apr	Rp 13,182.95	
	May	Rp 13,352.60	
	Jun	Rp 13,421.68	
	Jul	Rp 13,184.53	
	Aug	Rp 13,230.91	
	Sep	Rp 13,183.76	
	Oct	Rp 12,952.24	
	Nov	Rp 13,243.95	

Source: Bank Indonesia, 2016

Appendix 5 Table of Historical Data of Basic Assumption of State Budget of Indonesia (APBN) in 2004-2016

State Budget of Indonesia			
Year	ICP	Exchange Rate	Inflation Rate
2004	$ 22	Rp 8,600.00	0.54%
2005	$ 24	Rp 8,600.00	0.46%
2006	$ 57	Rp 9,900.00	0.67%
2007	$ 63	Rp 9,300.00	0.54%
2008	$ 60	Rp 9,100.00	0.50%
2009	$ 80	Rp 9,400.00	0.52%
2010	$ 60	Rp 10,000.00	0.42%
2011	$ 80	Rp 9,250.00	0.44%
2012	$ 90	Rp 8,800.00	0.44%
2013	$ 100	Rp 9,300.00	0.41%
2014	$ 105	Rp 10,500.00	0.46%
2015	$ 105	Rp 11,900.00	0.37%
2016	$ 50	Rp 13,900.00	0.39%

Source: Kementerian Keuangan Republik Indonesia, 2004-2016

Appendix 6 Calculation of Percentage of Tariff Adjustment, Δ Exchange Rate, ΔICP, and ΔInflation

Period		PLN Tariff	TA%	Inflation		ICP		Exchange Rate	
2012		605		Historical Data	ΔInflation	Historical Data	ΔICP	Historical Data	ΔExchange Rate
2013	Jan	Rp 629		1.03%	0.59%	$ 111.07	$ 21.07	Rp 9,735.57	Rp 935.57
	Feb	Rp 629	3.97%	0.75%	0.31%	$ 114.86	$ 24.86	Rp 9,735.05	Rp 935.05
	Mar	Rp 629		0.63%	0.19%	$ 107.42	$ 17.42	Rp 9,758.11	Rp 958.11
	Apr	Rp 654		-0.10%	-0.54%	$ 100.19	$ 10.19	Rp 9,772.95	Rp 972.95
	May	Rp 654	3.97%	-0.03%	-0.47%	$ 99.01	$ 9.01	Rp 9,809.91	Rp 1,009.91
	Jun	Rp 654		1.03%	0.59%	$ 99.97	$ 9.97	Rp 9,931.00	Rp 1,131.00
	Jul	Rp 689		3.29%	2.85%	$ 103.12	$ 13.12	Rp 10,123.70	Rp 1,323.70
	Aug	Rp 689	5.35%	1.12%	0.68%	$ 106.50	$ 16.50	Rp 10,625.28	Rp 1,825.28
	Sep	Rp 689		-0.35%	-0.79%	$ 109.69	$ 19.69	Rp 11,402.95	Rp 2,602.95
	Oct	Rp 723		0.09%	-0.35%	$ 106.39	$ 16.39	Rp 11,423.86	Rp 2,623.86
	Nov	Rp 723		0.12%	-0.32%	$ 104.69	$ 14.69	Rp 11,671.25	Rp 2,871.25
	Dec	Rp 723		0.55%	0.11%	$ 107.20	$ 17.20	Rp 12,147.55	Rp 3,347.55
2014	Jan	Rp 723	4.93%	1.07%	0.66%	$ 105.80	$ 5.80	Rp 12,240.55	Rp 2,940.55
	Feb	Rp 723		0.26%	-0.15%	$ 106.08	$ 6.08	Rp 11,994.75	Rp 2,694.75
	Mar	Rp 723		0.08%	-0.33%	$ 106.9	$ 6.90	Rp 11,484.15	Rp 2,184.15
	Apr	Rp 723		-0.02%	-0.43%	$ 106.44	$ 6.44	Rp 11,492.95	Rp 2,192.95
	May	Rp 819	13.3%	0.16%	-0.25%	$ 106.2	$ 6.20	Rp 11,583.72	Rp 2,283.72
	Jun	Rp 819		0.43%	0.02%	$ 108.95	$ 8.95	Rp 11,952.10	Rp 2,652.10
	Jul	Rp 928	13.3%	0.93%	0.52%	$ 104.63	$ 4.63	Rp 11,747.50	Rp 2,447.50
	Aug	Rp 928		0.47%	0.06%	$ 99.51	$ (0.49)	Rp 11,770.95	Rp 2,470.95
	Sep	Rp 1,051	13.3%	0.27%	-0.14%	$ 94.97	$ (5.03)	Rp 11,959.00	Rp 2,659.00
	Oct	Rp 1,051		0.47%	0.06%	$ 83.72	$ (16.28)	Rp 12,205.57	Rp 2,905.57
	Nov	Rp 1,191	13.3%	1.50%	1.09%	$ 75.39	$ (24.61)	Rp 12,219.25	Rp 2,919.25
	Dec	Rp 1,191		2.46%	2.05%	$ 59.56	$ (40.44)	Rp 12,500.48	Rp 3,200.48
2015	Jan	Rp 1,011.99	-15%	-0.24%	-0.698 %	$ 45.30	$ (59.70)	Rp 12,641.95	Rp 2,141.95
	Feb	Rp 993.19	-1.86%	-0.36%	-0.82%	$ 54.32	$ (50.68)	Rp 12,813.53	Rp 2,313.53

Appendix 6 Calculation of Percentage of Tariff Adjustment, Δ Exchange Rate, ΔICP, and ΔInflation (*Continued*)

Period		PLN Tariff	TA%	Inflation		ICP		Exchange Rate	
				Historical Data	ΔInflation	Historical Data	ΔICP	Historical Data	ΔExchange Rate
2016	Mar	Rp 965.00	-2.84%	0.17%	-0.29%	$ 53.66	$ (51.34)	Rp 13,132.09	Rp 2,632.09
	Apr	Rp 991.60	2.76%	0.36%	-0.10%	$ 57.48	$ (47.52)	Rp 13,012.62	Rp 2,512.62
	May	Rp 1,063.80	7.28%	0.50%	0.04%	$ 61.86	$ (43.14)	Rp 13,206.26	Rp 2,706.26
	Jun	Rp 1,070.42	0.62%	0.54%	0.08%	$ 59.45	$ (45.55)	Rp 13,379.95	Rp 2,879.95
	Jul	Rp 1,087.07	1.56%	0.93%	0.47%	$ 51.82	$ (53.19)	Rp 13,441.79	Rp 2,941.79
	Aug	Rp 1,086	-0.10%	0.39%	-0.07%	$ 42.81	$ (62.19)	Rp 13,850.70	Rp 3,350.70
	Sep	Rp 1,069.85	-1.49%	-0.05%	-0.51%	$ 49.67	$ (55.33)	Rp 14,468.00	Rp 3,968.00
	Oct	Rp 1,058	-1.11%	-0.08%	-0.54%	$ 43.68	$ (61.32)	Rp 13,864.76	Rp 3,364.76
	Nov	Rp 1,059	0.09%	0.21%	-0.25%	$ 41.44	$ (63.56)	Rp 13,740.95	Rp 3,240.95
	Dec	Rp 1,059.99	0.09%	0.96%	0.50%	$ 35.48	$ (69.53)	Rp 13,923.75	Rp 3,423.75
2016	Jan	Rp 970.35	-8.46%	0.51%	0.14%	$ 27.49	$ (77.51)	Rp 13,958.35	Rp 2,058.35
	Feb	Rp 958.62	-1.21%	-0.09%	-0.46%	$ 28.54	$ (76.46)	Rp 13,583.20	Rp 1,683.20
	Mar	Rp 933.26	-2.65%	0.19%	-0.18%	$ 34.17	$ (70.83)	Rp 13,259.14	Rp 1,359.14
	Apr	Rp 924.78	-0.91%	-0.45%	-0.82%	$ 37.20	$ (67.80)	Rp 13,182.95	Rp 1,282.95
	May	Rp 931.99	0.78%	0.24%	-0.13%	$ 44.68	$ (60.32)	Rp 13,352.60	Rp 1,452.60
	Jun	Rp 939.85	0.84%	0.66%	0.29%	$ 44.50	$ (60.50)	Rp 13,421.68	Rp 1,521.68
	Jul	Rp 972.76	3.50%	0.69%	0.32%	$ 40.70	$ (64.30)	Rp 13,184.53	Rp 1,284.53
	Aug	Rp 971.01	-0.18%	-0.02%	-0.39%	$ 41.11	$ (63.89)	Rp 13,230.91	Rp 1,330.91
	Sep	Rp 993.42	2.31%	0.22%	-0.15%	$ 42.17	$ (62.83)	Rp 13,183.76	Rp 1,283.76
	Oct	Rp 994.80	0.14%	0.14%	-0.23%	$ 46.64	$ (58.36)	Rp 12,952.24	Rp 1,052.24
	Nov	Rp 996.21	0.14%	0.47%	0.10%	$ 43.25	$ (61.75)	Rp 13,243.95	Rp 1,343.95

Appendix 7 Tariff Adjustment Equation Testing

Tariff Adjustment Calculation Testing						NewTariff Calculation Testing				
Period		TA%	Inflation (%)	ICP (%)	Exchange Rate (%)	TL	TB	Difference	Absolute Value of Difference	Error
2013	Jan	3.220	2.49	0.37	0.363	Rp 605	Rp 624.48	Rp 4.52	Rp 4.52	0.007
	Feb	2.102	1.30	0.44	0.363	Rp 629	Rp 642.22	-Rp 13.22	Rp 13.22	0.021
	Mar	1.473	0.80	0.30	0.372	Rp 629	Rp 638.27	-Rp 9.27	Rp 9.27	0.015
	Apr	(1.735)	(2.29)	0.18	0.378	Rp 629	Rp 618.08	Rp 35.92	Rp 35.92	0.055
	May	(1.446)	(2.00)	0.16	0.392	Rp 654	Rp 644.55	Rp 9.45	Rp 9.45	0.014
	Jun	3.102	2.49	0.17	0.439	Rp 654	Rp 674.29	-Rp 20.29	Rp 20.29	0.031
	Jul	12.792	12.05	0.23	0.514	Rp 654	Rp 737.66	-Rp 48.66	Rp 48.66	0.071
	Aug	3.866	2.87	0.29	0.708	Rp 689	Rp 715.64	-Rp 26.64	Rp 26.64	0.039
	Sep	(1.994)	(3.35)	0.34	1.010	Rp 689	Rp 675.26	Rp 13.74	Rp 13.74	0.020
	Oct	(0.183)	(1.49)	0.29	1.018	Rp 689	Rp 687.74	Rp 35.26	Rp 35.26	0.049
	Nov	0.010	(1.36)	0.26	1.114	Rp 723	Rp 723.08	-Rp 0.08	Rp 0.08	0.000
	Dec	2.058	0.46	0.30	1.299	Rp 723	Rp 737.88	-Rp 14.88	Rp 14.88	0.021
2014	Jan	4.041	2.80	0.10	1.141	Rp 723	Rp 752.22	-Rp 29.22	Rp 29.22	0.040
	Feb	0.525	(0.63)	0.11	1.046	Rp 723	Rp 726.79	-Rp 3.79	Rp 3.79	0.005
	Mar	(0.421)	(1.39)	0.12	0.847	Rp 723	Rp 719.96	Rp 3.04	Rp 3.04	0.004
	Apr	(0.848)	(1.81)	0.11	0.851	Rp 723	Rp 716.87	Rp 6.13	Rp 6.13	0.008
	May	(0.056)	(1.05)	0.11	0.886	Rp 723	Rp 722.60	Rp 96.40	Rp 96.40	0.118
	Jun	1.277	0.09	0.16	1.029	Rp 819	Rp 829.46	-Rp 10.46	Rp 10.46	0.013
	Jul	3.237	2.21	0.08	0.950	Rp 819	Rp 845.51	Rp 82.49	Rp 82.49	0.089
	Aug	1.211	0.26	(0.01)	0.959	Rp 928	Rp 939.24	-Rp 11.24	Rp 11.24	0.012
	Sep	0.359	(0.59)	(0.09)	1.032	Rp 928	Rp 931.33	Rp 119.67	Rp 119.67	0.114
	Oct	1.103	0.26	(0.28)	1.127	Rp 1,051	Rp 1,062.60	-Rp 11.60	Rp 11.60	0.011
	Nov	5.320	4.62	(0.43)	1.133	Rp 1,051	Rp 1,106.91	Rp 84.09	Rp 84.09	0.071
	Dec	9.213	8.68	(0.71)	1.242	Rp 1,191	Rp 1,300.72	-Rp 109.72	Rp 109.72	0.092
2015	Jan	(3.168)	(2.95)	(1.04)	0.831	Rp 1,191	Rp 1,153.27	-Rp 141.28	Rp 141.28	0.140
	Feb	(3.451)	(3.46)	(0.89)	0.898	Rp 1,011.99	Rp 977.07	Rp 16.12	Rp 16.12	0.016
	Mar	(1.097)	(1.22)	(0.90)	1.021	Rp 993.19	Rp 982.30	-Rp 17.30	Rp 17.30	0.018
	Apr	(0.273)	(0.42)	(0.83)	0.975	Rp 965.00	Rp 962.37	Rp 29.23	Rp 29.23	0.029
	May	0.471	0.18	(0.75)	1.050	Rp 991.60	Rp 996.27	Rp 67.53	Rp 67.53	0.063
	Jun	0.666	0.35	(0.80)	1.117	Rp 1,063.80	Rp 1,070.88	-Rp 0.46	Rp 0.46	0.000
	Jul	2.206	2.00	(0.93)	1.141	Rp 1,070.42	Rp 1,094.03	-Rp 6.96	Rp 6.96	0.006
	Aug	(0.077)	(0.29)	(1.09)	1.300	Rp 1,087.07	Rp 1,086.23	-Rp 0.23	Rp 0.23	0.000
	Sep	(1.579)	(2.15)	(0.97)	1.540	Rp 1,086.00	Rp 1,068.85	Rp 1.00	Rp 1.00	0.001
	Oct	(2.045)	(2.28)	(1.07)	1.306	Rp 1,069.85	Rp 1,047.97	Rp 10.03	Rp 10.03	0.009
	Nov	(0.905)	(1.05)	(1.11)	1.257	Rp 1,058.00	Rp 1,048.42	Rp 10.57	Rp 10.57	0.010
	Dec	2.234	2.12	(1.22)	1.328	Rp 1,059.00	Rp 1,082.65	-Rp 22.66	Rp 22.66	0.021

Appendix 7 Tariff Adjustment Equation Testing (*Continued*)

Tariff Adjustment Calculation Testing						NewTariff Calculation Testing				
Period		TA%	Inflation (%)	ICP (%)	Exchange Rate (%)	TL	TB	Difference	Absolute Value of Difference	Error
2016	Jan	0.049	0.61	(1.36)	0.799	Rp 1,059.99	Rp 1,060.5	-Rp 90.15	Rp 90.15	0.093
	Feb	(2.617)	(1.93)	(1.34)	0.653	Rp 970.35	Rp 944.96	Rp 13.66	Rp 13.66	0.014
	Mar	(1.459)	(0.75)	(1.24)	0.527	Rp 958.62	Rp 944.63	-Rp 11.37	Rp 11.37	0.012
	Apr	(4.143)	(3.45)	(1.19)	0.498	Rp 933.26	Rp 894.59	Rp 30.19	Rp 30.19	0.033
	May	(1.028)	(0.54)	(1.06)	0.564	Rp 924.78	Rp 915.27	Rp 16.72	Rp 16.72	0.018
	Jun	0.772	1.24	(1.06)	0.590	Rp 931.99	Rp 939.19	Rp 0.66	Rp 0.66	0.001
	Jul	0.741	1.37	(1.13)	0.498	Rp 939.85	Rp 946.81	Rp 25.95	Rp 25.95	0.027
	Aug	(2.237)	(1.64)	(1.12)	0.516	Rp 972.76	Rp 951	Rp 20.01	Rp 20.01	0.021
	Sep	(1.222)	(0.62)	(1.10)	0.498	Rp 971.01	Rp 959.15	Rp 34.27	Rp 34.27	0.035
	Oct	(1.572)	(0.96)	(1.02)	0.408	Rp 993.42	Rp 977.81	Rp 16.99	Rp 16.99	0.017
	Nov	(0.122)	0.44	(1.08)	0.521	Rp 994.80	Rp 993.59	Rp 2.62	Rp 2.62	0.003

MAPE	3.21%
Cofidence Level	96.79%

Appendix 8 Annual Value of Influence Factors and Differences with APBN Assumption in 2005-2016

ICP				Exchange Rate				Inflation Rate			
Period		Annual ICP	Annual ICP - APBN Assumption	Period		Annual Exchange Rate	Annual Exc.Rate - APBN Assumption	Period		Annual Interest Rate	Annual Interest Rate - APBN Assumption
2005	Jan	$ 53.44	$ 31.44	2005	Jan	Rp 9,753.97	Rp 1,153.97	2005	Jan	1.351%	0.809%
	Feb				Feb				Feb		
	Mar				Mar				Mar		
	Apr				Apr				Apr		
	May				May				May		
	Jun				Jun				Jun		
	Jul				Jul				Jul		
	Aug				Aug				Aug		
	Sep				Sep				Sep		
	Oct				Oct				Oct		
	Nov				Nov				Nov		
	Dec				Dec				Dec		
2006	Jan	$ 64.27	$ 40.27	2006	Jan	Rp 9,210.33	Rp 610.33	2006	Jan	0.534%	0.076%
	Feb				Feb				Feb		
	Mar				Mar				Mar		
	Apr				Apr				Apr		
	May				May				May		
	Jun				Jun				Jun		
	Jul				Jul				Jul		
	Aug				Aug				Aug		
	Sep				Sep				Sep		
	Oct				Oct				Oct		
	Nov				Nov				Nov		
	Dec				Dec				Dec		
2007	Jan	$ 72.31	$ 15.11	2007	Jan	Rp 9,188.71	Rp (711.29)	2007	Jan	0.534%	(0.133%)
	Feb				Feb				Feb		
	Mar				Mar				Mar		
	Apr				Apr				Apr		
	May				May				May		
	Jun				Jun				Jun		
	Jul				Jul				Jul		
	Aug				Aug				Aug		
	Sep				Sep				Sep		
	Oct				Oct				Oct		
	Nov				Nov				Nov		
	Dec				Dec				Dec		

Appendix 8 Annual Value of Influence Factors and Differences with APBN Assumption in 2005-2016 (*Continued*)

ICP				Exchange Rate				Inflation Rate			
Period		Annual ICP	Annual ICP - APBN Assumption	Period		Annual Exchange Rate	Annual Exc.Rate - APBN Assumption	Period		Annual Interest Rate	Annual Interest Rate - APBN Assumption
2008	Jan	$ 97.02	$ 34.02	2008	Jan	Rp 9,740.61	Rp 440.61	2008	Jan	0.933%	0.391%
	Feb				Feb				Feb		
	Mar				Mar				Mar		
	Apr				Apr				Apr		
	May				May				May		
	Jun				Jun				Jun		
	Jul				Jul				Jul		
	Aug				Aug				Aug		
	Sep				Sep				Sep		
	Oct				Oct				Oct		
	Nov				Nov				Nov		
	Dec				Dec				Dec		
2009	Jan	$ 61.58	$ 1.58	2009	Jan	Rp 10,459.86	Rp 1,359.86	2009	Jan	0.229%	(0.271%)
	Feb				Feb				Feb		
	Mar				Mar				Mar		
	Apr				Apr				Apr		
	May				May				May		
	Jun				Jun				Jun		
	Jul				Jul				Jul		
	Aug				Aug				Aug		
	Sep				Sep				Sep		
	Oct				Oct				Oct		
	Nov				Nov				Nov		
	Dec				Dec				Dec		
2010	Jan	$ 79.40	$ (0.60)	2010	Jan	Rp 9,132.34	Rp (267.66)	2010	Jan	0.563%	0.047%
	Feb				Feb				Feb		
	Mar				Mar				Mar		
	Apr				Apr				Apr		
	May				May				May		
	Jun				Jun				Jun		
	Jul				Jul				Jul		
	Aug				Aug				Aug		
	Sep				Sep				Sep		
	Oct				Oct				Oct		
	Nov				Nov				Nov		
	Dec				Dec				Dec		

Appendix 8 Annual Value of Influence Factors and Differences with APBN Assumption in 2005-2016 (*Continued*)

ICP				Exchange Rate				Inflation Rate			
Period		Annual ICP	Annual ICP - APBN Assumption	Period		Annual Exchange Rate	Annual Exc.Rate - APBN Assumption	Period		Annual Interest Rate	Annual Interest Rate - APBN Assumption
2011	Jan	$ 111.55	$ 51.55	2011	Jan	Rp 8,819.93	Rp (1,180.07)	2011	Jan	0.310%	(0.107%)
	Feb				Feb				Feb		
	Mar				Mar				Mar		
	Apr				Apr				Apr		
	May				May				May		
	Jun				Jun				Jun		
	Jul				Jul				Jul		
	Aug				Aug				Aug		
	Sep				Sep				Sep		
	Oct				Oct				Oct		
	Nov				Nov				Nov		
	Dec				Dec				Dec		
2012	Jan	$ 112.73	$ 32.73	2012	Jan	Rp 9,431.09	Rp 181.09	2012	Jan	0.351%	(0.091%)
	Feb				Feb				Feb		
	Mar				Mar				Mar		
	Apr				Apr				Apr		
	May				May				May		
	Jun				Jun				Jun		
	Jul				Jul				Jul		
	Aug				Aug				Aug		
	Sep				Sep				Sep		
	Oct				Oct				Oct		
	Nov				Nov				Nov		
	Dec				Dec				Dec		
2013	Jan	$ 105.84	$ 15.84	2013	Jan	Rp 10,511.43	Rp 1,711.43	2013	Jan	0.678%	0.236%
	Feb				Feb				Feb		
	Mar				Mar				Mar		
	Apr				Apr				Apr		
	May				May				May		
	Jun				Jun				Jun		
	Jul				Jul				Jul		
	Aug				Aug				Aug		
	Sep				Sep				Sep		
	Oct				Oct				Oct		
	Nov				Nov				Nov		
	Dec				Dec				Dec		

Appendix 8 Annual Value of Influence Factors and Differences with APBN Assumption in 2005-2016 (*Continued*)

ICP				Exchange Rate				Inflation Rate			
Period		Annual ICP	Annual ICP - APBN Assumption	Period		Annual Exchange Rate	Annual Exc.Rate - APBN Assumption	Period		Annual Interest Rate	Annual Interest Rate - APBN Assumption
2014	Jan	$ 96.51	$ (3.49)	2014	Jan	Rp 11,929.25	Rp 2,629.25	2014	Jan	0.673%	0.265%
	Feb				Feb				Feb		
	Mar				Mar				Mar		
	Apr				Apr				Apr		
	May				May				May		
	Jun				Jun				Jun		
	Jul				Jul				Jul		
	Aug				Aug				Aug		
	Sep				Sep				Sep		
	Oct				Oct				Oct		
	Nov				Nov				Nov		
	Dec				Dec				Dec		
2015	Jan	$ 49.75	$ (55.25)	2015	Jan	Rp 13,456.36	Rp 2,956.36	2015	Jan	0.278%	(0.181%)
	Feb				Feb				Feb		
	Mar				Mar				Mar		
	Apr				Apr				Apr		
	May				May				May		
	Jun				Jun				Jun		
	Jul				Jul				Jul		
	Aug				Aug				Aug		
	Sep				Sep				Sep		
	Oct				Oct				Oct		
	Nov				Nov				Nov		
	Dec				Dec				Dec		
2016	Jan	$ 9.13	$ (65.87)	2016	Jan	Rp 13,323.03	Rp 1,423.03	2016	Jan	0.233%	(0.134%)
	Feb				Feb				Feb		
	Mar				Mar				Mar		
	Apr				Apr				Apr		
	May				May				May		
	Jun				Jun				Jun		
	Jul				Jul				Jul		
	Aug				Aug				Aug		
	Sep				Sep				Sep		
	Oct				Oct				Oct		
	Nov				Nov				Nov		
	Dec				Dec				Dec		

Appendix 8 Annual Value of Influence Factors and Differences with APBN Assumption in 2005-2016 (*Continued*)

ICP			Exchange Rate			Inflation Rate		
Period	Annual ICP	Annual ICP - APBN Assumption	Period	Annual Exchange Rate	Annual Exc.Rate - APBN Assumption	Period	Annual Interest Rate	Annual Interest Rate - APBN Assumption
AVERAGE		$ 8.11	AVERAGE		Rp 858.91	AVERAGE		0.076%

Appendix 9 Calculation Data of Forecasting PLN Tariff 2017-2044

Period		TA	TL	TB	Annum	
2016	December	0.48%	Rp1,003.85	Rp1,008.65	IDR	USD
2017	January	0.48%	Rp1,008.65	Rp1,013.48	**Rp1,040.57**	**$0.078**
	February	0.48%	Rp1,013.48	Rp1,018.33		
	March	0.48%	Rp1,018.33	Rp1,023.20		
	April	0.48%	Rp1,023.20	Rp1,028.09		
	May	0.48%	Rp1,028.09	Rp1,033.01		
	June	0.48%	Rp1,033.01	Rp1,037.95		
	July	0.48%	Rp1,037.95	Rp1,042.92		
	August	0.48%	Rp1,042.92	Rp1,047.90		
	September	0.48%	Rp1,047.90	Rp1,052.92		
	October	0.48%	Rp1,052.92	Rp1,057.95		
	November	0.48%	Rp1,057.95	Rp1,063.01		
	December	0.48%	Rp1,063.01	Rp1,068.10		
2018	January	0.48%	Rp1,068.10	Rp1,073.21	**Rp1,101.90**	**$0.083**
	February	0.48%	Rp1,073.21	Rp1,078.34		
	March	0.48%	Rp1,078.34	Rp1,083.50		
	April	0.48%	Rp1,083.50	Rp1,088.68		
	May	0.48%	Rp1,088.68	Rp1,093.89		
	June	0.48%	Rp1,093.89	Rp1,099.13		
	July	0.48%	Rp1,099.13	Rp1,104.38		
	August	0.48%	Rp1,104.38	Rp1,109.67		
	September	0.48%	Rp1,109.67	Rp1,114.97		
	October	0.48%	Rp1,114.97	Rp1,120.31		
	November	0.48%	Rp1,120.31	Rp1,125.67		
	December	0.48%	Rp1,125.67	Rp1,131.05		
2019	January	0.48%	Rp1,131.05	Rp1,136.46	**Rp1,166.84**	**$0.088**
	February	0.48%	Rp1,136.46	Rp1,141.90		
	March	0.48%	Rp1,141.90	Rp1,147.36		
	April	0.48%	Rp1,147.36	Rp1,152.85		
	May	0.48%	Rp1,152.85	Rp1,158.36		
	June	0.48%	Rp1,158.36	Rp1,163.91		
	July	0.48%	Rp1,163.91	Rp1,169.47		
	August	0.48%	Rp1,169.47	Rp1,175.07		
	September	0.48%	Rp1,175.07	Rp1,180.69		
	October	0.48%	Rp1,180.69	Rp1,186.34		
	November	0.48%	Rp1,186.34	Rp1,192.01		
	December	0.48%	Rp1,192.01	Rp1,197.71		
2020	January	0.48%	Rp1,197.71	Rp1,203.44	**Rp1,235.62**	**$0.093**
	February	0.48%	Rp1,203.44	Rp1,209.20		
	March	0.48%	Rp1,209.20	Rp1,214.98		

Appendix 9 Calculation Data of Forecasting PLN Tariff 2017-2044 (*Continued*)

Period		TA	TL	TB	Annum	
					IDR	USD
	April	0.48%	Rp1,214.98	Rp1,220.80		
	May	0.48%	Rp1,220.80	Rp1,226.64		
	June	0.48%	Rp1,226.64	Rp1,232.50		
	July	0.48%	Rp1,232.50	Rp1,238.40		
	August	0.48%	Rp1,238.40	Rp1,244.32		
	September	0.48%	Rp1,244.32	Rp1,250.28		
	October	0.48%	Rp1,250.28	Rp1,256.26		
	November	0.48%	Rp1,256.26	Rp1,262.27		
	December	0.48%	Rp1,262.27	Rp1,268.30		
2021	January	0.48%	Rp1,268.30	Rp1,274.37	**Rp1,308.44**	**$0.098**
	February	0.48%	Rp1,274.37	Rp1,280.47		
	March	0.48%	Rp1,280.47	Rp1,286.59		
	April	0.48%	Rp1,286.59	Rp1,292.75		
	May	0.48%	Rp1,292.75	Rp1,298.93		
	June	0.48%	Rp1,298.93	Rp1,305.14		
	July	0.48%	Rp1,305.14	Rp1,311.39		
	August	0.48%	Rp1,311.39	Rp1,317.66		
	September	0.48%	Rp1,317.66	Rp1,323.96		
	October	0.48%	Rp1,323.96	Rp1,330.30		
	November	0.48%	Rp1,330.30	Rp1,336.66		
	December	0.48%	Rp1,336.66	Rp1,343.06		
2022	January	0.48%	Rp1,343.06	Rp1,349.48	**Rp1,385.56**	**$0.104**
	February	0.48%	Rp1,349.48	Rp1,355.94		
	March	0.48%	Rp1,355.94	Rp1,362.42		
	April	0.48%	Rp1,362.42	Rp1,368.94		
	May	0.48%	Rp1,368.94	Rp1,375.49		
	June	0.48%	Rp1,375.49	Rp1,382.07		
	July	0.48%	Rp1,382.07	Rp1,388.68		
	August	0.48%	Rp1,388.68	Rp1,395.32		
	September	0.48%	Rp1,395.32	Rp1,402.00		
	October	0.48%	Rp1,402.00	Rp1,408.70		
	November	0.48%	Rp1,408.70	Rp1,415.44		
	December	0.48%	Rp1,415.44	Rp1,422.21		
2023	January	0.48%	Rp1,422.21	Rp1,429.02	**Rp1,467.22**	**$0.110**
	February	0.48%	Rp1,429.02	Rp1,435.85		
	March	0.48%	Rp1,435.85	Rp1,442.72		
	April	0.48%	Rp1,442.72	Rp1,449.62		
	May	0.48%	Rp1,449.62	Rp1,456.56		
	June	0.48%	Rp1,456.56	Rp1,463.52		

Appendix 9 Calculation Data of Forecasting PLN Tariff 2017-2044 (*Continued*)

Period		TA	TL	TB	Annum	
					IDR	USD
	July	0.48%	Rp1,463.52	Rp1,470.52		
	August	0.48%	Rp1,470.52	Rp1,477.56		
	September	0.48%	Rp1,477.56	Rp1,484.63		
	October	0.48%	Rp1,484.63	Rp1,491.73		
	November	0.48%	Rp1,491.73	Rp1,498.87		
	December	0.48%	Rp1,498.87	Rp1,506.04		
2024	January	0.48%	Rp1,506.04	Rp1,513.24	**Rp1,553.69**	**$0.117**
	February	0.48%	Rp1,513.24	Rp1,520.48		
	March	0.48%	Rp1,520.48	Rp1,527.75		
	April	0.48%	Rp1,527.75	Rp1,535.06		
	May	0.48%	Rp1,535.06	Rp1,542.40		
	June	0.48%	Rp1,542.40	Rp1,549.78		
	July	0.48%	Rp1,549.78	Rp1,557.19		
	August	0.48%	Rp1,557.19	Rp1,564.64		
	September	0.48%	Rp1,564.64	Rp1,572.13		
	October	0.48%	Rp1,572.13	Rp1,579.65		
	November	0.48%	Rp1,579.65	Rp1,587.21		
	December	0.48%	Rp1,587.21	Rp1,594.80		
2025	January	0.48%	Rp1,594.80	Rp1,602.43	**Rp1,645.27**	**$0.124**
	February	0.48%	Rp1,602.43	Rp1,610.09		
	March	0.48%	Rp1,610.09	Rp1,617.79		
	April	0.48%	Rp1,617.79	Rp1,625.53		
	May	0.48%	Rp1,625.53	Rp1,633.31		
	June	0.48%	Rp1,633.31	Rp1,641.12		
	July	0.48%	Rp1,641.12	Rp1,648.97		
	August	0.48%	Rp1,648.97	Rp1,656.86		
	September	0.48%	Rp1,656.86	Rp1,664.79		
	October	0.48%	Rp1,664.79	Rp1,672.75		
	November	0.48%	Rp1,672.75	Rp1,680.75		
	December	0.48%	Rp1,680.75	Rp1,688.79		
2026	January	0.48%	Rp1,688.79	Rp1,696.87	**Rp1,742.23**	**$0.131**
	February	0.48%	Rp1,696.87	Rp1,704.99		
	March	0.48%	Rp1,704.99	Rp1,713.14		
	April	0.48%	Rp1,713.14	Rp1,721.34		
	May	0.48%	Rp1,721.34	Rp1,729.57		
	June	0.48%	Rp1,729.57	Rp1,737.85		
	July	0.48%	Rp1,737.85	Rp1,746.16		
	August	0.48%	Rp1,746.16	Rp1,754.51		
	September	0.48%	Rp1,754.51	Rp1,762.91		

Appendix 29 Calculation Data of Forecasting PLN Tariff 2017-2044 (*Continued*)

Period		TA	TL	TB	Annum	
					IDR	USD
	October	0.48%	Rp1,762.91	Rp1,771.34		
	November	0.48%	Rp1,771.34	Rp1,779.81		
	December	0.48%	Rp1,779.81	Rp1,788.33		
2027	January	0.48%	Rp1,788.33	Rp1,796.88	**Rp1,844.92**	**$0.139**
	February	0.48%	Rp1,796.88	Rp1,805.48		
	March	0.48%	Rp1,805.48	Rp1,814.11		
	April	0.48%	Rp1,814.11	Rp1,822.79		
	May	0.48%	Rp1,822.79	Rp1,831.51		
	June	0.48%	Rp1,831.51	Rp1,840.27		
	July	0.48%	Rp1,840.27	Rp1,849.07		
	August	0.48%	Rp1,849.07	Rp1,857.92		
	September	0.48%	Rp1,857.92	Rp1,866.81		
	October	0.48%	Rp1,866.81	Rp1,875.74		
	November	0.48%	Rp1,875.74	Rp1,884.71		
	December	0.48%	Rp1,884.71	Rp1,893.73		
2028	January	0.48%	Rp1,893.73	Rp1,902.79	**Rp1,953.65**	**$0.147**
	February	0.48%	Rp1,902.79	Rp1,911.89		
	March	0.48%	Rp1,911.89	Rp1,921.03		
	April	0.48%	Rp1,921.03	Rp1,930.22		
	May	0.48%	Rp1,930.22	Rp1,939.46		
	June	0.48%	Rp1,939.46	Rp1,948.73		
	July	0.48%	Rp1,948.73	Rp1,958.06		
	August	0.48%	Rp1,958.06	Rp1,967.42		
	September	0.48%	Rp1,967.42	Rp1,976.83		
	October	0.48%	Rp1,976.83	Rp1,986.29		
	November	0.48%	Rp1,986.29	Rp1,995.79		
	December	0.48%	Rp1,995.79	Rp2,005.34		
2029	January	0.48%	Rp2,005.34	Rp2,014.93	**Rp2,068.80**	**$0.156**
	February	0.48%	Rp2,014.93	Rp2,024.57		
	March	0.48%	Rp2,024.57	Rp2,034.25		
	April	0.48%	Rp2,034.25	Rp2,043.99		
	May	0.48%	Rp2,043.99	Rp2,053.76		
	June	0.48%	Rp2,053.76	Rp2,063.59		
	July	0.48%	Rp2,063.59	Rp2,073.46		
	August	0.48%	Rp2,073.46	Rp2,083.38		
	September	0.48%	Rp2,083.38	Rp2,093.34		
	October	0.48%	Rp2,093.34	Rp2,103.36		
	November	0.48%	Rp2,103.36	Rp2,113.42		
	December	0.48%	Rp2,113.42	Rp2,123.53		

Appendix 9 Calculation Data of Forecasting PLN Tariff 2017-2044 (*Continued*)

Period		TA	TL	TB	Annum	
					IDR	USD
2030	January	0.48%	Rp2,123.53	Rp2,133.69	**Rp2,190.73**	**$0.165**
	February	0.48%	Rp2,133.69	Rp2,143.89		
	March	0.48%	Rp2,143.89	Rp2,154.15		
	April	0.48%	Rp2,154.15	Rp2,164.45		
	May	0.48%	Rp2,164.45	Rp2,174.81		
	June	0.48%	Rp2,174.81	Rp2,185.21		
	July	0.48%	Rp2,185.21	Rp2,195.67		
	August	0.48%	Rp2,195.67	Rp2,206.17		
	September	0.48%	Rp2,206.17	Rp2,216.72		
	October	0.48%	Rp2,216.72	Rp2,227.33		
	November	0.48%	Rp2,227.33	Rp2,237.98		
	December	0.48%	Rp2,237.98	Rp2,248.69		
2031	January	0.48%	Rp2,248.69	Rp2,259.44	**Rp2,319.85**	**$0.174**
	February	0.48%	Rp2,259.44	Rp2,270.25		
	March	0.48%	Rp2,270.25	Rp2,281.11		
	April	0.48%	Rp2,281.11	Rp2,292.02		
	May	0.48%	Rp2,292.02	Rp2,302.99		
	June	0.48%	Rp2,302.99	Rp2,314.00		
	July	0.48%	Rp2,314.00	Rp2,325.07		
	August	0.48%	Rp2,325.07	Rp2,336.20		
	September	0.48%	Rp2,336.20	Rp2,347.37		
	October	0.48%	Rp2,347.37	Rp2,358.60		
	November	0.48%	Rp2,358.60	Rp2,369.88		
	December	0.48%	Rp2,369.88	Rp2,381.22		
2032	January	0.48%	Rp2,381.22	Rp2,392.61	**Rp2,456.57**	**$0.185**
	February	0.48%	Rp2,392.61	Rp2,404.06		
	March	0.48%	Rp2,404.06	Rp2,415.56		
	April	0.48%	Rp2,415.56	Rp2,427.11		
	May	0.48%	Rp2,427.11	Rp2,438.72		
	June	0.48%	Rp2,438.72	Rp2,450.39		
	July	0.48%	Rp2,450.39	Rp2,462.11		
	August	0.48%	Rp2,462.11	Rp2,473.89		
	September	0.48%	Rp2,473.89	Rp2,485.72		
	October	0.48%	Rp2,485.72	Rp2,497.61		
	November	0.48%	Rp2,497.61	Rp2,509.56		
	December	0.48%	Rp2,509.56	Rp2,521.56		
2033	January	0.48%	Rp2,521.56	Rp2,533.63	**Rp2,601.36**	**$0.196**
	February	0.48%	Rp2,533.63	Rp2,545.75		
	March	0.48%	Rp2,545.75	Rp2,557.92		

Appendix 9 Calculation Data of Forecasting PLN Tariff 2017-2044 (*Continued*)

Period		TA	TL	TB	Annum	
					IDR	USD
	April	0.48%	Rp2,557.92	Rp2,570.16		
	May	0.48%	Rp2,570.16	Rp2,582.45		
	June	0.48%	Rp2,582.45	Rp2,594.81		
	July	0.48%	Rp2,594.81	Rp2,607.22		
	August	0.48%	Rp2,607.22	Rp2,619.69		
	September	0.48%	Rp2,619.69	Rp2,632.22		
	October	0.48%	Rp2,632.22	Rp2,644.82		
	November	0.48%	Rp2,644.82	Rp2,657.47		
	December	0.48%	Rp2,657.47	Rp2,670.18		
2034	January	0.48%	Rp2,670.18	Rp2,682.95	**Rp2,754.68**	**$0.207**
	February	0.48%	Rp2,682.95	Rp2,695.79		
	March	0.48%	Rp2,695.79	Rp2,708.68		
	April	0.48%	Rp2,708.68	Rp2,721.64		
	May	0.48%	Rp2,721.64	Rp2,734.66		
	June	0.48%	Rp2,734.66	Rp2,747.74		
	July	0.48%	Rp2,747.74	Rp2,760.88		
	August	0.48%	Rp2,760.88	Rp2,774.09		
	September	0.48%	Rp2,774.09	Rp2,787.36		
	October	0.48%	Rp2,787.36	Rp2,800.70		
	November	0.48%	Rp2,800.70	Rp2,814.09		
	December	0.48%	Rp2,814.09	Rp2,827.55		
2035	January	0.48%	Rp2,827.55	Rp2,841.08	**Rp2,917.03**	**$0.219**
	February	0.48%	Rp2,841.08	Rp2,854.67		
	March	0.48%	Rp2,854.67	Rp2,868.33		
	April	0.48%	Rp2,868.33	Rp2,882.05		
	May	0.48%	Rp2,882.05	Rp2,895.83		
	June	0.48%	Rp2,895.83	Rp2,909.69		
	July	0.48%	Rp2,909.69	Rp2,923.61		
	August	0.48%	Rp2,923.61	Rp2,937.59		
	September	0.48%	Rp2,937.59	Rp2,951.64		
	October	0.48%	Rp2,951.64	Rp2,965.76		
	November	0.48%	Rp2,965.76	Rp2,979.95		
	December	0.48%	Rp2,979.95	Rp2,994.20		
2036	January	0.48%	Rp2,994.20	Rp3,008.53	**Rp3,088.96**	**$0.232**
	February	0.48%	Rp3,008.53	Rp3,022.92		
	March	0.48%	Rp3,022.92	Rp3,037.38		
	April	0.48%	Rp3,037.38	Rp3,051.91		
	May	0.48%	Rp3,051.91	Rp3,066.51		
	June	0.48%	Rp3,066.51	Rp3,081.18		

Appendix 9 Calculation Data of Forecasting PLN Tariff 2017-2044 (*Continued*)

Period		TA	TL	TB	Annum	
					IDR	USD
	July	0.48%	Rp3,081.18	Rp3,095.92		
	August	0.48%	Rp3,095.92	Rp3,110.73		
	September	0.48%	Rp3,110.73	Rp3,125.61		
	October	0.48%	Rp3,125.61	Rp3,140.56		
	November	0.48%	Rp3,140.56	Rp3,155.58		
	December	0.48%	Rp3,155.58	Rp3,170.68		
2037	January	0.48%	Rp3,170.68	Rp3,185.84	**Rp3,271.01**	**$0.246**
	February	0.48%	Rp3,185.84	Rp3,201.08		
	March	0.48%	Rp3,201.08	Rp3,216.40		
	April	0.48%	Rp3,216.40	Rp3,231.78		
	May	0.48%	Rp3,231.78	Rp3,247.24		
	June	0.48%	Rp3,247.24	Rp3,262.78		
	July	0.48%	Rp3,262.78	Rp3,278.38		
	August	0.48%	Rp3,278.38	Rp3,294.07		
	September	0.48%	Rp3,294.07	Rp3,309.82		
	October	0.48%	Rp3,309.82	Rp3,325.66		
	November	0.48%	Rp3,325.66	Rp3,341.57		
	December	0.48%	Rp3,341.57	Rp3,357.55		
2038	January	0.48%	Rp3,357.55	Rp3,373.61	**Rp3,463.80**	**$0.260**
	February	0.48%	Rp3,373.61	Rp3,389.75		
	March	0.48%	Rp3,389.75	Rp3,405.96		
	April	0.48%	Rp3,405.96	Rp3,422.26		
	May	0.48%	Rp3,422.26	Rp3,438.63		
	June	0.48%	Rp3,438.63	Rp3,455.08		
	July	0.48%	Rp3,455.08	Rp3,471.61		
	August	0.48%	Rp3,471.61	Rp3,488.21		
	September	0.48%	Rp3,488.21	Rp3,504.90		
	October	0.48%	Rp3,504.90	Rp3,521.66		
	November	0.48%	Rp3,521.66	Rp3,538.51		
	December	0.48%	Rp3,538.51	Rp3,555.44		
2039	January	0.48%	Rp3,555.44	Rp3,572.45	**Rp3,667.95**	**$0.276**
	February	0.48%	Rp3,572.45	Rp3,589.53		
	March	0.48%	Rp3,589.53	Rp3,606.71		
	April	0.48%	Rp3,606.71	Rp3,623.96		
	May	0.48%	Rp3,623.96	Rp3,641.29		
	June	0.48%	Rp3,641.29	Rp3,658.71		
	July	0.48%	Rp3,658.71	Rp3,676.21		
	August	0.48%	Rp3,676.21	Rp3,693.80		
	September	0.48%	Rp3,693.80	Rp3,711.47		

Appendix 9 Calculation Data of Forecasting PLN Tariff 2017-2044 (*Continued*)

Period		TA	TL	TB	Annum	
					IDR	USD
	October	0.48%	Rp3,711.47	Rp3,729.22		
	November	0.48%	Rp3,729.22	Rp3,747.06		
	December	0.48%	Rp3,747.06	Rp3,764.99		
2040	January	0.48%	Rp3,764.99	Rp3,783.00	**Rp3,884.13**	**$0.292**
	February	0.48%	Rp3,783.00	Rp3,801.09		
	March	0.48%	Rp3,801.09	Rp3,819.28		
	April	0.48%	Rp3,819.28	Rp3,837.55		
	May	0.48%	Rp3,837.55	Rp3,855.90		
	June	0.48%	Rp3,855.90	Rp3,874.35		
	July	0.48%	Rp3,874.35	Rp3,892.88		
	August	0.48%	Rp3,892.88	Rp3,911.51		
	September	0.48%	Rp3,911.51	Rp3,930.22		
	October	0.48%	Rp3,930.22	Rp3,949.02		
	November	0.48%	Rp3,949.02	Rp3,967.91		
	December	0.48%	Rp3,967.91	Rp3,986.89		
2041	January	0.48%	Rp3,986.89	Rp4,005.96	**Rp4,113.06**	**$0.309**
	February	0.48%	Rp4,005.96	Rp4,025.12		
	March	0.48%	Rp4,025.12	Rp4,044.38		
	April	0.48%	Rp4,044.38	Rp4,063.72		
	May	0.48%	Rp4,063.72	Rp4,083.16		
	June	0.48%	Rp4,083.16	Rp4,102.70		
	July	0.48%	Rp4,102.70	Rp4,122.32		
	August	0.48%	Rp4,122.32	Rp4,142.04		
	September	0.48%	Rp4,142.04	Rp4,161.86		
	October	0.48%	Rp4,161.86	Rp4,181.76		
	November	0.48%	Rp4,181.76	Rp4,201.77		
	December	0.48%	Rp4,201.77	Rp4,221.87		
2042	January	0.48%	Rp4,221.87	Rp4,242.06	**Rp4,355.47**	**$0.327**
	February	0.48%	Rp4,242.06	Rp4,262.36		
	March	0.48%	Rp4,262.36	Rp4,282.75		
	April	0.48%	Rp4,282.75	Rp4,303.23		
	May	0.48%	Rp4,303.23	Rp4,323.82		
	June	0.48%	Rp4,323.82	Rp4,344.50		
	July	0.48%	Rp4,344.50	Rp4,365.28		
	August	0.48%	Rp4,365.28	Rp4,386.17		
	September	0.48%	Rp4,386.17	Rp4,407.15		
	October	0.48%	Rp4,407.15	Rp4,428.23		
	November	0.48%	Rp4,428.23	Rp4,449.41		
	December	0.48%	Rp4,449.41	Rp4,470.70		

Appendix 9 Calculation Data of Forecasting PLN Tariff 2017-2044 (*Continued*)

Period		TA	TL	TB	Annum	
					IDR	USD
2043	January	0.48%	Rp4,470.70	Rp4,492.08	**Rp4,612.17**	**$0.347**
	February	0.48%	Rp4,492.08	Rp4,513.57		
	March	0.48%	Rp4,513.57	Rp4,535.16		
	April	0.48%	Rp4,535.16	Rp4,556.86		
	May	0.48%	Rp4,556.86	Rp4,578.65		
	June	0.48%	Rp4,578.65	Rp4,600.56		
	July	0.48%	Rp4,600.56	Rp4,622.56		
	August	0.48%	Rp4,622.56	Rp4,644.68		
	September	0.48%	Rp4,644.68	Rp4,666.90		
	October	0.48%	Rp4,666.90	Rp4,689.22		
	November	0.48%	Rp4,689.22	Rp4,711.65		
	December	0.48%	Rp4,711.65	Rp4,734.19		
2044	January	0.48%	Rp4,734.19	Rp4,756.84	**Rp4,884.01**	**$0.367**
	February	0.48%	Rp4,756.84	Rp4,779.59		
	March	0.48%	Rp4,779.59	Rp4,802.46		
	April	0.48%	Rp4,802.46	Rp4,825.43		
	May	0.48%	Rp4,825.43	Rp4,848.51		
	June	0.48%	Rp4,848.51	Rp4,871.70		
	July	0.48%	Rp4,871.70	Rp4,895.01		
	August	0.48%	Rp4,895.01	Rp4,918.43		
	September	0.48%	Rp4,918.43	Rp4,941.95		
	October	0.48%	Rp4,941.95	Rp4,965.59		
	November	0.48%	Rp4,965.59	Rp4,989.35		
	December	0.48%	Rp4,989.35	Rp5,013.21		

Appendix 10 Financial Calculation of Smelter Company for Power Supply Matter for 25 years (2020-2044) (Source Option: PLN)

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025
Electricity Cost									
per kWh				$ 0.093	$ 0.098	$ 0.104	$ 0.110	$ 0.117	$ 0.124
Total Cost				$ (101,938,297.78)	$ (106,800,142.82)	$ (111,880,980.90)	$ (117,189,737.49)	$ (122,735,629.50)	$ (128,528,168.51)
Net Loss	**$ -**	**$ -**	**$ -**	**$ (101,938,297.78)**	**$(106,800,142.82)**	**$ (111,880,980.90)**	**$ (117,189,737.49)**	**$ (122,735,629.50)**	**$ (128,528,168.51)**

Appendix 10 Financial Calculation of Smelter Company for Power Supply Matter for 25 years (2020-2044) (Source Option: PLN)(*Continued*)

Year	2026	2027	2028	2029	2030	2031	2032
Electricity Cost							
per kWh	$0.131	$0.139	$0.147	$0.152	$0.165	$0.174	$0.185
Total Cost	$(134,577,163.60)	$(140,892,723.32)	$(147,485,256.91)	$(150,873,552.00)	$(161,544,387.26)	$(169,033,303.89)	$(176,843,829.31)
Net Loss	**$(134,577,163.60)**	**$(140,892,723.32)**	**$(147,485,256.91)**	**$(150,873,552.00)**	**$(161,544,387.26)**	**$(169,033,303.89)**	**$(176,843,829.31)**

Appendix 22 Financial Calculation of Smelter Company for Power Supply Matter for 25 years (2020-2044) (Source Option: PLN)(*Continued*)

Year	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
Electricity Cost							
per kWh	$0.196	$0.207	$0.219	$0.232	$0.246	$0.260	$0.276
Total Cost	$(184,987,859.30)	$(193,477,574.74)	$(202,325,433.83)	$(211,544,162.48)	$(221,146,742.61)	$(231,146,398.13)	$(241,556,578.31)
Net Loss	**$(184,987,859.30)**	**$(193,477,574.74)**	**$(202,325,433.83)**	**$(211,544,162.48)**	**$(221,146,742.61)**	**$(231,146,398.13)**	**$(241,556,578.31)**

Appendix 10 Financial Calculation of Smelter Company for Power Supply Matter for 25 years (2020-2044) (Source Option: PLN)(*Continued*)

Year	**2040**	**2041**	**2042**	**2043**	**2044**
Electricity Cost					
per kWh	$0.292	$0.309	$0.327	$0.347	$0.367
Total Cost	$(252,390,938.50)	$(263,663,317.62)	$(275,387,712.39)	$(287,578,247.90)	$(300,249,144.07)
Net Loss	**$(252,390,938.50)**	**$(263,663,317.62)**	**$(275,387,712.39)**	**$(287,578,247.90)**	**$(300,249,144.07)**

NPV	***($1,331,342,799.49)***

Appendix 11 Source of Fund for Power Plant Project

Description	Percentage	2017	2018	2019	Total
Source of Investment Fund					
Equity	15.5%	$23,049,467	$24,048,400	$20,947,334	$68,045,201
Bank Loan	12.7%	$11,160,000	$22,320,000	$22,320,000	$55,800,000
ECA Loan	71.9%	$63,240,000	$126,480,000	$126,480,000	$316,200,000
Total Investment	**100%**	**$97,449,467**	**$172,848,400**	**$169,747,334**	**$440,045,201**
Financing Cost (IDC)					
Equity	100.0%	$1,550,533	$4,651,600	$7,752,666	$13,954,799
Bank Loan	0.0%	$0	$0	$0	$0
ECA Loan	0.0%	$0	$0	$0	$0
Total IDC	**100%**	**$1,550,533**	**$4,651,600**	**$7,752,666**	**$13,954,799**
Source of Investment and Financing Cost					
Equity	18.1%	$24,600,000	$28,700,000	$28,700,000	$82,000,000
Bank Loan	12.3%	$11,160,000	$22,320,000	$22,320,000	$55,800,000
ECA Loan	69.6%	$63,240,000	$126,480,000	$126,480,000	$316,200,000
Total Investment and IDC Fund	**100.0%**	**$99,000,000**	**$177,500,000**	**$177,500,000**	**$454,000,000**

Appendix 12 Project Financing Plan of Power Plant

Year	2017	2018	2019
Total Investment	$99,000,000	$177,500,000	$177,500,000
Liabilities			
ECA Loan	$63,240,000	$126,480,000	$126,480,000
Loan	$11,160,000	$22,320,000	$22,320,000
Total Liabilities	$74,400,000	$148,800,000	$148,800,000
Cummulative Liabilities	$74,400,000	$223,200,000	$372,000,000
Equity			
Working Capital	$22,449,466.80	$23,348,400.40	$20,247,334.00
Permit	$600,000.00	$700,000.00	$700,000.00
IDC	$1,550,533.20	$4,651,599.60	$7,752,666.00
Total Equity	$24,600,000	$28,700,000	$28,700,000

Appendix 13 Repayment Plan of Power Plant

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Principal ECA Payment	$0	$0	$0	$26,350,000	$26,350,000	$26,350,000	$26,350,000	$26,350,000	$26,350,000	$26,350,000	$26,350,000
Principal Loan Payment	$0	$0	$0	$7,971,429	$7,971,429	$7,971,429	$7,971,429	$7,971,429	$7,971,429	$7,971,429	$0
Total Principal Payment	$0	$0	$0	$34,321,429	$34,321,429	$34,321,429	$34,321,429	$34,321,429	$34,321,429	$34,321,429	$26,350,000
Interest ECA Payment	$994,765	$2,984,296	$4,973,826	$5,036,417	$5,037,401	$4,622,931	$4,201,926	$3,780,818	$3,359,709	$2,938,599	$2,517,490
Interest Loan Payment	$555,768	$1,667,304	$2,778,840	$2,778,840	$2,381,863	$1,984,886	$1,587,909	$1,190,931	$793,954	$396,977	$0
Interest Payment	$1,550,533	$4,651,600	$7,752,666	$7,815,257	$7,419,264	$6,607,817	$5,789,835	$4,971,750	$4,153,663	$3,335,576	$2,517,490
Total Payment	$1,550,533	$4,651,600	$7,752,666	$42,136,685	$41,740,693	$40,929,245	$40,111,263	$39,293,178	$38,475,091	$37,657,005	$28,867,490

Appendix 13 Repayment Plan of Power Plant (*Continued*)

Year	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Principal ECA Payment	$26,350,000	$26,350,000	$26,350,000	$26,350,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Principal Loan Payment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Principal Payment	$26,350,000	$26,350,000	$26,350,000	$26,350,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest ECA Payment	$2,096,380	$1,675,270	$1,254,161	$833,051	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest Loan Payment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest Payment	$2,096,380	$1,675,270	$1,254,161	$833,051	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Payment	$28,446,380	$28,025,270	$27,604,161	$27,183,051	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Appendix 14 List of Cost / Expenses for Generating Power

FIXED COST OF OPERATIONS and MAINTENANCE

Personnel Cost				
	Number	Standard Salary / Month	Annual Salary (include compensation)	
Management				
Director	3	$6,000	$84,000	$252,000
Commisioner	3	$6,000	$84,000	$252,000
General Manager	4	$4,000	$56,000	$224,000
Senior Manager	5	$3,000	$42,000	$210,000
Manager	8	$2,500	$35,000	$280,000
Supervisor	8	$1,500	$21,000	$168,000
Administrative Staff	8	$600	$8,400	$67,200
Operation				
Operator	24	$600	$8,400	$201,600
Supporting Staff	40	$500	$7,000	$280,000
Technician	18	$500	$7,000	$126,000
Security	40	$350	$4,900	$196,000
Total	161			$2,256,800

Maintenance	=	4%	(from total Investment)
Others	=	7%	(the other Operation Cost)

Personnel Cost	=	$	2,256,800
Maintenance Cost	=	$	18,160,000.00
Others	=	$	1,429,176
Total	=	$	21,845,976

FUEL COST

Consumption Rate			
1 MWh el	=	7.053074205	mmBtu
		2.083	MWh th
1 MWh th	=	3.412	mmBtu
1 mmBtu	=	$2.752	
1 MWh th	=	$9.39	

Heating Steam needs LNG			
1 MWh	=	0.05652	mmBtu
1 mmBtu	=	$7.50	

Appendix 14 List of Cost / Expenses for Generating Power (*Continued*)

VARIABLE COST OF OPERATIONS and MAINTENANCE

Description		Consumption		Cost / m^3	
Water Softened	=	0.024	m^3/ MWh el	$	2.0
Industrial Water	=	4.15	m^3/ MWh el	$	0.5

Appendix 15 Calculation Recapitulation of Synthesis Gas Price

COMPONENT A / CAPITAL COST

d	=	4%	
i	=	6.93%	
Period	=	25	Years
Power Generated	=	283.0	MW el
Installed Capacity	=	283,000.0	kW el
Capital Recovery Factor (CRF)	=	0.1093	
Time (hour in 1 year)	=	8250	hours
Nett Power Generated / annum	=	1,097,250	MWh el
Time (hour in 1 year)	=	1,097,250,000	kWh el
Total Investment	=	$ 454,000,000	
Construction Cost	=	$1,604.24	/kW

CRF	=	10.93%
Interest Rate Factor (fs)	=	9.31%
Depreciation Factor (fd)	=	2.40%

Total Investment		
IGCC Unit	=	$ 68,400,000
Construction	=	$ 03,600,000
Permit	=	$ 2,000,000
Working Capital	=	$ 80,000,000
Total	=	454,000,000

Description		Amount	Value	Percentage
Risk Free		Indonesian Government Bond		
RI0144	=	6.75%	$ 82,000,000	18.1%
ECA	=	1.57%	$ 316,200,000	69.6%
Loan	=	4.98%	$ 55,800,000	12.3%
WACC	=	2.93%		
Expected Profit	=	4%		
MARR	=	6.93%		

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Power Generated	100%	99%	98%	97%	96%	95%	94%	93%	92%	91%	90%	89%	88%	87%	86%
	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283
Availability	94.2%	93.2%	92.2%	91.2%	90.2%	89.2%	88.2%	87.2%	86.2%	85.2%	84.2%	83.2%	82.2%	81.2%	80.2%
Working Hours	8250	8162.4	8074.8	7987.2	7899.6	7812	7724.4	7636.8	7549.2	7461.6	7374	7286.4	7198.8	7111.2	7023.6
Capital Cost	$0.0212	$0.0215	$0.0217	$0.0219	$0.0222	$0.0224	$0.0227	$0.0230	$0.0232	$0.0235	$0.0238	$0.0241	$0.0243	$0.0246	$0.0250
Smelter (MW)	133	133	133	133	133	133	133	133	133	133	133	133	133	133	133
PLN (MW)	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150

Appendix 15 Calculation Recapitulation of Synthesis Gas Price (*Continued*)

Year	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Power Generated	85%	84%	83%	82%	81%	80%	79%	78%	77%	76%
	283	283	283	283	283	283	283	283	283	283
Availability	79.2%	78.2%	77.2%	76.2%	75.2%	74.2%	73.2%	72.2%	71.2%	70.2%
Working Hours	6936	6848.4	6760.8	6673.2	6585.6	6498	6410.4	6322.8	6235.2	6147.6
Capital Cost	$0.0253	$0.0256	$0.0259	$0.0263	$0.0266	$0.0270	$0.0273	$0.0277	$0.0281	$0.0285
Smelter (MW)	133	133	133	133	133	133	133	133	133	133
PLN (MW)	150	150	150	150	150	150	150	150	150	150

Appendix 15 Calculation Recapitulation of Synthesis Gas Price (*Continued*)

FIXED COST OF OPERATIONS and MAINTENANCE / COMPONENT B

Personnel Cost				
	Number	Standard Salary / Month	Annual Salary (include compensation)	
Management				
Director	3	$6,000	$84,000	$252,000
Commisioner	3	$6,000	$84,000	$252,000
General Manager	4	$4,000	$56,000	$224,000
Senior Manager	5	$3,000	$42,000	$210,000
Manager	8	$2,500	$35,000	$280,000
Supervisor	8	$1,500	$21,000	$168,000
Administrative Staff	8	$600	$8,400	$67,200
Operation				
Operator	24	$600	$8,400	$201,600
Supporting Staff	40	$500	$7,000	$280,000
Technician	18	$500	$7,000	$126,000
Security	40	$350	$4,900	$196,000
Total	161			$2,256,800

Maintenance	=	4%	(from total Investment)
Others	=	7%	(the other Operation Cost)

Personnel Cost	=	$	2,256,800
Maintenance Cost	=	$	18,160,000.00
Others	=	$	1,429,176
Total	=	$	21,845,976

Appendix 15 Calculation Recapitulation of Synthesis Gas Price (*Continued*)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028
Fixed Cost for OandM	$21,845,976	$22,173,666	$22,506,271	$22,843,865	$23,186,523	$23,534,320	$23,887,335	$24,245,645	$24,609,330
	$0.0094	$0.0096	$0.0098	$0.0101	$0.0104	$0.0106	$0.0109	$0.0112	$0.0115

Appendix 15 Calculation Recapitulation of Synthesis Gas Price (*Continued*)

Year	2029	2030	2031	2032	2033	2034	2035	2036	2037
Fixed Cost for OandM	$24,978,470	$25,353,147	$25,733,444	$26,119,446	$26,511,238	$26,908,906	$27,312,540	$27,722,228	$28,138,061
	$0.0118	$0.0121	$0.0125	$0.0128	$0.0132	$0.0135	$0.0139	$0.0143	$0.0147

Appendix 15 Calculation Recapitulation of Synthesis Gas Price (*Continued*)

Year	2038	2039	2040	2041	2042	2043	2044
Fixed Cost for OandM	$28,560,132	$28,988,534	$29,423,362	$29,864,713	$30,312,683	$30,767,374	$31,228,884
	$0.0151	$0.0156	$0.0160	$0.0165	$0.0169	$0.0174	$0.0179

Appendix 15 Calculation Recapitulation of Synthesis Gas Price (*Continued*)

FUEL COST

Consumption Rate			
1 MWh el	=	7.053074205	mmBtu
		2.083	MWh th
1 MWh th	=	3.412	mmBtu
1 mmBtu	=	$2.752	
1 MWh th	=	$9.39	

Heating Steam needs LNG			
1 MWh	=	0.05652	mmBtu
1 mmBtu	=	$7.50	

Appendix 15 Calculation Recapitulation of Synthesis Gas Price (*Continued*)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Gas Price	$2.75	$2.79	$2.84	$2.88	$2.92	$2.97	$3.01	$3.05	$3.10	$3.15	$3.19	$3.24
LNG Price	$7.50	$7.61	$7.73	$7.84	$7.96	$8.08	$8.20	$8.32	$8.45	$8.58	$8.70	$8.83
Gas Supply	16,479,107	16,304,129	16,129,151	15,954,173	15,779,194	15,604,216	15,429,238	15,254,260	15,079,282	14,904,304	14,729,325	14,554,347
Fuel Cost	$0.0199	$0.0201	$0.0205	$0.0208	$0.0211	$0.0214	$0.0217	$0.0220	$0.0224	$0.0227	$0.0230	$0.0234

Appendix 15 Calculation Recapitulation of Synthesis Gas Price (*Continued*)

Year	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Gas Price	$3.29	$3.34	$3.39	$3.44	$3.49	$3.55	$3.60	$3.65	$3.71	$3.76	$3.82	$3.88	$3.93
LNG Price	$8.97	$9.10	$9.24	$9.38	$9.52	$9.66	$9.81	$9.95	$10.10	$10.25	$10.41	$10.56	$10.72
Gas Supply	14,379,369	14,204,391	14,029,413	13,854,435	13,679,457	13,504,478	13,329,500	13,154,522	12,979,544	12,804,566	12,629,588	12,454,609	12,279,631
Fuel Cost	$0.0237	$0.0241	$0.0245	$0.0248	$0.0252	$0.0256	$0.0260	$0.0263	$0.0267	$0.0271	$0.0275	$0.0280	$0.0284

Appendix 15 Calculation Recapitulation of Synthesis Gas Price (*Continued*)

VARIABLE COST OF OPERATIONS and MAINTENANCE

Description		Consumption		Cost / m^3	
Water Softened	=	0.024	m^3/ MWh el	$	2.0
Industrial Water	=	4.15	m^3/ MWh el	$	0.5

Appendix 15 Calculation Recapitulation of Synthesis Gas Price (*Continued*)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Water Consumption Cost	$2.123	$2.155	$2.187	$2.220	$2.253	$2.287	$2.321	$2.356	$2.392	$2.427	$2.464	$2.501	$2.538	$2.576
Variable Cost for OandM	$0.00212	$0.00215	$0.00219	$0.00222	$0.00225	$0.00229	$0.00232	$0.00236	$0.00239	$0.00243	$0.00246	$0.00250	$0.00254	$0.00258

Appendix 15 Calculation Recapitulation of Synthesis Gas Price (*Continued*)

Year	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Water Consumption Cost	$2.615	$2.654	$2.694	$2.734	$2.775	$2.817	$2.859	$2.902	$2.946	$2.990	$3.035
Variable Cost for OandM	$0.00262	$0.00265	$0.00269	$0.00273	$0.00278	$0.00282	$0.00286	$0.00290	$0.00295	$0.00299	$0.00303

Appendix 16 Projection of Electricity Supply and Demand in Lampung Province (2015-2025)

Power Data Recapitulation in Lampung					
Year	Peak Load (MW)	Installed Power (MW)	Additional Power (MW)	Total Power (MW)	Surplus / (Shortage)
2015	854	593.5	-	593.5	(260.5)
2016	893	593.5	200	793.5	(99.5)
2017	972	593.5	110	903.5	(68.5)
2018	1059	593.5	56	959.5	(99.5)
2019	1153	593.5	27	986.5	(166.5)
2020	1257	593.5	-	986.5	(270.5)
2021	1370	593.5	200	1186.5	(183.5)
2022	1493	593.5	15	1201.5	(291.5)
2023	1628	593.5	275	1476.5	(151.5)
2024	1776	593.5		1476.5	(299.5)
2025	1937	593.5	252	1728.5	(208.5)

Power Plant Development Planning				
COD	Amount	Type	Developer	Status
2016	100	Gas-Fired Power Plant	Private Entity	Construction
2016	100	Coal-Fired Power Plant	PLN	Construction
2017	110	Geothermal Power Plant	Private Entity	Construction
2018	56	Hydro Power Plant	Private Entity	Construction
2019	27	Hydro Power Plant	Private Entity	Planning
2021	200	Combined Cycle Power Plant	PLN	Planning
2022	15	Waste Power Plant	Private Entity	Planning
2023	220	Geothermal Power Plant	Private Entity	Commited
2023	55	Geothermal Power Plant	Private Entity	Commited
2025	220	Geothermal Power Plant	Private Entity	Commited
2025	32	Hydro Power Plant	Private Entity	Planning

Source: RUPTL PLN 2016-2025, 2016

Appendix 17 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 1

COMPONENT A / CAPITAL COST

d	=	4%	
i	=	6.93%	
Period	=	25	Years
Power Generated	=	283.0	MW el
Installed Capacity	=	283,000.0	kW el
Capital Recovery Factor (CRF)	=	0.1093	
Time (hour in 1 year)	=	8250	hours
Nett Power Generated / annum	=	1,097,250	MWh el
Time (hour in 1 year)	=	1,097,250,000	kWh el
Total Investment	=	$ 454,000,000	
Construction Cost	=	$1,604.24	/kW

CRF	=	10.93%
Interest Rate Factor (fs)	=	8.53%
Depreciation Factor (fd)	=	2.40%

Total Investment		
IGCC Unit	=	$ 68,400,000
Construction	=	$ 03,600,000
Permit	=	$ 2,000,000
Working Capital	=	$ 80,000,000
Total	=	454,000,000

Description		Amount	Value	Percentage
Risk Free		Indonesian Government Bond		
RI0144	=	6.75%	$ 82,000,000	18.1%
ECA	=	1.57%	$ 316,200,000	69.6%
Loan	=	4.98%	$ 55,800,000	12.3%
WACC	=	2.93%		
Expected Profit	=	4%		
MARR	=	6.93%		

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Power Generated	100%	99%	98%	97%	96%	95%	94%	93%	92%	91%	90%	89%	88%	87%	86%
	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283
Availability	94.2%	93.2%	92.2%	91.2%	90.2%	89.2%	88.2%	87.2%	86.2%	85.2%	84.2%	83.2%	82.2%	81.2%	80.2%
Working Hours	8250	8162.4	8074.8	7987.2	7899.6	7812	7724.4	7636.8	7549.2	7461.6	7374	7286.4	7198.8	7111.2	7023.6
Capital Cost	$0.0212	$0.0215	$0.0217	$0.0219	$0.0222	$0.0224	$0.0227	$0.0230	$0.0232	$0.0235	$0.0238	$0.0241	$0.0243	$0.0246	$0.0250
Smelter (MW)	133	133	133	133	133	133	133	133	133	133	133	133	133	133	133
PLN (MW)	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150

Appendix 17 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 1 (*Continued*)

Year	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Power Generated	85%	84%	83%	82%	81%	80%	79%	78%	77%	76%
	283	283	283	283	283	283	283	283	283	283
Availability	79.2%	78.2%	77.2%	76.2%	75.2%	74.2%	73.2%	72.2%	71.2%	70.2%
Working Hours	6936	6848.4	6760.8	6673.2	6585.6	6498	6410.4	6322.8	6235.2	6147.6
Capital Cost	$0.0253	$0.0256	$0.0259	$0.0263	$0.0266	$0.0270	$0.0273	$0.0277	$0.0281	$0.0285
Smelter (MW)	133	133	133	133	133	133	133	133	133	133
PLN (MW)	150	150	150	150	150	150	150	150	150	150

Appendix 17 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 1 (*Continued*)

FIXED COST OF OPERATIONS and MAINTENANCE / COMPONENT B

Personnel Cost				
	Number	Standard Salary / Month	Annual Salary (include compensation)	
Management				
Director	3	$6,000	$84,000	$252,000
Commisioner	3	$6,000	$84,000	$252,000
General Manager	4	$4,000	$56,000	$224,000
Senior Manager	5	$3,000	$42,000	$210,000
Manager	8	$2,500	$35,000	$280,000
Supervisor	8	$1,500	$21,000	$168,000
Administrative Staff	8	$600	$8,400	$67,200
Operation				
Operator	24	$600	$8,400	$201,600
Supporting Staff	40	$500	$7,000	$280,000
Technician	18	$500	$7,000	$126,000
Security	40	$350	$4,900	$196,000
Total	161			$2,256,800

Maintenance	=	4%	(from total Investment)
Others	=	7%	(the other Operation Cost)

Personnel Cost	=	$	2,256,800
Maintenance Cost	=	$	18,160,000.00
Others	=	$	1,429,176
Total	=	$	21,845,976

Appendix 17 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 1 (*Continued*)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028
Fixed Cost for OandM	$21,845,976	$22,173,666	$22,506,271	$22,843,865	$23,186,523	$23,534,320	$23,887,335	$24,245,645	$24,609,330
	$0.0094	$0.0096	$0.0098	$0.0101	$0.0104	$0.0106	$0.0109	$0.0112	$0.0115

Appendix 17 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 1 (*Continued*)

Year	2029	2030	2031	2032	2033	2034	2035	2036	2037
Fixed Cost for OandM	$24,978,470	$25,353,147	$25,733,444	$26,119,446	$26,511,238	$26,908,906	$27,312,540	$27,722,228	$28,138,061
	$0.0118	$0.0121	$0.0125	$0.0128	$0.0132	$0.0135	$0.0139	$0.0143	$0.0147

Appendix 17 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 1 (*Continued*)

Year	2038	2039	2040	2041	2042	2043	2044
Fixed Cost for OandM	$28,560,132	$28,988,534	$29,423,362	$29,864,713	$30,312,683	$30,767,374	$31,228,884
	$0.0151	$0.0156	$0.0160	$0.0165	$0.0169	$0.0174	$0.0179

Appendix 17 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 1 (*Continued*)

FUEL COST

Consumption Rate			
1 MWh el	=	7.053074205	mmBtu
		2.083	MWh th
1 MWh th	=	3.412	mmBtu
1 mmBtu	=	$2.752	
1 MWh th	=	$9.39	

Heating Steam needs LNG			
1 MWh	=	0.05652	mmBtu
1 mmBtu	=	$7.50	

Appendix 17 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 1 (*Continued*)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Gas Price	$2.75	$2.79	$2.84	$2.88	$2.92	$2.97	$3.01	$3.05	$3.10	$3.15	$3.19	$3.24
LNG Price	$7.50	$7.61	$7.73	$7.84	$7.96	$8.08	$8.20	$8.32	$8.45	$8.58	$8.70	$8.83
Gas Supply	16,479,107	16,304,129	16,129,151	15,954,173	15,779,194	15,604,216	15,429,238	15,254,260	15,079,282	14,904,304	14,729,325	14,554,347
Fuel Cost	$0.0199	$0.0201	$0.0205	$0.0208	$0.0211	$0.0214	$0.0217	$0.0220	$0.0224	$0.0227	$0.0230	$0.0234

Appendix 17 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 1 (*Continued*)

Year	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Gas Price	$3.29	$3.34	$3.39	$3.44	$3.49	$3.55	$3.60	$3.65	$3.71	$3.76	$3.82	$3.88	$3.93
LNG Price	$8.97	$9.10	$9.24	$9.38	$9.52	$9.66	$9.81	$9.95	$10.10	$10.25	$10.41	$10.56	$10.72
Gas Supply	14,379,369	14,204,391	14,029,413	13,854,435	13,679,457	13,504,478	13,329,500	13,154,522	12,979,544	12,804,566	12,629,588	12,454,609	12,279,631
Fuel Cost	$0.0237	$0.0241	$0.0245	$0.0248	$0.0252	$0.0256	$0.0260	$0.0263	$0.0267	$0.0271	$0.0275	$0.0280	$0.0284

Appendix 17 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 1 (*Continued*)

VARIABLE COST OF OPERATIONS and MAINTENANCE

Description		Consumption		Cost / m^3	
Water Softened	=	0.024	m^3/ MWh el	$	2.0
Industrial Water	=	4.15	m^3/ MWh el	$	0.5

Appendix 17 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 1 (*Continued*)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Water Consumption Cost	$2.123	$2.155	$2.187	$2.220	$2.253	$2.287	$2.321	$2.356	$2.392	$2.427	$2.464	$2.501	$2.538	$2.576
Variable Cost for OandM	$0.00212	$0.00215	$0.00219	$0.00222	$0.00225	$0.00229	$0.00232	$0.00236	$0.00239	$0.00243	$0.00246	$0.00250	$0.00254	$0.00258

Appendix 17 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 1 (*Continued*)

Year	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Water Consumption Cost	$2.615	$2.654	$2.694	$2.734	$2.775	$2.817	$2.859	$2.902	$2.946	$2.990	$3.035
Variable Cost for OandM	$0.00262	$0.00265	$0.00269	$0.00273	$0.00278	$0.00282	$0.00286	$0.00290	$0.00295	$0.00299	$0.00303

Appendix 18 Financial Calculation of Smelter Company in Scenario 1

Year	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Electricity Cost									
per kWh				$0.053	$0.053	$0.054	$0.055	$0.056	$0.057
Required Electricity				1,097,250,000	1,085,599,200	1,073,948,400	1,062,297,600	1,050,646,800	1,038,996,000
Electricity Cost				$57,689,000	$57,944,810	$58,200,560	$58,456,190	$58,711,639	$58,966,844
Total Cost				($57,689,000)	($57,944,810)	($58,200,560)	($58,456,190)	($58,711,639)	($58,966,844)
Synthesis Gas									
Per mmBtu				$2.752	$2.794	$2.836	$2.878	$2.921	$2.965
Total Revenue				$45,356,580	$45,548,100	$45,735,161	$45,917,585	$46,095,191	$46,267,794
Net Profit	**$0**	**$0**	**$0**	**($12,332,420)**	**($12,396,710)**	**($12,465,399)**	**($12,538,605)**	**($12,616,448)**	**($12,699,049)**

Appendix 18 Financial Calculation of Smelter Company in Scenario 1 (*Continued*)

Year	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Electricity Cost							
per kWh	$0.058	$0.059	$0.059	$0.060	$0.061	$0.062	$0.063
Required Electricity	1,027,345,200	1,015,694,400	1,004,043,600	992,392,800	980,742,000	969,091,200	957,440,400
Electricity Cost	$59,221,740	$59,476,260	$59,730,336	$59,983,898	$60,236,872	$60,489,184	$60,740,757
Total Cost	($59,221,740)	($59,476,260)	($59,730,336)	($59,983,898)	($60,236,872)	($60,489,184)	($60,740,757)
Synthesis Gas							
Per mmBtu	$3.010	$3.055	$3.101	$3.147	$3.194	$3.242	$3.291
Total Revenue	$46,435,204	$46,597,226	$46,753,661	$46,904,304	$47,048,947	$47,187,376	$47,319,371
Net Profit	**($12,786,535)**	**($12,879,034)**	**($12,976,676)**	**($13,079,594)**	**($13,187,925)**	**($13,301,808)**	**($13,421,385)**

Appendix 18 Financial Calculation of Smelter Company in Scenario 1 (*Continued*)

Year	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
Electricity Cost							
per kWh	$0.064	$0.066	$0.067	$0.068	$0.069	$0.070	$0.071
Required Electricity	945,789,600	934,138,800	922,488,000	910,837,200	899,186,400	887,535,600	875,884,800
Electricity Cost	$60,991,512	$61,241,369	$61,490,243	$61,738,049	$61,984,699	$62,230,103	$62,474,168
Total Cost	($60,991,512)	($61,241,369)	($61,490,243)	($61,738,049)	($61,984,699)	($62,230,103)	($62,474,168)
Synthesis Gas							
Per mmBtu	$3.340	$3.390	$3.441	$3.493	$3.545	$3.598	$3.652
Total Revenue	$47,444,710	$47,563,161	$47,674,491	$47,778,460	$47,874,820	$47,963,322	$48,043,706
Net Profit	**($13,546,803)**	**($13,678,207)**	**($13,815,751)**	**($13,959,589)**	**($14,109,879)**	**($14,266,781)**	**($14,430,461)**

Appendix 18 Financial Calculation of Smelter Company in Scenario 1 (*Continued*)

Year	**2040**	**2041**	**2042**	**2043**	**2044**
Electricity Cost					
per kWh	$0.073	$0.074	$0.075	$0.076	$0.078
Required Electricity	864,234,000	852,583,200	840,932,400	829,281,600	817,630,800
Electricity Cost	$62,716,797	$62,957,894	$63,197,358	$63,435,085	$63,670,970
Total Cost	($62,716,797)	($62,957,894)	($63,197,358)	($63,435,085)	($63,670,970)
Synthesis Gas					
Per mmBtu	$3.707	$3.763	$3.819	$3.876	$3.935
Total Revenue	$48,115,711	$48,179,065	$48,233,494	$48,278,716	$48,314,442
Net Profit	**($14,601,087)**	**($14,778,829)**	**($14,963,864)**	**($15,156,369)**	**($15,356,528)**

NPV	***($126,388,447.87)***

Appendix 19 Free Cash Flow Report of Power Plant in Scenario 1

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Net Profit	$0	$0	$0	$20,180,695	$20,853,469	$21,845,502	$22,850,343	$23,863,415	$24,884,898	$25,915,060
Depreciation	$0	$0	$0	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000
Interest (1-Tax)	$1,162,899.90	$3,488,699.70	$5,814,499.50	$5,861,442.47	$5,564,448.03	$4,955,862.66	$4,342,375.97	$3,728,812.18	$3,115,247.17	$2,501,682.15
Investment Cost and CAPEX	($74,400,000)	($148,800,000)	($148,800,000)	$0	$0	$0	$0	$0	$0	$0
Total Flow	($73,237,100)	($145,311,300)	($142,985,501)	$40,922,138	$41,297,917	$41,681,365	$42,072,719	$42,472,227	$42,880,145	$43,296,742

Appendix 19 Free Cash Flow Report of Power Plant in Scenario 1 (*Continued*)

Year	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Net Profit	$26,954,182	$27,704,821	$28,465,017	$29,235,088	$30,015,366	$31,115,157	$31,601,078	$32,098,300	$32,607,221	$33,128,259
Depreciation	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000
Interest (1-Tax)	$1,888,117.13	$1,572,284.97	$1,256,452.80	$940,620.64	$624,788.47	$0.00	$0.00	$0.00	$0.00	$0.00
Investment Cost and CAPEX	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Flow	$43,722,299	$44,157,106	$44,601,470	$45,055,709	$45,520,155	$45,995,157	$46,481,078	$46,978,300	$47,487,221	$48,008,259

Appendix 19 Free Cash Flow Report of Power Plant in Scenario 1 (*Continued*)

Year	2037	2038	2039	2040	2041	2042	2043	2044
Net Profit	$33,661,853	$34,208,461	$34,768,565	$35,342,672	$35,931,314	$36,535,048	$37,154,465	$37,790,181
Depreciation	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000
Interest (1-Tax)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Investment Cost and CAPEX	$0	$0	$0	$0	$0	$0	$0	$0
Total Flow	$48,541,853	$49,088,461	$49,648,565	$50,222,672	$50,811,314	$51,415,048	$52,034,465	$52,670,181

NPV	**$319,418,721.91**
IRR	**9.4%**

Appendix 20 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 2

COMPONENT A / CAPITAL COST

d	=	4%	
i	=	6.93%	
Period	=	25	Years
Power Generated	=	233	MW el
Installed Capacity	=	233,000	kW el
Capital Recovery Factor (CRF)	=	0.1093	
Time (hour in 1 year)	=	8250	hours
Nett Power Generated / annum	=	1,097,250	MWh el
Time (hour in 1 year)	=	1,097,250,000	kWh el
Total Investment	=	$ 454,000,000	
Construction Cost	=	$1,948.50	/kW

CRF	=	10.93%
Interest Rate Factor (fs)	=	8.53%
Depreciation Factor (fd)	=	2.40%

Total Investment		
IGCC Unit	=	$268,400,000
Construction	=	$103,600,000
Permit	=	$ 2,000,000
Working Capital	=	$ 80,000,000
Total	=	$454,000,000

Description		Amount		
Risk Free		Indonesian Government Bond	Value	Percentage
RI0144	=	6.75%	$ 82,000,000	18.1%
ECA	=	1.57%	$ 316,200,000	69.6%
Loan	=	4.98%	$ 55,800,000	12.3%
WACC	=	2.93%		
Expected Profit	=	4%		
MARR	=	6.93%		

Appendix 20 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 2 (*Continued*)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Power Generated	100%	99%	98%	97%	96%	95%	94%	93%	92%	91%	90%	89%	88%	87%	86%
	233	233	233	233	233	233	233	233	233	233	233	233	233	233	233
Availability	94.2%	93.2%	92.2%	91.2%	90.2%	89.2%	88.2%	87.2%	86.2%	85.2%	84.2%	83.2%	82.2%	81.2%	80.2%
Working Hours	8250	8162.4	8074.8	7987.2	7899.6	7812	7724.4	7636.8	7549.2	7461.6	7374	7286.4	7198.8	7111.2	7023.6
Capital Cost	$0.0258	$0.0261	$0.0264	$0.0267	$0.0269	$0.0273	$0.0276	$0.0279	$0.0282	$0.0285	$0.0289	$0.0292	$0.0296	$0.0299	$0.0303
Smelter (MW)	133	133	133	133	133	133	133	133	133	133	133	133	133	133	133
PLN (MW)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Appendix 20 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 2 (*Continued*)

Year	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Power Generated	85%	84%	83%	82%	81%	80%	79%	78%	77%	76%
	233	233	233	233	233	233	233	233	233	233
Availability	79.2%	78.2%	77.2%	76.2%	75.2%	74.2%	73.2%	72.2%	71.2%	70.2%
Working Hours	6936	6848.4	6760.8	6673.2	6585.6	6498	6410.4	6322.8	6235.2	6147.6
Capital Cost	$0.0307	$0.0311	$0.0315	$0.0319	$0.0323	$0.0328	$0.0332	$0.0337	$0.0341	$0.0346
Smelter (MW)	133	133	133	133	133	133	133	133	133	133
PLN (MW)	100	100	100	100	100	100	100	100	100	100

Appendix 20 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 2 (*Continued*)

FIXED COST OF OPERATIONS and MAINTENANCE / COMPONENT B

Personnel Cost				
	Number	Standard Salary / Month	Annual Salary (include compensation)	
Management				
Director	3	$6,000	$84,000	$252,000
Commisioner	3	$6,000	$84,000	$252,000
General Manager	4	$4,000	$56,000	$224,000
Senior Manager	5	$3,000	$42,000	$210,000
Manager	8	$2,500	$35,000	$280,000
Supervisor	8	$1,500	$21,000	$168,000
Administrative Staff	8	$600	$8,400	$67,200
Operation				
Operator	24	$600	$8,400	$201,600
Supporting Staff	40	$500	$7,000	$280,000
Technician	18	$500	$7,000	$126,000
Security	40	$350	$4,900	$196,000
Total	161			$2,256,800

Maintenance	=	4%	(from total Investment)
Others	=	7%	(the other Operation Cost)

Personnel Cost	=	$	2,256,800
Maintenance Cost	=	$	18,160,000.00
Others	=	$	1,429,176
Total	=	$	21,845,976

Appendix 20 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 2 (*Continued*)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028
Fixed	$21,845,976	$22,173,666	$22,506,271	$22,843,865	$23,186,523	$23,534,320	$23,887,335	$24,245,645	$24,609,330
Cost for OandM	$0.0114	$0.0117	$0.0120	$0.0123	$0.0126	$0.0129	$0.0133	$0.0136	$0.0140

Appendix 20 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 2 (*Continued*)

Year	2029	2030	2031	2032	2033	2034	2035	2036	2037
Fixed	$24,978,470	$25,353,147	$25,733,444	$26,119,446	$26,511,238	$26,908,906	$27,312,540	$27,722,228	$28,138,061
Cost for OandM	$0.0144	$0.0148	$0.0152	$0.0156	$0.0160	$0.0164	$0.0169	$0.0174	$0.0179

Appendix 20 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 2 (*Continued*)

Year	2038	2039	2040	2041	2042	2043	2044
Fixed Cost for OandM	$28,560,132	$28,988,534	$29,423,362	$29,864,713	$30,312,683	$30,767,374	$31,228,884
	$0.0184	$0.0189	$0.0194	$0.0200	$0.0206	$0.0212	$0.0218

Appendix 20 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 2 (*Continued*)

FUEL COST

Consumption Rate			
1 MWh el	=	7.053074205	mmBtu
		2.083	MWh th
1 MWh th	=	3.412	mmBtu
1 mmBtu	=	$32.752	
1 MWh th	=	$9.39	

Heating Steam needs LNG			
1 MWh	=	0.05652	mmBtu
1 mmBtu	=	$7.50	

Appendix 20 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 2 (*Continued*)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Gas Price	$2.75	$2.79	$2.84	$2.88	$2.92	$2.97	$3.01	$3.05	$3.10	$3.15	$3.19	$3.24
LNG Price	$7.50	$7.61	$7.73	$7.84	$7.96	$8.08	$8.20	$8.32	$8.45	$8.58	$8.70	$8.83
Gas Supply	16,479,107	16,304,129	16,129,151	15,954,173	15,779,194	15,604,216	15,429,238	15,254,260	15,079,282	14,904,304	14,729,325	14,554,347
Fuel Cost	$0.0241	$0.0245	$0.0248	$0.0252	$0.0256	$0.0260	$0.0264	$0.0268	$0.0272	$0.0276	$0.0280	$0.0284

Appendix 20 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 2 (*Continued*)

Year	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Gas Price	$3.29	$3.34	$3.39	$3.44	$3.49	$3.55	$3.60	$3.65	$3.71	$3.76	$3.82	$3.88	$3.93
LNG Price	$8.97	$9.10	$9.24	$9.38	$9.52	$9.66	$9.81	$9.95	$10.10	$10.25	$10.41	$10.56	$10.72
Gas Supply	14,379,369	14,204,391	14,029,413	13,854,435	13,679,457	13,504,478	13,329,500	13,154,522	12,979,544	12,804,566	12,629,588	12,454,609	12,279,631
Fuel Cost	$0.0288	$0.0293	$0.0297	$0.0301	$0.0306	$0.0311	$0.0315	$0.0320	$0.0325	$0.0330	$0.0335	$0.0340	$0.0345

Appendix 20 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 2 (*Continued*)

VARIABLE COST OF OPERATIONS and MAINTENANCE

Description		Consumption		Cost / m^3	
Water Softened	=	0.024	m^3/ MWh el	$	2.0
Industrial Water	=	4.15	m^3/ MWh el	$	0.5

Appendix 20 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 2 (*Continued*)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Water Consumption Cost	$2.123	$2.155	$2.187	$2.220	$2.253	$2.287	$2.321	$2.356	$2.392	$2.427	$2.464	$2.501	$2.538	$2.576
Variable Cost for OandM	$0.00258	$0.00262	$0.00266	$0.00270	$0.00274	$0.00278	$0.00282	$0.00286	$0.00290	$0.00295	$0.00299	$0.00304	$0.00308	$0.00313

Appendix 20 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 2 (*Continued*)

Year	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Water Consumption Cost	$2.615	$2.654	$2.694	$2.734	$2.775	$2.817	$2.859	$2.902	$2.946	$2.990	$3.035
Variable Cost for OandM	$0.00318	$0.00322	$0.00327	$0.00332	$0.00337	$0.00342	$0.00347	$0.00353	$0.00358	$0.00363	$0.00369

Appendix 21 Financial Calculation of Smelter Company in Scenario 2

Year	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Electricity Cost									
per kWh				$0.064	$0.065	$0.066	$0.067	$0.068	$0.069
Required Electricity				1,097,250,000	1,085,599,200	1,073,948,400	1,062,297,600	1,050,646,800	1,038,996,000
Electricity Cost				$70,068,613	$70,379,319	$70,689,951	$71,000,437	$71,310,703	$71,620,673
Total Cost				($70,068,613)	($70,379,319)	($70,689,951)	($71,000,437)	($71,310,703)	($71,620,673)
Synthesis Gas									
Per mmBtu				$2.75	$2.79	$2.84	$2.88	$2.92	$2.97
Total Revenue				$45,356,580	$45,548,100	$45,735,161	$45,917,585	$46,095,191	$46,267,794
Net Profit	**$0**	**$0**	**$0**	**($24,712,033)**	**($24,831,219)**	**($24,954,790)**	**($25,082,852)**	**($25,215,512)**	**($25,352,878)**

Appendix 21 Financial Calculation of Smelter Company in Scenario 2 (*Continued*)

Year	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Electricity Cost							
per kWh	$0.070	$0.071	$0.072	$0.073	$0.075	$0.076	$0.077
Required Electricity	1,027,345,200	1,015,694,400	1,004,043,600	992,392,800	980,742,000	969,091,200	957,440,400
Electricity Cost	$71,930,267	$72,239,406	$72,548,005	$72,855,979	$73,163,239	$73,469,695	$73,775,254
Total Cost	($71,930,267)	($72,239,406)	($72,548,005)	($72,855,979)	($73,163,239)	($73,469,695)	($73,775,254)
Synthesis Gas							
Per mmBtu	$3.01	$3.05	$3.10	$3.15	$3.19	$3.24	$3.29
Total Revenue	$46,435,204	$46,597,226	$46,753,661	$46,904,304	$47,048,947	$47,187,376	$47,319,371
Net Profit	**($25,495,063)**	**($25,642,180)**	**($25,794,344)**	**($25,951,675)**	**($26,114,292)**	**($26,282,319)**	**($26,455,883)**

Appendix 21 Financial Calculation of Smelter Company in Scenario 2 (*Continued*)

Year	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
Electricity Cost							
per kWh	$0.078	$0.080	$0.081	$0.082	$0.084	$0.085	$0.087
Required Electricity	945,789,600	934,138,800	922,488,000	910,837,200	899,186,400	887,535,600	875,884,800
Electricity Cost	$74,079,820	$74,383,293	$74,685,574	$74,986,558	$75,286,137	$75,584,203	$75,880,641
Total Cost	($74,079,820)	($74,383,293)	($74,685,574)	($74,986,558)	($75,286,137)	($75,584,203)	($75,880,641)
Synthesis Gas							
Per mmBtu	$3.34	$3.39	$3.44	$3.49	$3.55	$3.60	$3.65
Total Revenue	$47,444,710	$47,563,161	$47,674,491	$47,778,460	$47,874,820	$47,963,322	$48,043,706
Net Profit	**($26,635,110)**	**($26,820,132)**	**($27,011,083)**	**($27,208,098)**	**($27,411,317)**	**($27,620,881)**	**($27,836,935)**

Appendix 21 Financial Calculation of Smelter Company in Scenario 2 (*Continued*)

Year	**2040**	**2041**	**2042**	**2043**	**2044**
Electricity Cost					
per kWh	$0.088	$0.090	$0.091	$0.093	$0.095
Required Electricity	864,234,000	852,583,200	840,932,400	829,281,600	817,630,800
Electricity Cost	$76,175,338	$76,468,172	$76,759,023	$77,047,765	$77,334,269
Total Cost	($76,175,338)	($76,468,172)	($76,759,023)	($77,047,765)	($77,334,269)
Synthesis Gas					
Per mmBtu	$3.71	$3.76	$3.82	$3.88	$3.93
Total Revenue	$48,115,711	$48,179,065	$48,233,494	$48,278,716	$48,314,442
Net Profit	**($28,059,627)**	**($28,289,107)**	**($28,525,529)**	**($28,769,049)**	**($29,019,827)**

NPV	***($249,699,289.10)***

Appendix 22 Free Cash Flow Report of Power Plant in Scenario 2

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Net Profit	$0	$0	$0	$13,199,710	$13,779,820	$14,680,749	$15,596,102	$16,521,361	$17,456,769	$18,402,653
Depreciation	$0	$0	$0	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000
Interest (1-Tax)	$1,162,899.90	$3,488,699.70	$5,814,499.50	$5,861,442.47	$5,564,448.03	$4,955,862.66	$4,342,375.97	$3,728,812.18	$3,115,247.17	$2,501,682.15
Investment Cost and CAPEX	($74,400,000)	($148,800,000)	($148,800,000)	$0	$0	$0	$0	$0	$0	$0
Total Flow	($73,237,100)	($145,311,300)	($142,985,501)	$33,941,153	$34,224,269	$34,516,612	$34,818,478	$35,130,174	$35,452,016	$35,784,335

Appendix 22 Free Cash Flow Report of Power Plant in Scenario 2 (*Continued*)

Year	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Net Profit	$19,359,357	$20,029,504	$20,711,196	$21,404,820	$22,110,774	$23,138,432	$23,554,484	$23,984,169	$24,427,959	$24,886,345
Depreciation	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000
Interest (1-Tax)	$1,888,117.13	$1,572,284.97	$1,256,452.80	$940,620.64	$624,788.47	$0.00	$0.00	$0.00	$0.00	$0.00
Investment Cost and CAPEX	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Flow	$36,127,474	$36,481,789	$36,847,649	$37,225,440	$37,615,562	$38,018,432	$38,434,484	$38,864,169	$39,307,959	$39,766,345

Appendix 22 Free Cash Flow Report of Power Plant in Scenario 2 (*Continued*)

Year	2037	2038	2039	2040	2041	2042	2043	2044
Net Profit	$25,359,840	$25,848,979	$26,354,321	$26,876,449	$27,415,976	$27,973,539	$28,549,809	$29,145,487
Depreciation	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000
Interest (1-Tax)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Investment Cost and CAPEX	$0	$0	$0	$0	$0	$0	$0	$0
Total Flow	$40,239,840	$40,728,979	$41,234,321	$41,756,449	$42,295,976	$42,853,539	$43,429,809	$44,025,487

NPV	**$268,369,699.94**
IRR	**8.2%**

Appendix 23 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 3

COMPONENT A / CAPITAL COST

d	=	4%	
i	=	6.93%	
Period	=	25	Years
Power Generated	=	183	MW el
Installed Capacity	=	183,000	kW el
Capital Recovery Factor (CRF)	=	0.1093	
Time (hour in 1 year)	=	8250	hours
Nett Power Generated / annum	=	1,097,250	MWh el
Time (hour in 1 year)	=	1,097,250,000	kWh el
Total Investment	=	$ 454,000,000	
Construction Cost	=	$2,480.87	/kW

CRF	=	10.93%
Interest Rate Factor (fs)	=	8.53%
Depreciation Factor (fd)	=	2.40%

Total Investment		
IGCC Unit	=	$268,400,000
Construction	=	$103,600,000
Permit	=	$ 2,000,000
Working Capital	=	$ 80,000,000
Total	=	$454,000,000

Description		Amount		
Risk Free		Indonesian Government Bond	Value	Percentage
RI0144	=	6.75%	$ 82,000,000	18.1%
ECA	=	1.57%	$ 316,200,000	69.6%
Loan	=	4.98%	$ 55,800,000	12.3%
WACC	=	2.93%		
Expected Profit	=	4%		
MARR	=	6.93%		

Appendix 23 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 3 (*Continued*)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Power Generated	100%	99%	98%	97%	96%	95%	94%	93%	92%	91%	90%	89%	88%	87%	86%
	233	233	233	233	233	233	233	233	233	233	233	233	233	233	233
Availability	94.2%	93.2%	92.2%	91.2%	90.2%	89.2%	88.2%	87.2%	86.2%	85.2%	84.2%	83.2%	82.2%	81.2%	80.2%
Working Hours	8250	8162.4	8074.8	7987.2	7899.6	7812	7724.4	7636.8	7549.2	7461.6	7374	7286.4	7198.8	7111.2	7023.6
Capital Cost	$0.0329	$0.0332	$0.0336	$0.0339	$0.0343	$0.0347	$0.0351	$0.0355	$0.0359	$0.0363	$0.0368	$0.0372	$0.0377	$0.0381	$0.0386
Smelter (MW)	133	133	133	133	133	133	133	133	133	133	133	133	133	133	133
PLN (MW)	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50

Appendix 23 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 3 (*Continued*)

Year	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Power Generated	85%	84%	83%	82%	81%	80%	79%	78%	77%	76%
	233	233	233	233	233	233	233	233	233	233
Availability	79.2%	78.2%	77.2%	76.2%	75.2%	74.2%	73.2%	72.2%	71.2%	70.2%
Working Hours	6936	6848.4	6760.8	6673.2	6585.6	6498	6410.4	6322.8	6235.2	6147.6
Capital Cost	$0.0391	$0.0396	$0.0401	$0.0406	$0.0412	$0.0417	$0.0423	$0.0429	$0.0435	$0.0441
Smelter (MW)	133	133	133	133	133	133	133	133	133	133
PLN (MW)	50	50	50	50	50	50	50	50	50	50

Appendix 23 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 3 (*Continued*)

FIXED COST OF OPERATIONS and MAINTENANCE / COMPONENT B

Personnel Cost				
	Number	Standard Salary / Month	Annual Salary (include compensation)	
Management				
Director	3	$6,000	$84,000	$252,000
Commisioner	3	$6,000	$84,000	$252,000
General Manager	4	$4,000	$56,000	$224,000
Senior Manager	5	$3,000	$42,000	$210,000
Manager	8	$2,500	$35,000	$280,000
Supervisor	8	$1,500	$21,000	$168,000
Administrative Staff	8	$600	$8,400	$67,200
Operation				
Operator	24	$600	$8,400	$201,600
Supporting Staff	40	$500	$7,000	$280,000
Technician	18	$500	$7,000	$126,000
Security	40	$350	$4,900	$196,000
Total	161			$2,256,800

Maintenance	=	4%	(from total Investment)
Others	=	7%	(the other Operation Cost)

Personnel Cost	=	$	2,256,800
Maintenance Cost	=	$	18,160,000.00
Others	=	$	1,429,176
Total	=	$	21,845,976

Appendix 23 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 3 (*Continued*)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028
Fixed Cost for OandM	$21,845,976	$22,173,666	$22,506,271	$22,843,865	$23,186,523	$23,534,320	$23,887,335	$24,245,645	$24,609,330
	$0.0145	$0.0148	$0.0152	$0.0156	$0.0160	$0.0165	$0.0169	$0.0173	$0.0178

Appendix 23 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 3 (*Continued*)

Year	2029	2030	2031	2032	2033	2034	2035	2036	2037
Fixed Cost for OandM	$24,978,470	$25,353,147	$25,733,444	$26,119,446	$26,511,238	$26,908,906	$27,312,540	$27,722,228	$28,138,061
	$0.0183	$0.0188	$0.0193	$0.0198	$0.0204	$0.0209	$0.0215	$0.0221	$0.0227

Appendix 23 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 3 (*Continued*)

Year	2038	2039	2040	2041	2042	2043	2044
Fixed Cost for OandM	$28,560,132	$28,988,534	$29,423,362	$29,864,713	$30,312,683	$30,767,374	$31,228,884
	$0.0234	$0.0241	$0.0247	$0.0255	$0.0262	$0.0270	$0.0278

Appendix 23 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 3 (*Continued*)

FUEL COST

Consumption Rate			
1 MWh el	=	7.053074205	mmBtu
		2.083	MWh th
1 MWh th	=	3.412	mmBtu
1 mmBtu	=	$2.752	
1 MWh th	=	$9.39	

Heating Steam needs LNG			
1 MWh	=	0.05652	mmBtu
1 mmBtu	=	$7.50	

Appendix 23 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 3 (*Continued*)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Gas Price	$2.75	$2.79	$2.84	$2.88	$2.92	$2.97	$3.01	$3.05	$3.10	$3.15	$3.19	$3.24
LNG Price	$7.50	$7.61	$7.73	$7.84	$7.96	$8.08	$8.20	$8.32	$8.45	$8.58	$8.70	$8.83
Gas Supply	16,479,107	16,304,129	16,129,151	15,954,173	15,779,194	15,604,216	15,429,238	15,254,260	15,079,282	14,904,304	14,729,325	14,554,347
Fuel Cost	$0.0307	$0.0312	$0.0316	$0.0321	$0.0326	$0.0331	$0.0336	$0.0341	$0.0346	$0.0351	$0.0356	$0.0362

Appendix 23 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 3 (*Continued*)

Year	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Gas Price	$3.29	$3.34	$3.39	$3.44	$3.49	$3.55	$3.60	$3.65	$3.71	$3.76	$3.82	$3.88	$3.93
LNG Price	$8.97	$9.10	$9.24	$9.38	$9.52	$9.66	$9.81	$9.95	$10.10	$10.25	$10.41	$10.56	$10.72
Gas Supply	14,379,369	14,204,391	14,029,413	13,854,435	13,679,457	13,504,478	13,329,500	13,154,522	12,979,544	12,804,566	12,629,588	12,454,609	12,279,631
Fuel Cost	$0.0367	$0.0373	$0.0378	$0.0384	$0.0390	$0.0395	$0.0401	$0.0407	$0.0413	$0.0420	$0.0426	$0.0432	$0.0439

Appendix 23 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 3 (*Continued*)

VARIABLE COST OF OPERATIONS and MAINTENANCE

Description		Consumption		Cost / m^3	
Water Softened	=	0.024	m^3/ MWh el	$	2.0
Industrial Water	=	4.15	m^3/ MWh el	$	0.5

Appendix 23 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 3 (*Continued*)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Water Consumption Cost	$2.123	$2.155	$2.187	$2.220	$2.253	$2.287	$2.321	$2.356	$2.392	$2.427	$2.464	$2.501	$2.538	$2.576
Variable Cost for OandM	$0.00328	$0.00333	$0.00338	$0.00343	$0.00348	$0.00354	$0.00359	$0.00364	$0.00370	$0.00375	$0.00381	$0.00387	$0.00393	$0.00398

Appendix 23 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 3 (*Continued*)

Year	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Water Consumption Cost	$2.615	$2.654	$2.694	$2.734	$2.775	$2.817	$2.859	$2.902	$2.946	$2.990	$3.035
Variable Cost for OandM	$0.00404	$0.00410	$0.00417	$0.00423	$0.00429	$0.00436	$0.00442	$0.00449	$0.00456	$0.00462	$0.00469

Appendix 24 Financial Calculation of Smelter Company in Scenario 3

Year	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Electricity Cost									
per kWh				$0.081	$0.083	$0.084	$0.085	$0.086	$0.088
Required Electricity				1,097,250,000	1,085,599,200	1,073,948,400	1,062,297,600	1,050,646,800	1,038,996,000
Electricity Cost				$89,213,043	$89,608,641	$90,004,145	$90,399,463	$90,794,502	$91,189,163
Total Cost				($89,213,043)	($89,608,641)	($90,004,145)	($90,399,463)	($90,794,502)	($91,189,163)
Synthesis Gas									
Per mmBtu				$2.75	$2.79	$2.84	$2.88	$2.92	$2.97
Total Revenue				$45,356,580	$45,548,100	$45,735,161	$45,917,585	$46,095,191	$46,267,794
Net Profit	**$0**	**$0**	**$0**	**($43,856,463)**	**($44,060,541)**	**($44,268,984)**	**($44,481,878)**	**($44,699,310)**	**($44,921,368)**

Appendix 24 Financial Calculation of Smelter Company in Scenario 3 (*Continued*)

Year	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Electricity Cost							
per kWh	$0.089	$0.091	$0.092	$0.093	$0.095	$0.097	$0.098
Required Electricity	1,027,345,200	1,015,694,400	1,004,043,600	992,392,800	980,742,000	969,091,200	957,440,400
Electricity Cost	$91,583,346	$91,976,949	$92,369,864	$92,761,984	$93,153,195	$93,543,382	$93,932,427
Total Cost	($91,583,346)	($91,976,949)	($92,369,864)	($92,761,984)	($93,153,195)	($93,543,382)	($93,932,427)
Synthesis Gas							
Per mmBtu	$3.01	$3.05	$3.10	$3.15	$3.19	$3.24	$3.29
Total Revenue	$46,435,204	$46,597,226	$46,753,661	$46,904,304	$47,048,947	$47,187,376	$47,319,371
Net Profit	**($45,148,142)**	**($45,379,722)**	**($45,616,204)**	**($45,857,680)**	**($46,104,248)**	**($46,356,007)**	**($46,613,056)**

Appendix 24 Financial Calculation of Smelter Company in Scenario 3 (*Continued*)

Year	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
Electricity Cost							
per kWh	$0.100	$0.101	$0.103	$0.105	$0.107	$0.108	$0.110
Required Electricity	945,789,600	934,138,800	922,488,000	910,837,200	899,186,400	887,535,600	875,884,800
Electricity Cost	$94,320,207	$94,706,598	$95,091,469	$95,474,688	$95,856,120	$96,235,624	$96,613,057
Total Cost	($94,320,207)	($94,706,598)	($95,091,469)	($95,474,688)	($95,856,120)	($96,235,624)	($96,613,057)
Synthesis Gas							
Per mmBtu	$3.34	$3.39	$3.44	$3.49	$3.55	$3.60	$3.65
Total Revenue	$47,444,710	$47,563,161	$47,674,491	$47,778,460	$47,874,820	$47,963,322	$48,043,706
Net Profit	**($46,875,498)**	**($47,143,436)**	**($47,416,977)**	**($47,696,228)**	**($47,981,299)**	**($48,272,302)**	**($48,569,351)**

Appendix 24 Financial Calculation of Smelter Company in Scenario 3 (*Continued*)

Year	**2040**	**2041**	**2042**	**2043**	**2044**
Electricity Cost					
per kWh	$0.112	$0.114	$0.116	$0.118	$0.120
Required Electricity	864,234,000	852,583,200	840,932,400	829,281,600	817,630,800
Electricity Cost	$96,988,271	$97,361,115	$97,731,434	$98,099,067	$98,463,850
Total Cost	($96,988,271)	($97,361,115)	($97,731,434)	($98,099,067)	($98,463,850)
Synthesis Gas					
Per mmBtu	$3.71	$3.76	$3.82	$3.88	$3.93
Total Revenue	$48,115,711	$48,179,065	$48,233,494	$48,278,716	$48,314,442
Net Profit	**($48,872,561)**	**($49,182,050)**	**($49,497,939)**	**($49,820,351)**	**($50,149,408)**

NPV	***($440,393,103.67)***

Appendix 25 Free Cash Flow Report of Power Plant in Scenario 3

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Net Profit	$0	$0	$0	$11,292,337	$11,706,954	$12,437,781	$13,178,282	$13,923,791	$14,674,398	$15,430,273
Depreciation	$0	$0	$0	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000
Interest (1-Tax)	$1,162,899.90	$3,488,699.70	$5,814,499.50	$5,861,442.47	$5,564,448.03	$4,955,862.66	$4,342,375.97	$3,728,812.18	$3,115,247.17	$2,501,682.15
Investment Cost and CAPEX	($74,400,000)	($148,800,000)	($148,800,000)	$0	$0	$0	$0	$0	$0	$0
Total Flow	($73,237,100)	($145,311,300)	($142,985,501)	$32,033,780	$32,151,402	$32,273,643	$32,400,658	$32,532,603	$32,669,646	$32,811,955

Appendix 25 Free Cash Flow Report of Power Plant in Scenario 3 (*Continued*)

Year	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Net Profit	$16,191,592	$16,660,808	$17,135,845	$17,616,903	$18,104,187	$18,906,872	$19,091,435	$19,282,899	$19,481,507	$19,687,513
Depreciation	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000
Interest (1-Tax)	$1,888,117.13	$1,572,284.97	$1,256,452.80	$940,620.64	$624,788.47	$0.00	$0.00	$0.00	$0.00	$0.00
Investment Cost and CAPEX	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Flow	$32,959,709	$33,113,093	$33,272,298	$33,437,523	$33,608,976	$33,786,872	$33,971,435	$34,162,899	$34,361,507	$34,567,513

Appendix 25 Free Cash Flow Report of Power Plant in Scenario 3 (*Continued*)

Year	2037	2038	2039	2040	2041	2042	2043	2044
Net Profit	$19,901,182	$20,122,789	$20,352,623	$20,590,985	$20,838,189	$21,094,565	$21,360,456	$21,636,223
Depreciation	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000
Interest (1-Tax)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Investment Cost and CAPEX	$0	$0	$0	$0	$0	$0	$0	$0
Total Flow	$34,781,182	$35,002,789	$35,232,623	$35,470,985	$35,718,189	$35,974,565	$36,240,456	$36,516,223

NPV	**$202,981,280.53**
IRR	**7.2%**

Appendix 26 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 4

COMPONENT A / CAPITAL COST

d	=	4%	
i	=	6.93%	
Period	=	25	Years
Power Generated	=	133	MW el
Installed Capacity	=	133,000	kW el
Capital Recovery Factor (CRF)	=	0.1093	
Time (hour in 1 year)	=	8250	hours
Nett Power Generated / annum	=	1,097,250	MWh el
Time (hour in 1 year)	=	1,097,250,000	kWh el
Total Investment	=	$ 454,000,000	
Construction Cost	=	$3,413.53	/kW

CRF	=	10.93%
Interest Rate Factor (fs)	=	9.31%
Depreciation Factor (fd)	=	2.40%

Total Investment		
IGCC Unit	=	$ 68,400,000
Construction	=	$ 103,600,000
Permit	=	$ 2,000,000
Working Capital	=	$ 80,000,000
Total	=	$ 454,000,000

Description		Amount	Value	Percentage
Risk Free		Indonesian Government Bond		
RI0144	=	6.75%	$ 82,000,000	18.1%
ECA	=	1.57%	$ 316,200,000	69.6%
Loan	=	4.98%	$ 55,800,000	12.3%
WACC	=	2.93%		
Expected Profit	=	4%		
MARR	=	6.93%		

Appendix 26 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 4 (*Continued*)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Power Generated	100%	99%	98%	97%	96%	95%	94%	93%	92%	91%	90%	89%	88%	87%	86%
	233	233	233	233	233	233	233	233	233	233	233	233	233	233	233
Availability	94.2%	93.2%	92.2%	91.2%	90.2%	89.2%	88.2%	87.2%	86.2%	85.2%	84.2%	83.2%	82.2%	81.2%	80.2%
Working Hours	8250	8162.4	8074.8	7987.2	7899.6	7812	7724.4	7636.8	7549.2	7461.6	7374	7286.4	7198.8	7111.2	7023.6
Capital Cost	$0.045	$0.046	$0.046	$0.047	$0.047	$0.048	$0.048	$0.049	$0.049	$0.050	$0.051	$0.051	$0.052	$0.052	$0.053
Smelter (MW)	133	133	133	133	133	133	133	133	133	133	133	133	133	133	133
PLN (MW)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 26 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 4 (*Continued*)

Year	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Power Generated	85%	84%	83%	82%	81%	80%	79%	78%	77%	76%
	233	233	233	233	233	233	233	233	233	233
Availability	79.2%	78.2%	77.2%	76.2%	75.2%	74.2%	73.2%	72.2%	71.2%	70.2%
Working Hours	6936	6848.4	6760.8	6673.2	6585.6	6498	6410.4	6322.8	6235.2	6147.6
Capital Cost	$0.054	$0.054	$0.055	$0.056	$0.057	$0.057	$0.058	$0.059	$0.060	$0.061
Smelter (MW)	133	133	133	133	133	133	133	133	133	133
PLN (MW)	0	0	0	0	0	0	0	0	0	0

Appendix 26 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 4 (*Continued*)

FIXED COST OF OPERATIONS and MAINTENANCE / COMPONENT B

Personnel Cost				
	Number	Standard Salary / Month	Annual Salary (include compensation)	
Management				
Director	3	$6,000	$84,000	$252,000
Commisioner	3	$6,000	$84,000	$252,000
General Manager	4	$4,000	$56,000	$224,000
Senior Manager	5	$3,000	$42,000	$210,000
Manager	8	$2,500	$35,000	$280,000
Supervisor	8	$1,500	$21,000	$168,000
Administrative Staff	8	$600	$8,400	$67,200
Operation				
Operator	24	$600	$8,400	$201,600
Supporting Staff	40	$500	$7,000	$280,000
Technician	18	$500	$7,000	$126,000
Security	40	$350	$4,900	$196,000
Total	161			$2,256,800

Maintenance	=	4%	(from total Investment)
Others	=	7%	(the other Operation Cost)

Personnel Cost	=	$	2,256,800
Maintenance Cost	=	$	18,160,000.00
Others	=	$	1,429,176
Total	=	$	21,845,976

Appendix 26 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 4 (*Continued*)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028
Fixed	$21,845,976	$22,173,666	$22,506,271	$22,843,865	$23,186,523	$23,534,320	$23,887,335	$24,245,645	$24,609,330
Cost for OandM	$0.0199	$0.0204	$0.0210	$0.0215	$0.0221	$0.0227	$0.0233	$0.0239	$0.0245

Appendix 26 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 4 (*Continued*)

Year	2029	2030	2031	2032	2033	2034	2035	2036	2037
Fixed	$24,978,470	$25,353,147	$25,733,444	$26,119,446	$26,511,238	$26,908,906	$27,312,540	$27,722,228	$28,138,061
Cost for OandM	$0.0252	$0.0259	$0.0266	$0.0273	$0.0280	$0.0288	$0.0296	$0.0304	$0.0313

Appendix 26 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 4 (*Continued*)

Year	2038	2039	2040	2041	2042	2043	2044
Fixed Cost for OandM	$28,560,132	$28,988,534	$29,423,362	$29,864,713	$30,312,683	$30,767,374	$31,228,884
	$0.0322	$0.0331	$0.0340	$0.0350	$0.0360	$0.0371	$0.0382

Appendix 26 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 4 (*Continued*)

FUEL COST

Consumption Rate			
1 MWh el	=	7.053074205	mmBtu
		2.083	MWh th
1 MWh th	=	3.412	mmBtu
1 mmBtu	=	$2.752	
1 MWh th	=	$9.39	

Heating Steam needs LNG			
1 MWh	=	0.05652	mmBtu
1 mmBtu	=	$7.50	

Appendix 26 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 4 (*Continued*)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Gas Price	$2.75	$2.79	$2.84	$2.88	$2.92	$2.97	$3.01	$3.05	$3.10	$3.15	$3.19	$3.24
LNG Price	$7.50	$7.61	$7.73	$7.84	$7.96	$8.08	$8.20	$8.32	$8.45	$8.58	$8.70	$8.83
Gas Supply	16,479,107	16,304,129	16,129,151	15,954,173	15,779,194	15,604,216	15,429,238	15,254,260	15,079,282	14,904,304	14,729,325	14,554,347
Fuel Cost	$0.0422	$0.0429	$0.0435	$0.0442	$0.0448	$0.0455	$0.0462	$0.0469	$0.0476	$0.0483	$0.0490	$0.0498

Appendix 26 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 4 (*Continued*)

Year	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Gas Price	$3.29	$3.34	$3.39	$3.44	$3.49	$3.55	$3.60	$3.65	$3.71	$3.76	$3.82	$3.88	$3.93
LNG Price	$8.97	$9.10	$9.24	$9.38	$9.52	$9.66	$9.81	$9.95	$10.10	$10.25	$10.41	$10.56	$10.72
Gas Supply	14,379,369	14,204,391	14,029,413	13,854,435	13,679,457	13,504,478	13,329,500	13,154,522	12,979,544	12,804,566	12,629,588	12,454,609	12,279,631
Fuel Cost	$0.0505	$0.0513	$0.0520	$0.0528	$0.0536	$0.0544	$0.0552	$0.0560	$0.0569	$0.0577	$0.0586	$0.0595	$0.0604

Appendix 26 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 4 (*Continued*)

VARIABLE COST OF OPERATIONS and MAINTENANCE

Description		Consumption		Cost / m^3	
Water Softened	=	0.024	m^3/ MWh el	$	2.0
Industrial Water	=	4.15	m^3/ MWh el	$	0.5

Appendix 26 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 4 (*Continued*)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Water Consumption Cost	$2.123	$2.155	$2.187	$2.220	$2.253	$2.287	$2.321	$2.356	$2.392	$2.427	$2.464	$2.501	$2.538	$2.576
Variable Cost for OandM	$0.00452	$0.00459	$0.00465	$0.00472	$0.00479	$0.00487	$0.00494	$0.00501	$0.00509	$0.00517	$0.00524	$0.00532	$0.00540	$0.00548

Appendix 26 Calculation Recapitulation of Electricity Price for Smelter Company in Scenario 4 (*Continued*)

Year	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Water Consumption Cost	$2.615	$2.654	$2.694	$2.734	$2.775	$2.817	$2.859	$2.902	$2.946	$2.990	$3.035
Variable Cost for OandM	$0.00556	$0.00565	$0.00573	$0.00582	$0.00591	$0.00599	$0.00608	$0.00618	$0.00627	$0.00636	$0.00646

Appendix 27 Financial Calculation of Smelter Company in Scenario 4

Year	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Electricity Cost									
per kWh				$0.112	$0.114	$0.115	$0.117	$0.119	$0.121
Required Electricity				1,097,250,000	1,085,599,200	1,073,948,400	1,062,297,600	1,050,646,800	1,038,996,000
Electricity Cost				$122,751,781	$123,296,100	$123,840,290	$124,384,224	$124,927,773	$125,470,803
Total Cost				($122,751,781)	($123,296,100)	($123,840,290)	($124,384,224)	($124,927,773)	($125,470,803)
Synthesis Gas									
Per mmBtu				$2.75	$2.79	$2.84	$2.88	$2.92	$2.97
Total Revenue				$45,356,580	$45,548,100	$45,735,161	$45,917,585	$46,095,191	$46,267,794
Net Profit	**0**	**0**	**0**	**(77,395,201)**	**(77,748,000)**	**(78,105,129)**	**(78,466,639)**	**(78,832,582)**	**(79,203,008)**

Appendix 27 Financial Calculation of Smelter Company in Scenario 4 (*Continued*)

Year	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Electricity Cost							
per kWh	$0.123	$0.125	$0.127	$0.129	$0.131	$0.133	$0.135
Required Electricity	1,027,345,200	1,015,694,400	1,004,043,600	992,392,800	980,742,000	969,091,200	957,440,400
Electricity Cost	$126,013,175	$126,554,749	$127,095,377	$127,634,910	$128,173,193	$128,710,068	$129,245,370
Total Cost	($126,013,175)	($126,554,749)	($127,095,377)	($127,634,910)	($128,173,193)	($128,710,068)	($129,245,370)
Synthesis Gas							
Per mmBtu	$3.01	$3.05	$3.10	$3.15	$3.19	$3.24	$3.29
Total Revenue	$46,435,204	$46,597,226	$46,753,661	$46,904,304	$47,048,947	$47,187,376	$47,319,371
Net Profit	**(79,577,971)**	**(79,957,523)**	**(80,341,716)**	**(80,730,606)**	**(81,124,246)**	**(81,522,692)**	**(81,925,998)**

Appendix 27 Financial Calculation of Smelter Company in Scenario 4 (*Continued*)

Year	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
Electricity Cost							
per kWh	$0.137	$0.139	$0.142	$0.144	$0.147	$0.149	$0.152
Required Electricity	945,789,600	934,138,800	922,488,000	910,837,200	899,186,400	887,535,600	875,884,800
Electricity Cost	$129,778,932	$130,310,582	$130,840,141	$131,367,428	$131,892,255	$132,414,430	$132,933,755
Total Cost	($129,778,932)	($130,310,582)	($130,840,141)	($131,367,428)	($131,892,255)	($132,414,430)	($132,933,755)
Synthesis Gas							
Per mmBtu	$3.34	$3.39	$3.44	$3.49	$3.55	$3.60	$3.65
Total Revenue	$47,444,710	$47,563,161	$47,674,491	$47,778,460	$47,874,820	$47,963,322	$48,043,706
Net Profit	**(82,334,222)**	**(82,747,420)**	**(83,165,650)**	**(83,588,968)**	**(84,017,435)**	**(84,451,108)**	**(84,890,049)**

Appendix 27 Financial Calculation of Smelter Company in Scenario 4 (*Continued*)

Year	**2040**	**2041**	**2042**	**2043**	**2044**
Electricity Cost					
per kWh	$0.154	$0.157	$0.160	$0.163	$0.166
Required Electricity	864,234,000	852,583,200	840,932,400	829,281,600	817,630,800
Electricity Cost	$133,450,028	$133,963,039	$134,472,574	$134,978,415	$135,480,335
Total Cost	($133,450,028)	($133,963,039)	($134,472,574)	($134,978,415)	($135,480,335)
Synthesis Gas					
Per mmBtu	$3.71	$3.76	$3.82	$3.88	$3.93
Total Revenue	$48,115,711	$48,179,065	$48,233,494	$48,278,716	$48,314,442
Net Profit	**(85,334,317)**	**(85,783,973)**	**(86,239,080)**	**(86,699,699)**	**(87,165,893)**

NPV	***($688,227,001.71)***

Appendix 28 Free Cash Flow Report of Power Plant in Scenario 4

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Net Profit	$0	$0	$0	$20,180,695	$20,477,690	$21,086,275	$21,699,762	$22,313,326	$22,926,891	$23,540,456
Depreciation	$0	$0	$0	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000
Interest (1-Tax)	$1,162,900	$3,488,700	$5,814,500	$5,861,442	$4,822,522	$4,295,081	$3,763,393	$3,231,637	$2,699,881	$2,168,125
Investment Cost and CAPEX	($74,400,000)	($148,800,000)	($148,800,000)	$0	$0	$0	$0	$0	$0	$0
Total Flow	($73,237,100)	($145,311,300)	($142,985,501)	$40,922,138	$40,180,211	$40,261,356	$40,343,154	$40,424,963	$40,506,771	$40,588,580

Appendix 28 Free Cash Flow Report of Power Plant in Scenario 4 (*Continued*)

Year	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Net Profit	$24,154,021	$24,469,853	$24,785,685	$25,101,517	$25,417,349	$26,042,138	$26,042,138	$26,042,138	$26,042,138	$26,042,138
Depreciation	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000
Interest (1-Tax)	$1,636,368	$1,362,647	$1,088,926	$815,205	$541,483	$0	$0	$0	$0	$0
Investment Cost and CAPEX	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Flow	$40,670,389	$40,712,500	$40,754,611	$40,796,722	$40,838,833	$40,922,138	$40,922,138	$40,922,138	$40,922,138	$40,922,138

Appendix 28 Free Cash Flow Report of Power Plant in Scenario 4 (*Continued*)

Year	2037	2038	2039	2040	2041	2042	2043	2044
Net Profit	$26,042,138	$26,042,138	$26,042,138	$26,042,138	$26,042,138	$26,042,138	$26,042,138	$26,042,138
Depreciation	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000	$14,880,000
Interest (1-Tax)	$0	$0	$0	$0	$0	$0	$0	$0
Investment Cost and CAPEX	$0	$0	$0	$0	$0	$0	$0	$0
Total Flow	$40,922,138	$40,922,138	$40,922,138	$40,922,138	$40,922,138	$40,922,138	$40,922,138	$40,922,138

NPV	**$316,197,989.12**
IRR	**9.3%**

Appendix 29 Input of Minitab for Pricing Policy of Electricity Price (Smelter Company)

Scenario	Power Plant Tariff	Gas Price	Electricity Sales Volume
Scenario 1	$0.0526	$2.752	283
	$0.0534	$2.794	283
	$0.0542	$2.836	283
	$0.0550	$2.878	283
	$0.0559	$2.921	283
	$0.0568	$2.965	283
	$0.0576	$3.010	283
	$0.0586	$3.055	283
	$0.0595	$3.101	283
	$0.0604	$3.147	283
	$0.0614	$3.194	283
	$0.0624	$3.242	283
	$0.0634	$3.291	283
	$0.0645	$3.340	283
	$0.0656	$3.390	283
	$0.0667	$3.441	283
	$0.0678	$3.493	283
	$0.0689	$3.545	283
	$0.0701	$3.598	283
	$0.0713	$3.652	283
	$0.0726	$3.707	283
	$0.0738	$3.763	283
	$0.0752	$3.819	283
	$0.0765	$3.876	283
	$0.0779	$3.935	283
Scenario 2	$0.0639	$2.752	233
	$0.0648	$2.794	233
	$0.0658	$2.836	233
	$0.0668	$2.878	233
	$0.0679	$2.921	233
	$0.0689	$2.965	233
	$0.0700	$3.010	233
	$0.0711	$3.055	233
	$0.0723	$3.101	233
	$0.0734	$3.147	233
	$0.0746	$3.194	233
	$0.0758	$3.242	233
	$0.0771	$3.291	233
	$0.0783	$3.340	233
	$0.0796	$3.390	233
	$0.0810	$3.441	233
	$0.0823	$3.493	233
	$0.0837	$3.545	233
	$0.0852	$3.598	233
	$0.0866	$3.652	233
	$0.0881	$3.707	233
	$0.0897	$3.763	233
	$0.0913	$3.819	233
	$0.0929	$3.876	233
	$0.0946	$3.935	233

Appendix 29 Input of Minitab for Pricing Policy of Electricity Price (Smelter Company) (*Continued*)

Scenario	Power Plant Tariff	Gas Price	Electricity Sales Volume
Scenario 3	$0.0813	$2.752	183
	$0.0825	$2.794	183
	$0.0838	$2.836	183
	$0.0851	$2.878	183
	$0.0864	$2.921	183
	$0.0878	$2.965	183
	$0.0891	$3.010	183
	$0.0906	$3.055	183
	$0.0920	$3.101	183
	$0.0935	$3.147	183
	$0.0950	$3.194	183
	$0.0965	$3.242	183
	$0.0981	$3.291	183
	$0.0997	$3.340	183
	$0.1014	$3.390	183
	$0.1031	$3.441	183
	$0.1048	$3.493	183
	$0.1066	$3.545	183
	$0.1084	$3.598	183
	$0.1103	$3.652	183
	$0.1122	$3.707	183
	$0.1142	$3.763	183
	$0.1162	$3.819	183
	$0.1183	$3.876	183
	$0.1204	$3.935	183
Scenario 4	$0.1119	$2.752	133
	$0.1136	$2.794	133
	$0.1153	$2.836	133
	$0.1171	$2.878	133
	$0.1189	$2.921	133
	$0.1208	$2.965	133
	$0.1227	$3.010	133
	$0.1246	$3.055	133
	$0.1266	$3.101	133
	$0.1286	$3.147	133
	$0.1307	$3.194	133
	$0.1328	$3.242	133
	$0.1350	$3.291	133
	$0.1372	$3.340	133
	$0.1395	$3.390	133
	$0.1418	$3.441	133
	$0.1442	$3.493	133
	$0.1467	$3.545	133
	$0.1492	$3.598	133
	$0.1518	$3.652	133
	$0.1544	$3.707	133
	$0.1571	$3.763	133
	$0.1599	$3.819	133
	$0.1628	$3.876	133
	$0.1657	$3.935	133

Appendix 30 Testing Result of Pricing Policy

Electricity Tariff	Difference	Absolute Difference	Error
$0.0526	($0.0000)	0.00000	0.000
$0.0539	$0.0005	0.00049	0.009
$0.0552	$0.0010	0.00101	0.019
$0.0565	$0.0015	0.00155	0.028
$0.0579	$0.0020	0.00200	0.036
$0.0593	$0.0025	0.00248	0.044
$0.0607	$0.0031	0.00307	0.053
$0.0621	$0.0035	0.00349	0.060
$0.0635	$0.0040	0.00403	0.068
$0.0650	$0.0046	0.00459	0.076
$0.0665	$0.0051	0.00507	0.083
$0.0680	$0.0056	0.00557	0.089
$0.0695	$0.0061	0.00610	0.096
$0.0710	$0.0065	0.00655	0.102
$0.0726	$0.0070	0.00702	0.107
$0.0742	$0.0075	0.00752	0.113
$0.0758	$0.0080	0.00804	0.119
$0.0775	$0.0086	0.00858	0.125
$0.0792	$0.0091	0.00905	0.129
$0.0808	$0.0095	0.00955	0.134
$0.0826	$0.0100	0.00997	0.137
$0.0843	$0.0105	0.01051	0.142
$0.0861	$0.0109	0.01088	0.145
$0.0879	$0.0114	0.01138	0.149
$0.0897	$0.0118	0.01181	0.152
$0.0764	$0.0125	0.01250	0.196
$0.0777	$0.0129	0.01289	0.199
$0.0790	$0.0132	0.01321	0.201
$0.0803	$0.0135	0.01355	0.203
$0.0817	$0.0138	0.01380	0.203
$0.0831	$0.0142	0.01418	0.206
$0.0845	$0.0145	0.01447	0.207
$0.0859	$0.0148	0.01479	0.208
$0.0873	$0.0150	0.01503	0.208
$0.0888	$0.0154	0.01539	0.210
$0.0903	$0.0157	0.01567	0.210
$0.0918	$0.0160	0.01597	0.211
$0.0933	$0.0162	0.01620	0.210
$0.0948	$0.0165	0.01655	0.211
$0.0964	$0.0168	0.01682	0.211
$0.0980	$0.0170	0.01702	0.210
$0.0996	$0.0173	0.01734	0.211
$0.1013	$0.0176	0.01758	0.210
$0.1030	$0.0178	0.01775	0.208
$0.1046	$0.0180	0.01805	0.208
$0.1064	$0.0183	0.01827	0.207
$0.1081	$0.0184	0.01841	0.205
$0.1099	$0.0186	0.01858	0.204
$0.1117	$0.0188	0.01878	0.202
$0.1135	$0.0189	0.01891	0.200
$0.1002	$0.0189	0.01889	0.232
$0.1015	$0.0190	0.01895	0.230

Appendix 30 Testing Result of Pricing Policy (*Continued*)

Electricity Tariff	Difference	Absolute Difference	Error
$0.1028	$0.0190	0.01900	0.227
$0.1041	$0.0190	0.01905	0.224
$0.1055	$0.0191	0.01908	0.221
$0.1069	$0.0191	0.01911	0.218
$0.1083	$0.0191	0.01913	0.215
$0.1097	$0.0191	0.01913	0.211
$0.1111	$0.0191	0.01913	0.208
$0.1126	$0.0191	0.01911	0.204
$0.1141	$0.0191	0.01909	0.201
$0.1156	$0.0190	0.01905	0.197
$0.1171	$0.0190	0.01899	0.194
$0.1186	$0.0189	0.01892	0.190
$0.1202	$0.0188	0.01884	0.186
$0.1218	$0.0187	0.01874	0.182
$0.1234	$0.0186	0.01862	0.178
$0.1251	$0.0185	0.01848	0.173
$0.1268	$0.0183	0.01832	0.169
$0.1284	$0.0181	0.01814	0.164
$0.1302	$0.0179	0.01794	0.160
$0.1319	$0.0177	0.01772	0.155
$0.1337	$0.0175	0.01747	0.150
$0.1355	$0.0172	0.01719	0.145
$0.1373	$0.0169	0.01688	0.140
$0.1240	$0.0121	0.01210	0.108
$0.1253	$0.0117	0.01169	0.103
$0.1266	$0.0113	0.01131	0.098
$0.1279	$0.0108	0.01085	0.093
$0.1293	$0.0104	0.01040	0.087
$0.1307	$0.0099	0.00988	0.082
$0.1321	$0.0094	0.00937	0.076
$0.1335	$0.0089	0.00889	0.071
$0.1349	$0.0083	0.00833	0.066
$0.1364	$0.0078	0.00779	0.061
$0.1379	$0.0072	0.00717	0.055
$0.1394	$0.0066	0.00657	0.049
$0.1409	$0.0059	0.00590	0.044
$0.1424	$0.0052	0.00525	0.038
$0.1440	$0.0045	0.00452	0.032
$0.1456	$0.0038	0.00382	0.027
$0.1472	$0.0030	0.00304	0.021
$0.1489	$0.0022	0.00218	0.015
$0.1506	$0.0014	0.00135	0.009
$0.1522	$0.0004	0.00045	0.003
$0.1540	($0.0004)	0.00043	0.003
$0.1557	($0.0014)	0.00139	0.009
$0.1575	($0.0024)	0.00242	0.015
$0.1593	($0.0035)	0.00352	0.022
$0.1611	($0.0046)	0.00459	0.028

MAPE	3.8%
Confidence Level	96.2%

WRITER BIODATA

Writer's name is Josafat Eliezer Sucahyo, which was born in Surabaya, 29th January 1995. He already finished the formal eduation in Petra 9 Christian Elementary School, Petra 3 Christian Junior High School, and Petra 2 Christian Senior High School, then continued the bachelor degree in Industrial Engineering Department, Institut Teknologi Sepuluh Nopember since 2013. Writer is active in social and charity activities in the church. Besides, writer had joined in international forum, which is Community and Technology (CommTECH) 2016 as the course assistant for Sustainable Development that is held by International Office ITS. In addition, writer also active in developing his softskills and hardskills by various training and scientific forum, such as AutoCAD, Lingo, ARENA, Matlab, Logware, Disco, iGrafX, LSCM Update Forum, etc. Writer can be contacted by email in josafat_es@yahoo.com