UNIVERSITAS INDONESIA

FINANCIAL ASPECT OF FEASIBILITY STUDY (CASE OF 1 MW ON GRID SOLAR POWER PLANT PROJECT PT WIN)

THESIS

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MASTER OF MANAGEMENT PROGRAM
MANAGEMENT BUSINESS INTERNATIONAL
JAKARTA
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Submitted to fulfill one of the requirements to obtain degree of Magister Management – Master Business Administration

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HALAMAN PERNYATAAN ORISINALITAS

Tesis ini adalah hasil karya saya sendiri, dan semua sumber baik yang dikutip maupun dirujuk telah saya nyatakan benar.

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HALAMAN PENGESAHAN

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Telah berhasil dipertahankan di hadapan Dewan Penguji dan diterima sebagai bagian persyaratan yang diperlukan untuk memperoleh gelar *Master of Management - Master of Business Administration* pada Program Studi *International Business* Fakultas Ekonomi, Universitas Indonesia.

DEWAN PENGUJI

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PREFACE

Finishing a thesis has never been an easy job. Combining it with moving to a new office and wedding preparation has made it even harder. Fortunately, the author have a huge amount of support from the surroundings, and for that, the author would like to give warmest and sincerest thanks to these following individuals:

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This study is still far from perfect, any critics and suggestions that can make this study better and more useful will be very much appreciated. Hopefully this study will proved to be useful in developing solar power plant in Indonesia.

Jakarta, June 2011

Author

HALAMAN PERNYATAAN PERSETUJUAN PUBLIKASI TUGAS AKHIR UNTUK KEPENTINGAN AKADEMIS

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ABSTRACTS

Name : Rachmadi Kurniawan

Study Program : International Business

Title : Financial Aspects of Feasibility Study (Case of 1 MW on grid Solar Power Plant Project PT WIN)

The demand for electricity will continue to increase in Indonesia considering the high economic growth and the relatively low electrification ratio in Indonesia, especially in the eastern part. To boost the availability of electricity in Indonesia, the government has published regulations that allow private party to invest in power plant sector. This study is aiming to analyze the feasibility study of investment in power plant for private parties, especially in solar power plant projects. The tools for investment analysis used in this study are Net Present Value, Internal Rate of Return, and Payback Period. The study found that based on the investment criteria used, the solar power plant project is commercially feasible to be implemented.

Key words:

Feasibility Study, Investment Analysis

ABSTRAK

Nama : Rachmadi Kurniawan

Program Studi : International Business

Judul : Financial Aspects of Feasibility Study (Case of 1 MW on grid Solar Power Plant Project PT WIN)

Permintaan untuk listrik akan terus meningkat di Indonesia mengingat pertumbuhan ekonomi yang cukup tinggi dan rasio elektrifikasi di Indonesia relatif rendah, khususnya di bagian timur. Untuk meningkatkan ketersediaan listrik di Indonesia, Pemerintah telah menerbitkan peraturan yang memungkinkan pihak swasta untuk berinvestasi di sektor pembangkit listrik. Penelitian ini bertujuan untuk menganalisis kelayakan investasi di pembangkit listrik untuk pihak swasta, terutama dalam proyek pembangkit tenaga surya. Alat untuk analisis investasi yang digunakan dalam penelitian ini adalah Net Present Value, Internal Rate of Return, dan Payback Period. Studi ini menyimpulkan bahwa berdasarkan seluruh kriteria investasi yang digunakan, proyek pembangkit listrik tenaga surya secara komersial layak untuk dilaksanakan

Kata kunci:

Studi Kelayakan, Analisa Investasi

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CHAPTER 1
INTRODUCTION

1.1 Background

The electricity sector has been growing rapidly over the past years. The emergence of Independent Power Producer (IPP) scheme in Power Plant projects, where the projects will be funded by private entity or investor, help to boost the number of Power Plants nationwide. From the demand side, PT PLN, Indonesia state owned electricity company, has just launched a program called "1 million new connections per day" which will boost the number of their customer. Apart from the retail sector, the number of industrial customers is also increasing, along with the increase of Foreign Direct Investments (FDI) and the development of new industrial zone (RUPTL PLN 2010-2019).

As the number of Power Plant increase, the needs of fuel will also increase. Given the current fluctuation in oil prices, it is understandable that PLN search for a source of energy other than oil. Besides the oil price fluctuation, the issue of global warming has also triggered almost every country to increase the use of renewable energy such as geothermal, bio ethanol, hydro and solar power. As a tropical country, Indonesia is blessed with a huge source of renewable energy, especially geothermal and solar energy. And since the public awareness of global warming and renewable energy is increasing, it will be a huge opportunity to promote the use of geothermal and solar energy.

PT Wijaya Karya Intrade, a subsidiary of PT Wijaya Karya (Persero) Tbk, is a industry and trading company with 5 main businesses which are:

- Automotive Part and Industry Business Unit

  The main products of the Automotive & Industry Business Unit are automotive components for the sole brand license holders (ATPMs). Therefore, the Unit's growth and development are invariably connected to the growth of the domestic automotive market.

- Energy Conversion Business Unit

  The energy Conversion Business Unit is focused on its premier products, namely. Solar Water Heater (SWH) and Air Conditioning Water Heater (ACWH), a water heater that uses the heat generated by ACs meant for households and industries such as hotels, apartments, and textile factories. Currently WIKA SWH is the leader in the domestic market. This business also assembles and sells Photovoltaic products household lighting and other purposes.

- Gas Cylinder and Stove Business Unit

  Since 2008, the unit has benefitted from the tremendous opportunity presented by the government's energy conversion program, which is aimed at replacing the use of kerosene by the public with the use of LPG. This Business Unit was entrusted by the government through PT Pertamina to manufacture gas stoves and cylinders for the program.

- General Trading Business Unit

  The General Trading Business Unit focuses is business on the trade of materials for construction, engineering products/ material and products or engines related to Energy/Power Generation such as infrastructure and industry.

  Export/Import handling services are also strategic activities in General Trading Business Unit, that support/enhance the operational activities of infrastructure projects and those related to the construction of 10,000MW Power Plants targeted by government to overcome the electricity crisis in Indonesia.

- Coal Business Unit

  The Coal Business Unit was officially established in 2008 as a follow-up of the Business expansion that was carries out by the General Trading Business Unit during the previous years. The business expansion of coal trading by WIKA Intrade was based on the large coal trading market potential in Indonesia, both domestic as well as overseas. Domestic market potentials were projected to expand in line with the acceleration of the 10,000 MW power plant developments, all using coal as sources of energy.

In line with the growing prospects of renewable energy development in Indonesia, PT Wijaya Karya Intrade is expanding their energy conversion business unit. Their main focus is in the solar energy industry through their line of products such as WIKA Solar Water Heater, AC Water Heater, and Photovoltaic technology to be applied as solar power plant. Among those products, the development of solar power plant is more business attractive regarding to the scale of the project and the stable revenue from the power purchase agreement.

However, the development of solar power plant using photovoltaic technology in Indonesia is not commonly applied. Most of the solar power plant project is a government subsidized project to fulfill the electricity needs in remote area. Therefore, to expand their business in solar power plant industry, PT Wijaya Karya Intrade need to do a prudent feasibility study to make sure the project is commercially feasible.

1.2 Problem Formulation

The problem which will be addressed in this paper is as follow:

1. How attractive does the solar energy industry in Indonesia?
2. Does the solar power plant project commercially feasible for the company?

1.3 Objectives

The objectives of this study are:

1. To know the attractiveness of solar energy industry in Indonesia
2. To analyze the feasibility of solar power plant project for the company

1.4 Benefit

The benefits of this study are:

1. For the author
    a. Have the ability to applied the course material to the real world
2. For the company
    a. Explore investment opportunities in electricity sectors to expand company business
    b. To analyze the feasibility and attractiveness of photovoltaic technology
    c. Provide feasibility study guidelines to be used in other investment opportunities
3. For the subsequent study
    a. To provide a financial basis to do a comprehensive study on power plant investment

1.5 Systematic of Writing

This systematic is based on a business plan format and added by others supporting theories in analyzing a problem or a strategy (academic thesis report format). This thesis report consists of several chapters, where in each chapter, it consists sub-chapter to describe a topic or a problem. The contents of sub-chapter are problem, supporting theory, research method (exploratory research or descriptive research), analysis, strategy discussion and strategy implementation.

General description of the systematic thesis report is:

Chapter 1 Introduction

This chapter is regarding about background of this report including problems to be faced, objectives and systematic of writing. It consists of background, problem formulation, objectives, and systematic of writing.

Chapter 2 Literature Review

This chapter is regarding about the theory used to analyze the feasibility of the project. It will give an overview of the photovoltaic industry and the theory of capital budgeting analysis.

Chapter 3 Research Methodology

This chapter is about research methodology used in this study, including the data sources, and data processing. This chapter consists of systematic of research, data sources, research study, previous study and data processing methodology.

Chapter 4 Analysis

This chapter is regarding about the analysis of the research result

Chapter 5 Conclusion, Limitation and Suggestion

This is the ending chapter which concludes whether our business plan is a good investment or not.

CHAPTER 2
LITERATURE REVIEW

2.1 The Photovoltaic Industry

2.1.1 Definition

Photovoltaic (PV) is one type of technology used in transforming solar (sun) light into electricity. People often misunderstood by saying that photovoltaic is a synonym for solar energy. In fact, photovoltaic is a technology which uses a device (usually a solar panel) to produce free electrons when exposed to light, resulting in the production of an electric current. On the other hand, solar energy is the energy received by the earth from the sun, in the form of solar radiation, which makes the production of solar electricity possible. So photovoltaic is a technology that utilizes solar energy to become electricity. (http://www.clean-energy-ideas.com)

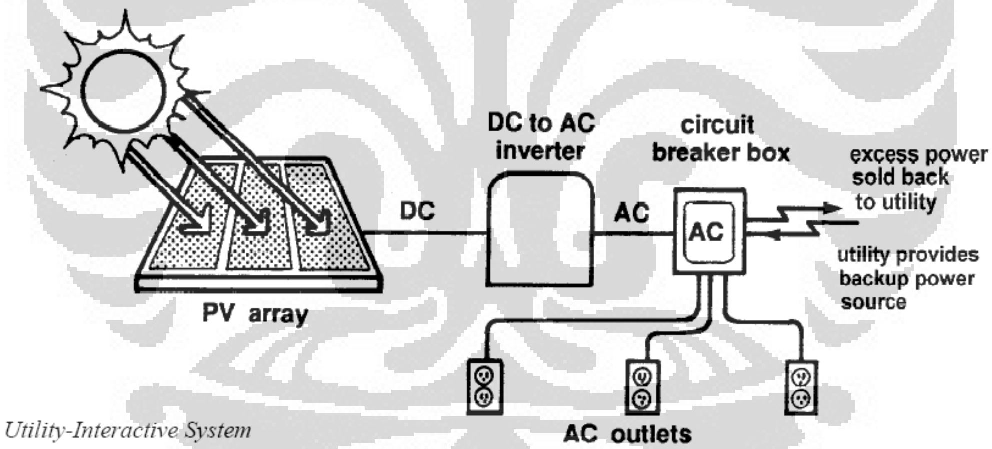


Figure 2.1. Typical Stand Alone Photovoltaic System

Source: North Carolina Solar Center (www.ncsc.ncsu.edu)

The Energy Technology Fact Sheet from United Nations Environment Programme (UNEP) states that there are around 30 different types of PV technology under development, but there are only 3 main technologies in commercial production, which are monocrystalline cells, polycrystalline cells and thin film technologies (United Nations Environment Programme).

Monocrystalline solar cells are manufactured from a water of high quality silicon and are generally the most efficient of the three technologies at converting solar energy into electricity. Polycrystalline solar cells are cut from a block of lower quality multi-crystalline silicon and are less efficient but less expensive to produce. Thin film solar cell are produced in a very different process that is similar to tinting glass. These solar cells are made from semi conductor material deposited as a thin film on a substrate such as glass or aluminum. Thin film solar cells are generally less than half as efficient as the best cells, but much less expensive to produce. They are widely used for powering customer device.

2.1.2 Photovoltaic Application

There are three general categorization of photovoltaic technology in the United States, which are residential, commercial, and grid sited (L. Frantzis, et al, 2001). Residential and commercial application can be further categorized into markets for both new construction and existing (retrofit) buildings.

Table 2.1. Key Grid Connected Application in the United States

Key Grid-Connected Applications in the US			
Application		Description	Typical Size Range
Residential	Retrofit	• PV modules installed on roofs of existing homes; average system size increasing	2-8 kW
	New Construction	• Increasingly, building integrated products are installed at time of home construction	1.5 – 5 kW
Commercial	Retrofit	• PV modules installed on roofs of existing commercial and industrial spaces; average system size increasing	20 – 1,000 kW
	New Construction	• Increasingly, building integrated products installed at time of building construction (especially in Europe)	20 – 1,000 kW
Grid-sited		• Ground-mounted PV systems installed on the wholesale side of the distribution grid	> 500 kW

Source: L. Frantzis, S. Graham, R. Katofsky, and H. Sawyer. "Photovoltaic Business Model",2008

The application of photovoltaic in the other area of the world is more or less the same with the application of photovoltaic in the United States. The possible difference is just on the size of the power generated by the system. In some developing countries, photovoltaic is becoming the best alternative to generate electricity in the rural area that still cannot be reached by the conventional electricity system.

There are also some variations in the application of the photovoltaic technology for the residential market. Instead of using photovoltaic as an electricity generator for houses, some company offer photovoltaic as a power generator for specific home appliances such as solar water heater and solar powered submersible pump. In the commercial market, photovoltaic is also being used as a power generator for base transmission unit (BTS) for the telecommunication industry. There is also an application of photovoltaic for public facilities such as street lamps.

2.1.3 Supply Chain of Photovoltaic business

Before the feasibility of the photovoltaic business for the company can be analyzed, it is necessary to determined in which part of the supply chain do the company operate.

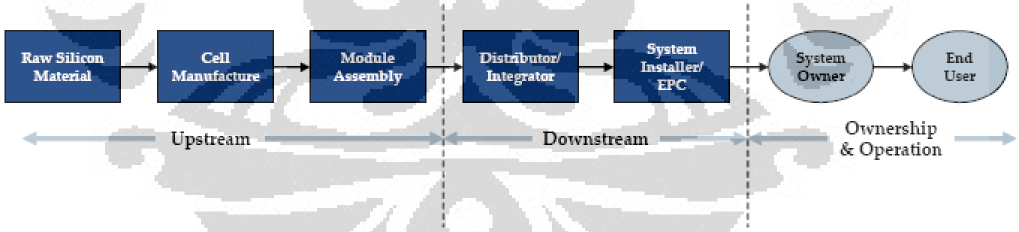


Figure 2.2. Basic Component of PV Product Supply Chain

Source: L. Frantzis, S. Graham, R. Katofsky, and H. Sawyer. "Photovoltaic Business Model",2008

The upstream business in the PV product supply chain related to the manufacture of solar panel module, starting from the raw material until it become a ready to use solar panel module. The downstream business is the user of the solar panel module, related to the distribution and trading of the solar panel module, up until the system installation and the engineering, procurement, construction (EPC) of the solar power plant. The last stage of the supply chain is the ownership and operation. The player in this stage is the operator of the solar power plant and the end user who invest in the solar system for the houses, offices and other commercial usage.

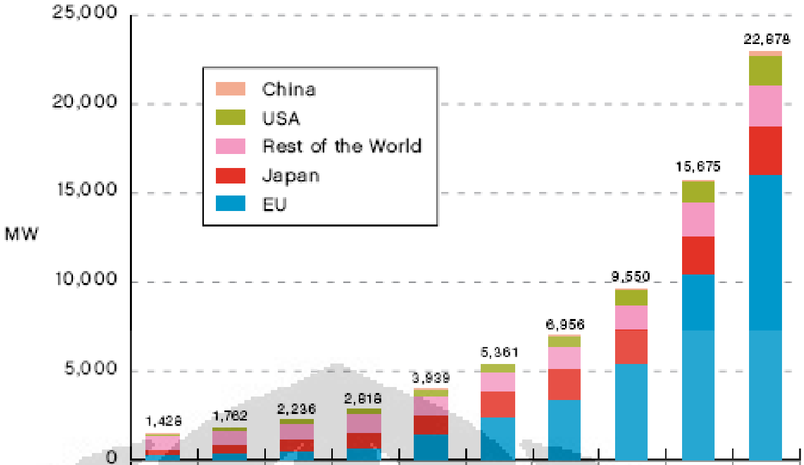
Currently, PT Wijaya Karya Intrade is engaged in the second stage of the supply chain. Through their energy conversion business unit, they are involved in the trading and installation of solar panel system. But for the longer term, the company is planning to expand their business by entering the third stage of the supply chain, by becoming the owner of the solar power plant. This study will analyze the business feasibility if the company realizes their plan to become the owner of solar power plant. (PT Wijaya Karya Intrade Company Profile).

2.1.4 Photovoltaic Market

- *The World Market*

The PV market grew by an average of 15% annually from 1990-2000 (The Energy Technology Fact Sheet, UNEP). At the end of 2009, more than 22 GW of solar power were installed throughout the world, and provisional figures show a global installed capacity exceeding 37 GW by the end of 2010 (European Photovoltaic Industry Association's Publication, 2011).

Of the 22 GW installed photovoltaic in the world, European continent leading the market with approximately 16 GW capacities installed, which is almost 70% of the world photovoltaic capacity. The strong commitment from the government to promote renewable energy and the establishment of policy to support the implementation of photovoltaic technology are some of the reason why Europe is leading the world photovoltaic installed capacities.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
China	19	30	45	55	64	68	80	100	145	305
USA	139	168	212	275	365	479	624	831	1,173	1,650
ROW	763	825	913	1,000	1,044	1,051	1,235	1,422	1,870	2,347
Japan	318	452	637	860	1,132	1,422	1,708	1,919	2,149	2,633
EU	189	286	429	628	1,334	2,341	3,309	5,279	10,338	15,943
Total	1,428	1,762	2,236	2,818	3,939	5,361	6,956	9,550	15,675	22,878

Figure 2.3. Historical Development of World Cumulative PV power installed

Source: Global Market Outlook for Photovoltaic, EPIA, may 2010

If we look in more detail, within the European countries, Germany is leading the amount of photovoltaic capacity installed in the world. The total capacities installed in Germany are about 53% of the world photovoltaic market in 2009.

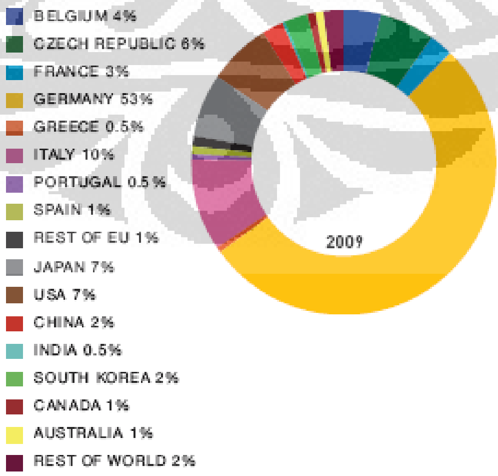


Figure 2.4. The world PV market in 2009

Source: EPIA Publication, 6th Edition, 2011

The growing trend of photovoltaic installed capacity in the world is further boost by the fact that there is also a decreasing trend of photovoltaic technology investment cost. Although in many cases photovoltaic remains more expensive than the conventional electricity production method, the price decrease is so fast that the competitiveness of photovoltaic with other energy sources will be achieved in the next 5 years in several countries.

- *The Indonesian Market*

As a tropical country, Indonesia unmistakably has a huge resource for solar energy. The sun that shines throughout the year will provide a huge source of energy for electricity. Based on General Plan for Electricity Generation 2010-2019 of PT PLN, Indonesian state owned Electricity Company, the total potential of solar energy in Indonesia is about 1.200 GW. And from that huge amount, the utilization is very low, only 0,001% of the total potential.

The huge amount of investment cost needed and the lack of incentives program from the government for the utilization of renewable energy makes the development of photovoltaic technology in Indonesia is practically limited. Only some local governments are paying attention to the utilization of photovoltaic technology to generate electricity for people in remote area.

For the commercial and residential sector, the most widely known application of photovoltaic is the use of solar water heater. The relatively affordable investment needed and the fact that solar water heater can give some sense of prestige to the owner made the solar water heater technology become widely known.

2.2 Project Feasibility Study

Project Feasibility Study is needed when a company wants to do a business expansion or entering a new business. It becomes very important because investment decision involves the commitment of a large amount of money and they will affect the business over a number of years.

Since the benefit of the investment are based on future events and the ability to foresee the future is imperfect, the company should make a considerable effort to evaluate investment alternative as thoroughly as possible (Boehlje and Ehmke, 2005).

In doing project feasibility study, company should first do macroeconomic analysis to analyze the macroeconomic factors related to the investment plan. This includes international economy, inflation, and industry analysis. From the micro economy perspective, the company should also do industry analysis and project specific investment analysis to identify the potential cost and benefit of the investment plan. The company should also not to forget to do risk assessment to analyze the potential risk related to the investment plan.

2.2.1 Macroeconomic Analysis

Economic analysis is used for two main purposes. The first is a scientific understanding of how allocations of goods and services – scarce resources – are actually determined. This is a positive analysis. The development of this positive theory suggests other uses of economics. Economic analysis suggests how distinct changes in laws, rules, and other government interventions in markets will affect people, and in some cases, one can draw a conclusion that a rule change is socially beneficial. Such analysis combine positive analysis with value judgements, and also known as normative analysis (McAfee, 2006).

The purpose of Macroeconomic analysis in this study is to analyze the law and regulation in the electricity sector, particularly in the solar power plant, and the effects of those regulations on the attractiveness of doing business in those sectors. The outcome of this analysis will provide the investor with a better understanding about the law and regulations in electricity industry to help them in making better investment decisions.

2.2.2 Industry Analysis

The purpose of industry analysis is to understand the growth potential and the industry attractiveness. By knowing this information, company can decide whether to enter the industry or not. The most common tool for doing industry analysis is Porter Five Forces Model (Porter, 2008).

Figure 2.5. Porter's Five Forces Model

Source: Porter (2008)

Porter Five Forces Model assumes that there are five important forces that determine industry attractiveness, which are:

- Competition Within the Industry

  The intensity of competition in the industry, which helps to determine how much value added the company can get given the current head-to-head competition in the industry.

- Threat of New Entry

  The profitability that the company can gain in the industry is not only determined by the existing competitor in the industry. There is potential new entrants that can potentially take some share of the industry profitability.

  The company can determine the threat of new entry based on the barrier to entry in the industry. The higher the barrier to entry in the industry, the smaller the threat of new entry. Barrier to entry can take in different forms, such as economies of scale, government regulations, and distribution channels.

- Threat of Substitute Products

  Beside the competition within the industry, there are also a potential of the emergence of substitute products. Substitute products will give a negative impact to the company since it will switch the existing and potential customer from the company.

  The threat of substitute product is affected with the switching cost in the industry. Some industries have a high switching cost that will affect customers' decision to switch products. In this kind of industry, the threat of substitute product is relatively low.

- Bargaining Power of Buyer

  Bargaining power of buyer influences the value that will be created in the industry. If the bargaining power of buyer is high, then the customer may have the ability to determine the price and the overall attractiveness of the industry. Bargaining power of buyer is determined by the number of buyers, the importance of each individual buyer to the business, the cost of switching products, and the degree of information the buyer have.

- Bargaining Power of Supplier

  The bargaining power of supplier will have almost the same effect with the bargaining power of buyer, only this is for the supplier side. The supplier with high bargaining power can dictate the price of the goods supplied to the company and the term and conditions of the transactions. Bargaining power of supplier is affected by the number of supplier of each key input, the uniqueness of their product or service, and the cost of switching from one to another.

2.2.3 Capital Budgeting Analysis

The final step of making investment decision is doing capital budgeting analysis. Capital budgeting analysis is the process of analyzing, evaluating, and deciding whether the investment project is feasible for the company. The result of capital budgeting analysis will highly influenced the go/no go decision in the investment project. Capital budgeting is very important because it involves a high amount of money which is not easily reversible. A failure of doing capital budgeting analysis will have a long term implication for the firm.

There are three most common used tools for capital budgeting analysis which are Net Present Value (NPV), payback period, and internal rate of return:

- Net Present Value (NPV)

  Net Present Value (NPV) is the present value of future cash flow minus the present value of the cost of investment (Ross, 2007). A project is categorized as feasible if the value of NPV is larger than zero. If the NPV is negative, then the company should reject the project.

  The formula of NPV is as follow:

$$NPV = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} - C_0$$

Where NPV = Net Present Value

Ct = Cash Flow of the project

Co = Initial Investment of the project

r = Discount rate of the project

NPV is the powerful method of doing capital budgeting analysis. Still according to Ross, there are three attributes of NPV that makes it a powerful method:

- NPV uses cash flow, not earning
- NPV uses all the cash flows of the project
- NPV discounts the cash flow properly

- Internal Rate of Return (IRR)

The internal rate of return, or universally known as IRR, is the most important alternative to NPV. IRR is the discount rate that will equate the present value or the outflow with the present value of the inflow (Gitman, 2009), to make it simpler, IRR is the discount rate that causes the NPV of the project to be zero. The general investment rule is to accept the project if IRR is greater than the discount rate, and reject the project if IRR is less than the discount rate.

The formula for calculating IRR is as follow

$$I_0 = \sum_{t=1}^{n} \frac{CF_t}{(1+IRR)^t}$$

Where IRR : Internal Rate of Return

CF : Cash Flow of the project

I_0 : Initial Investment

- Payback Period

  Another alternative to NPV is payback period. The payback period simply measures how long (in years and/or months) it takes to recover the initial investment. The maximum acceptable payback period is determined by the management. If the payback period is less than the maximum acceptable payback period, the company should accept the project. If the payback period is greater than the maximum acceptable payback period, the company should reject the project.

  Company use payback period because it is simple, intuitive, and consider cash flow rather than accounting profit. It also gives implicit consideration to the timing of cash flows and is widely used as a supplement to other methods such as Net Present Value and Internal Rate of Return (Gitman, 2009).

  However, there are some major drawbacks of using payback period (Ross, 2007):

  - Timing of cash flow within the payback period

    Payback period method does not consider the timing of the cash flow within the payback period. When there is two project with similar payback period, we cannot decide which one better. In fact, one project might have cash flow of $50 in year 1 and grows to $100 in the year 5, while the other project with identical payback period may have cash flow of $100 in year 1 and declines to $50 in year 5. This could make huge differences, but it cannot be detected using payback period method.

  - Payments after the payback period

    Payback period method did not consider the cash flow receipt after the payback period. Two projects might have identical payback period when in fact one project might have a constant stream of cash flow after the payback period while the other project doesn't have any cash flow after the payback period. Again, this problem cannot be detected using payback period method.

- Arbitrary standard for payback period

  While the other methods like NPV have the standard range of value related to the risk and the industry of the project, there is no consensus of payback period to help management to decide the appropriate payback period for the company.

2.2.4 Cost of Capital

Cost of Capital is defined as the opportunity cost of all capital invested in an enterprise (Giddy, 2008). In an enterprise, this refers to the fact that we are measuring the opportunity cost of all sources of capital which include debt and equity.

To calculate the cost of capital, first we calculate the cost of each kind of capital that the company/project used, which is debt and equity. The cost of debt is equivalent to the actual interest rate on the company/project debt. It should be noted that the cost of debt used in calculating the cost of capital is the after tax cost of debt.

We calculate cost of equity by using the Capital Asset Pricing Model (CAPM). This model says that equity shareholders demand a minimum rate of return equal to the return from a risk-free investment plus a return for bearing extra risk. This extra risk is often called the "equity risk premium", and is equivalent to the risk premium of the market as a whole time a multiplier-called "beta"-that measures how risky a specific security is relative to the total market.

$$CAPM = Rf + \beta(Rm\text{-}Rf)$$

Where Rf = Risk Free Rate

B = Beta

Rm = Market Risk

The next step is to weight the cost of debt and cost of equity based on their proportion in the total capital structure. This method is also known as the Weighted Average Cost of Capital (WACC).

$$WACC = K_e \times \frac{E}{V} + K_d \times (1 - T) \times \frac{D}{V}$$

Where Ke = Cost of Equity

Kd = Cost of Debt

E = Market value of Equity

D = Market value of Debt

T = Corporate Tax Rate

V = Market value of Equity plus Market Value of Debt

2.3 Scenario Analysis

In calculating the feasibility study of a project, we assume that the conditions we set up in the cash flow projection are the most likely scenario. However, there are probability of other scenario where the cash flow will be different from the expectations, be it higher or lower that the original scenario.

In scenario analysis, the expected cash flow and asset value are estimated under various scenarios, with the intent of getting a better sense of the effect of risk on investment value (Damodaran, 2007). The easiest way to do this is by setting the best case and worst case scenario. The difference outcome from the best case and worst case scenario can be used as a measure of a risk on an asset. The riskier asset should have a higher range of value.

Scenario analysis does not have to be restricted to the best and worst cases. In its most general form, the value of a risky asset can be computed under a number of different scenarios, varying the assumptions about both macroeconomic and asset specific variables.

The scenario analysis has four critical components:

- The determination of which factors the scenarios will built around. The analyst should focus on the two or three most critical factors that will determine the value of the asset and build scenarios around these factors.
- Determining the number of scenarios to analyze for each factor.
- The estimation of asset cash flow under each scenario
- The assignment of probabilities to each scenario.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Data Sources and Period

The data used in this study is a quantitative data in the form of secondary data derived from the annual report of PT Wijaya Karya (Persero) Tbk, the General Plan of Electricity Generation (RUPTL) 2010-2019 of PT Perusahaan Listrik Negara, and the project investment data of a selected Solar Power Plant Investment Project. The data period used in this study is in accordance with the project life, which is 30 years.

3.2 Research Study

The author has done some research study through library research and field study. The library research is a research based on secondary data which is publicly available. Most of the data used in this study is a secondary data as a result of extensive library research, which is available through websites, books and scholarship journals.

The field study is done by doing interview with the Business Development Manager of PT Wijaya Karya (Persero) Tbk, the parent company of PT Wijaya Karya Intrade, which is responsible in handling the execution of investment projects within the PT Wijaya Karya (Persero) Tbk group. The result of this interview is a more detail data about the 1 MW solar power plant project.

3.3 Previous Study

M. Retnanestri and H. Outhred, in their study "Off-grid Photovoltaic Applications in Indonesia: An Analysis of Preliminary Fieldwork Experience" (2003) examine the sustainability of photovoltaic technology as a mean of rural electrification. The study found that in order for the photovoltaic technology to be sustainable in off-grid application in Indonesia, it is imperative that PV is delivered to rural Indonesians in an institutional framework that accommodates the interests of all stakeholders. PV is best viewed as an enabling technology able to strengthen the rural socioeconomic culture, promote care for the environment, and from which they can earn their livelihood.

Another study by Peter Lorenz, Dickon Pinner, and Thomas Seitz, “The Economics of Solar Power” which is published in June 2008 edition of McKinsey Quarterly, states that the solar energy sector is currently still in infancy with so many challenges facing. However, solar energy is becoming more economically attractive. PV is best viewed as an enabling technology able to strengthen the rural socioeconomic culture, promote care for the environment, and from which they can earn their livelihood.

3.4 Data Processing Methodology

3.4.1 Macroeconomic Analysis

The macroeconomic data obtained in this study will be analyzed by looking at the historical data of each key economic indicator. By doing this analysis, the data trend of each economic indicator can be captured and used to identify whether the particular key economic indicator is favorable for the investment project to be done.

3.4.2 Industry Analysis

The analysis of photovoltaic industry in Indonesia will be done by using the porter 5 forces model. This analysis will focus in five key points which are the rivalry within the industry, the bargaining power of buyer, the bargaining power of supplier, the threat of substitute product and the threat of new entrants. The result of this analysis is the attractiveness of the photovoltaic industry in Indonesia.

3.4.3 Capital Budgeting Analysis

The capital budgeting analysis is directly related to the project itself. The analysis will focus on the profitability of the project with regards to the initial investment cost spent in the beginning of the project.

3.5 Systematic of Thinking

This research use systematic of thinking which will be explained by the following diagram:

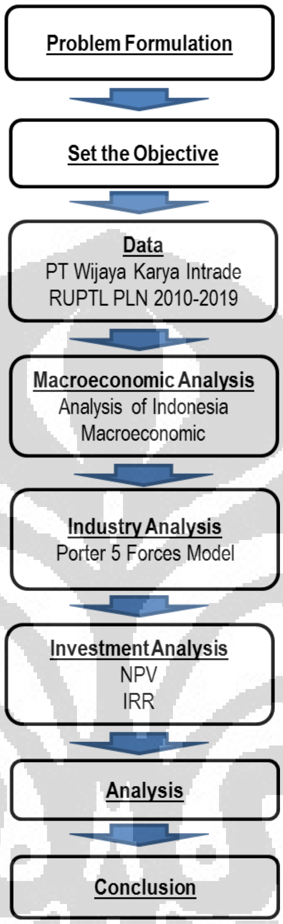


Figure 3.1. Systematic of Thinking

3.5.1 Problem Formulation

The first step of doing the research is to formulate the problem which is going to be analyzed. In this study, the problem which is going to be analyzed is the feasibility of solar power plant project.

3.5.2 Set the Objective

After formulating the problem, the researcher need to set the objective of the study. By setting the objective, the researcher can focus on specific aspect of the problem which is going to be analyzed.

3.5.3 Collection of Data

The first step of doing the research is collect the data needed for the research. The selection of data is based on the availability of the data and the suitability with the research objective. The data resources will be discussed more detail in the next sub chapter.

3.5.4 Macroeconomic Analysis

Macroeconomic analysis need to be done to analyze the attractiveness of Indonesia recent key economic indicator especially the indicator related to the electricity sector.

3.5.5 Industry Analysis

After doing macroeconomic analysis, we need to hold an industry analysis to measure the attractiveness of the electricity industry, particularly the photovoltaic industry in Indonesia. The writer will use porter 5 forces model to analyze the electricity industry.

3.5.6 Capital Budgeting Analysis

The next analysis is investment/capital budgeting analysis. This is the most important analysis since it is directly related to the investment project. The tool that will be used in doing investment analysis is Net Present Value, Internal Rate of Return, and Payback Period. The writer will also do a scenario analysis to analyze the sensitivity of the investment project.

3.5.7 Conclusion and Suggestion

The result of macroeconomic, industry, and investment analysis will then be used to make an overall conclusion about the electricity industry, particularly the photovoltaic industry, and to give recommendation for the company related to the investment plan.

CHAPTER 4
ANALYSIS

4.1 Macroeconomic Analysis

Amid the global economic recovery imbalance, Indonesia economic performance during 2010 continued to experience improvement. This is reflected by the increasing Gross Domectic Product (GDP), surplus in balance of payment, and the improving performance of the financial sector. The improvement is supported by solid domestic demand and conducive global environment. With the population amounting to 200 million people, Indonesia can maintain the stability of their economic from their own domestic demand.

From the global point of view, the world economy has started to recover from the global crises in 2008. The recovery, which started in 2009, is lead by the Asia Pacific economies, like China and Japan which shows no signs of slowing down, and some of the emerging economies like Indonesia, which is supported by strong domestic demand. However, the global recovery is not working that smooth, as there are still some debt problems for some European countries.

4.1.1 Global Economy

Global economic recovery which started in 2009 is still ongoing. The signs of economic recovery can be seen from the volume of world trade which is steadily growing, as depicted in picture 4.1. The world trade volume is experienced a 12% growth in 2010 after a contraction of 11% which happens in 2009 (Bank Indonesia: 2011). Emerging market economies which have strong trading base become the driver of the increase in world trading volume. Besides, the trades between the emerging economies have become more integrated, giving more boosts to the increasing volume of world trading. These two factors make the impact of the slowing economies in developed countries become minimal.

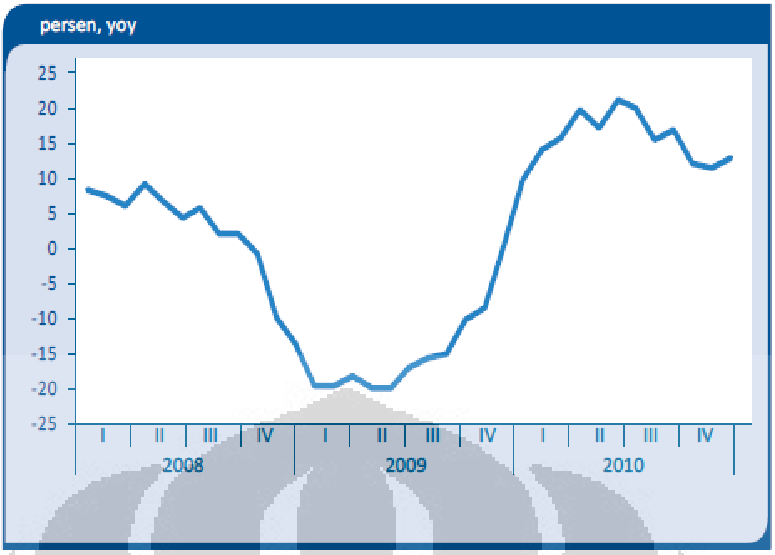


Figure 4.1. World Trade Volume

Source: Laporan Perekonomian Indonesia 2010, Bank Indonesia

The acceleration of world trade volume leads to the increase in global commodity prices. In the oil sector, the increase of demand along with the increase of world economies has led to the increase in oil price. On the other side, non-oil commodity price also increases, albeit not as high as the oil price increases.

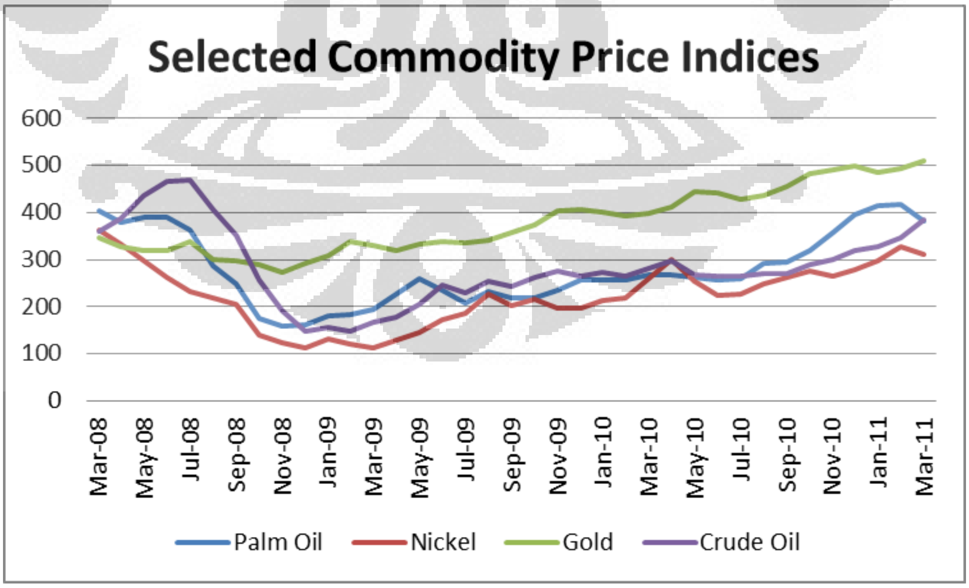


Figure 4.2. Historical Price Indices of Selected Commodities

Source: United Nation Conference on Trade and Development (www.unctad.org)

The increase in commodity price is mainly caused by the vulnerability of financial market conditions due to the global economic crises, and the weakening of US currency which lead to the stream of global funds to commodity market, in an attempt to do profit taking actions.

The increase in commodity price as a whole in the end will impact on the increase of world inflation level. The higher inflation pressure will be experienced by emerging market economies, as the demand for the commodities is higher in those countries. Especially for the non-oil commodities, the weather anomaly which happens in the second half of 2010, especially in Asia, have given extra pressure on the inflation of food commodities as the production level is decreasing while the demand is still high. On the other hand, the inflation rate in developed countries relatively stable, along with the slow acceleration in economic recovery. In 2010, the inflation rate in emerging markets reach 5,54%, while in the developed countries the inflation rates are 1,44% (Bank Indonesia:2011).

In response to the global economic recovery, the emerging markets and developed countries implement different policies. Developed countries, in an attempt to minimize the pressure from financial market and to keep the momentum of recovery, applied a more loose policy. The emerging markets, however, facing an inflation pressure which force central banks from those countries tend to implement policy normalization through increase in interest rates. The difference in policy has triggered the stream of capital inflow to the emerging markets.

The high level of capital inflow in emerging markets has significantly strengthened the currency of those countries which could potentially lower their competitiveness. Some countries therefore implement various policies to stabilize their exchange rate in order to keep their competitiveness level. These different exchange rate policies will in the end trigger a currency war which makes it harder to reach the balance in global economy.

4.1.2 Indonesia Economy

The domestic economy is positively affected by the recovery of global economy. The acceleration of world trade volume and the rising price of commodity, as mentioned in previous sub-chapter, have significantly affected the high level of export from Indonesia. In 2010, export has become the largest contributors to Indonesia economic growth (Bank Indonesia: 2011). As we can see in figure 4.3, the amount of export from Indonesia has continuously improving, with the growing contribution of non-oil and gas sectors.

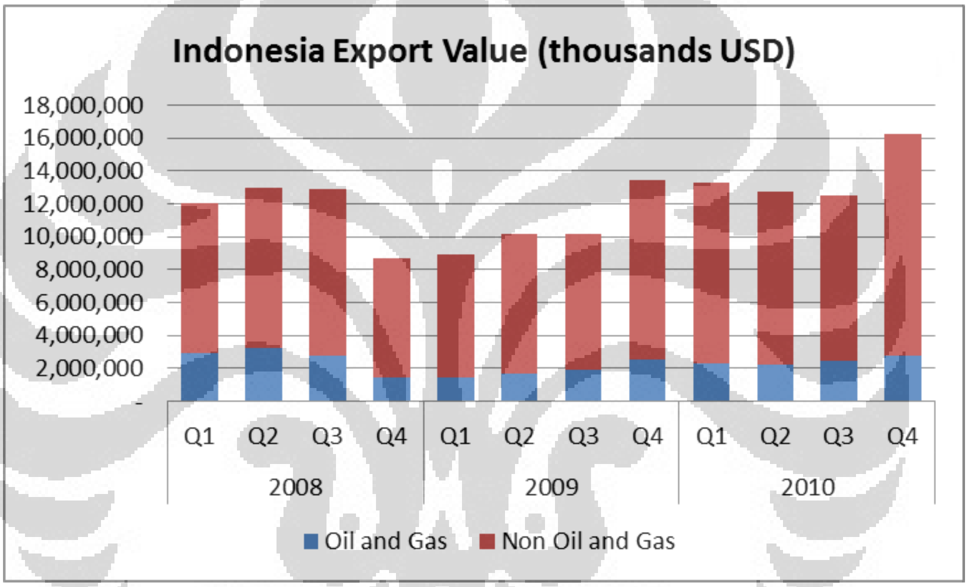


Figure 4.3. Indonesia Export Value

Source: Bank Indonesia, processed by author

The global economy recovery has also increase the amount of foreign direct investment to Indonesia. The improvements in investment climate and domestic economic performance have increased the confidence of foreign investor to invest in Indonesia. The increase of foreign direct investment can be seen by the increase of non-oil and gas sectors. In these sectors, foreign direct investment is largely spent on processing industry, mining, trading and communication industry.

The increase in foreign direct investment in Indonesia also has positive effect for Indonesia capital market. Jakarta Stock Exchange indices have continuously improving and make it become one of the best stock exchanges in the region. The rush of capital inflow in Indonesia, apart from the effect of policy gap between developed and developing countries, also supported by the strength of domestic economy and the raise of investment rating in Indonesia closer to become investment grade.

Besides affecting the stock exchange performance, the increase of foreign direct investment also affected the exchange rate of Indonesian Rupiah (IDR). Throughout 2010, IDR have shown an appreciation towards USD, as depicted in figure 4.4. The appreciation of IDR happens in line with the stream of foreign capital as a result of global liquidity surplus and policy gap between developed and developing countries. The appreciation of IDR is also affected by the negative prospects of USD which experienced depreciation exposure. The strength of domestic economy fundamentals and investment grade prospects of Indonesia have also given additional boost to IDR appreciation.

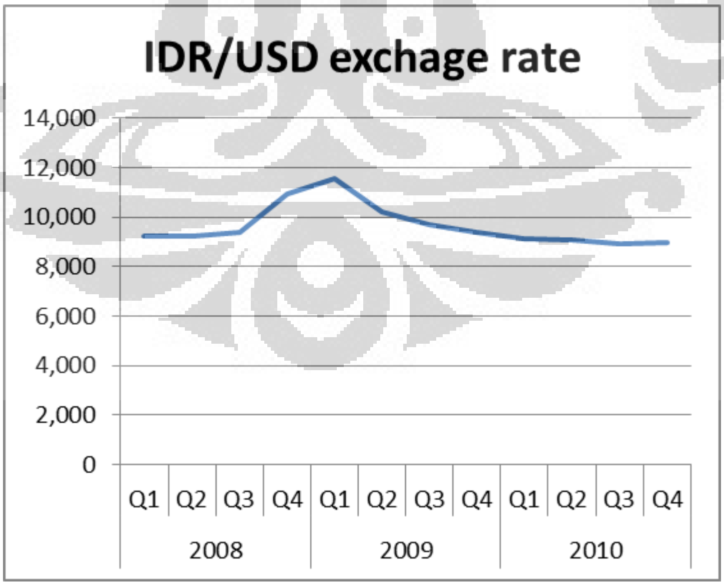


Figure 4.4. IDR Exchange Rate

Source: Bank Indonesia, processed by author

However, the appreciation of IDR also has negative effect to Indonesia economy. The appreciation of IDR has somehow created some complexity in macroeconomic policy. Apart from being very useful for inflation targeting, the appreciation of IDR can have an impact on the slowing down of Indonesia economy, because it makes the goods produced in Indonesia become more expensive in international market, and it will slows down the export from Indonesia.

Another issue is about the sustainability of the capital stream. Capital inflow, especially the capital invested in stock exchange, is very sensitive to global perception of economy. The change in global perception can result in the withdrawal of foreign direct investment which can create volatility in IDR exchange rate. The government needs to set up policy which can minimize the impact of such risk to avoid volatility of IDR exchange rate.

In 2010, Indonesia has also experienced a higher inflation exposure. Inflation based on consumer price indices have increase significantly to 6.96%, higher than the targeted inflation rate which is 5% ± 1% (Bank Indonesia). This increase is affected by both external and domestic factors which happen throughout 2010. From the external side, the increase in inflation rate is in line with the increase in global inflation rate, especially in emerging market economies, as a result of global economic recovery and the increase in commodity prices. However, the increase of world commodity price, which use USD as a base currency, can be offset by the appreciation of IDR exchange rate. The appreciation can minimize the exposure from world commodity price to the inflation rate in Indonesia.

From the domestic side, the increase in inflation expectation, demand and supply conditions, and the commodity tariff adjustment did not give over exposure to the inflation rate. The exposure is mainly caused the rising price of agricultural products since there are delays in distribution of agricultural products as a result of weather anomaly which happens throughout the year.

4.2 Industry Analysis: Electricity Sector in Indonesia

In doing industry analysis, the author will use a 5 forces approach developed by Michael Porter which includes rivalry among existing competitor, bargaining power of buyer, bargaining power of supplier, threat of new entrants and threat to substitute products.

4.2.1 Rivalry Among Existing Competitor

The rivalry among existing competitor in electricity sector in Indonesia is quite intense. The recent regulation which allow private sector to enter electricity business has attracts many investor to invest in the power plant projects. The competition is not only from domestic player, but from foreign investor as well, which make the competition more intense.

In solar panel industry, the rivalry among existing competitor in Indonesia is considered strong. Even though there are still a limited number of players in the industry, the solar panel industry itself is still limited, so those player is fighting to get their portion in the market. However, the intense competition exists in the manufacturer side of the industry. For the power plant investment side, the competition level is still low considering the high amount of investment needed and the economic feasibility of the investment in solar power plant which is still viewed as not economically feasible.

Despite the competition level, the electricity sector in Indonesia still has good prospects in the long term. Demand growth for electricity is expected to grow 8-9% annually, higher than the production growth. Demand from Java-Bali will continue to dominate and represent about 80% of total demand in Indonesia, while demand from outside Java-Bali is expected to increase in line with the favorable mining and agriculture business. The projection of electricity demand is depicted in figure 4.5.

Figure 4.5. Electricity Demand in Indonesia

Source: RUPTL PLN 2010-2019

Currently, the average electrification ratio in Indonesia as of June 30th, 2011 is around 66.1% (PT Perusahaan Listrik Negara: 2011). This means there are 34% of Indonesian people which still cannot experienced the use of electricity, which is a huge market potential for the electricity industry.

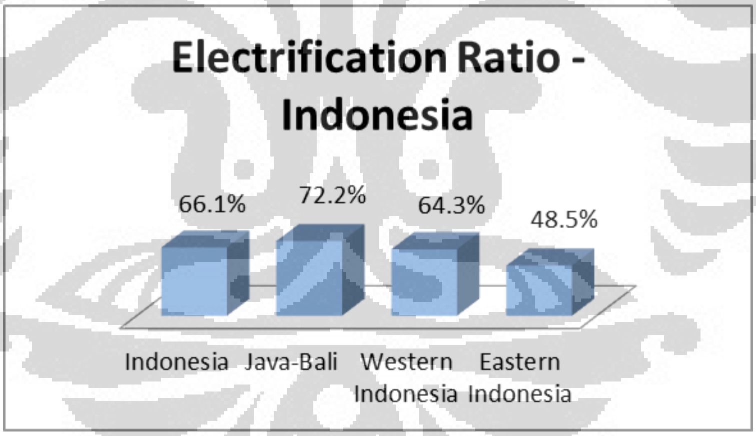


Figure 4.6. Electrification Ratio in Indonesia

Source: PT Perusahaan Listrik Negara (Persero)

As we can see from figure 4.6, the average electrification ratio in Indonesia is 66.1%, from that ratio, Java-Bali has the highest electrification ratio (72.2%), while the eastern part of Indonesia have the lowest electrification ratio (48.5%). This condition is understandable since most of the business and infrastructure development is still concentrated in Java-Bali. In the near future, PT Perusahaan

Listrik Negara (Persero) have set the target to increase average electrification ratio in Indonesia to 72%. To achieve this,PT PLN have budgeted IDR 5 trillion funds which is allocated to western part of Indonesia (IDR 0.92 trillion), Java-Bali (IDR 3.3 trillion), and eastern part of Indonesia (IDR 0.75 trillion).

4.2.2 Bargaining Power of Buyer

The electricity sector in Indonesia is a highly regulated industry, since it is one of basic human needs. In this sector, the Government of Indonesia have appointed PT Perusahaan Listrik Negara (PLN) (Persero), a state owned company, to fulfill the duty of providing electricity throughout Indonesia. Apart of being one of human basic needs, electricity also strategically important to the Government and one of the critical factors of economic development. The government will regulate the tariff, purchase price from the Independent Power Producers (IPP), distribution and transmission fees, as well as license approval for new operators.

PT PLN previously has a monopoly power in the electricity sector in Indonesia since they have mandate from the Government to provide electricity in Indonesia. But since 2009, the monopoly status have been lifted by the implementation of Electricity Law no. 30/2009 which allow other parties other than State Owned Enterprise (SOE), to participate in power generation business. However, PT PLN still has the first right of refusal to obtain power plant project in new area.

The increasing demands for electricity and limitations of PT PLN to fulfill all of the demand become the main reason for the government to lift the monopoly status of PT PLN, and encourage private sectors to involve in electricity generation. In the implementation, since PT PLN still the only company who has transmission and distribution networks, the other parties who involved in electricity business is restricted in terms of tariff setting and power distribution and they have to sell the electricity they generated to PT PLN as a single buyer through Power Purchase Agreement (PPA).

Tariff adjustment in electricity sectors is very inflexible because it is set by the Government. And the Government cannot easily adjust the tariff since it is very sensitive to the lives of their people and can create negative images to the Government. However, the private investor need not worry about the tariff adjustment since they will sell their generated electricity to PT PLN with an economically feasible tariff, and then PT PLN will be the one to bare the risk of tariff inflexibility.

The tariff set by the Government is currently not enough to cover the production cost of PT PLN, that is the reason why Government subsidies still hold an important role in the electricity sectors. Government subsidy contributes around 36% of PT PLN revenue in 2010 and is expected to play an important part in the company's revenue in the future.

Despite the inflexibility of electricity tariff adjustment, Government, through Presidential Decree No. 8/2011 increased the electricity tariff effective from July 2010, the first increase in electricity tariff since 2003. The average tariff increase was 10%. PPLN, based on Regulation of Ministry of Energy and Mineral Resources no. 7/2010, also withdrew the tariff capping for industrial customer effective per 1 January 2011. The tariff increase and the withdrawal of tariff capping for industrial customers are expected to reduce the gap between PPLN's selling price and its production cost and make PPLN's business more profitable in the long run. This will also lighten the electricity subsidy burden in the Government budget.

4.2.3 Bargaining Power of Supplier

The power plant equipment is still dominated by imported products due to the high technology involved. These conditions have made the supplier have a high bargaining power which make them in the position where they can set the term and conditions of the trade, and the financing used in the procurement of the equipment.

4.2.4 Threat of Substitute Products

In electricity business, the largest component of operating cost is the fuel cost. Currently, the power plants in Indonesia are still dominated by coal, followed by fuel oil as the second largest energy source. With the continuous fluctuation of oil price due to its sensitivity to global economic conditions, using fuel oil as a source of energy is not economically feasible. Government, through ministry of energy and mineral resources, have develop a strategic plan to change the composition of the fuel mix in order to lessen the exposure of oil price fluctuation to the domestic electricity industry.

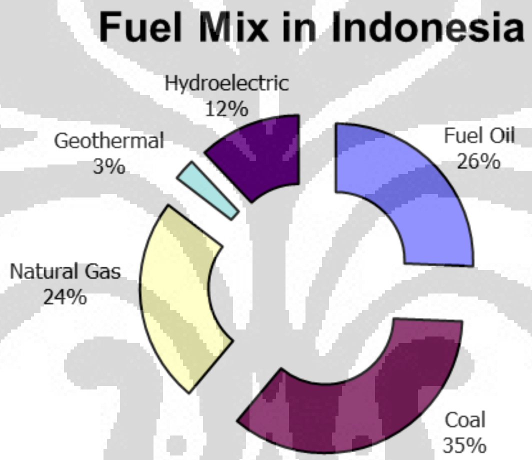


Figure 4.7. Composition of Energy Source in Indonesia

Source: PT Perusahaan Listrik Negara (Persero)

The first major step taken by the Government is the launch of Fast Track Program phase 1. Based on Presidential Decree No.71/2006, government introduced FTP I, in which PPLN has to develop coal fired power plants in 40 locations, 10 power plants with aggregate capacity of 6,900 MV in Java-Bali and 30 power plants with aggregate capacity of 1,852 MV outside Java-Bali. The choice of coal for the main energy sources is because coal price is less fluctuates than the oil price, and there is a huge amount of coal available in Indonesia. To accelerate the implementation of this program, based on Presidential Decree No.86/2006 and its new amendment No.91/2007, the Government agreed to give guarantee for loans that are dedicated to 10,000 MV FTP I to attract local and international financial institutions to finance the project.

Fast Track Program is being followed up by Fast Track Program Phase II, in which based on Presidential Decree No 4/2010, focuses on the utilization of renewable energy with estimated total investment of around USD16 billion. The largest portion of energy source used in phase II is geothermal energy, since Indonesia has a large geothermal potential which is not yet fully utilized. For FTP II, GOI has provided two step loans from several international agencies such as World Bank and Asian Development Bank (ADB), Japan International Cooperation Agency (JICA), which covered around 50% of the investment fund. For the remaining half of the projects done by the Independent Power Producers (IPP), GOI only provides a guarantee on the feasibility of the projects, based on Regulation of Ministry of Finance no. 77/PMK.01/2011.

With the implementation of these programs, the threat of substitute products to solar power plant is considered high, with the government have a higher interest in developing geothermal power plant, since there are a huge resources of geothermal power plant which still not fully utilized.

4.2.5 Threat of New Entrants

The investment in power plant business has created its own barrier to entry. The high level of investment needed, combined with the high risk nature of the business, have limits the interest of new player in this industry. However, the arrival of foreign investor in this sector, especially from China, who brings their own financing with them, can be a potential threat for the existing players.

The development of Chinese electric and power plant components have made China one of the respected technology producers in the world. Power plants components from China have been widely used in the world, including Indonesia. These technologies have made Chinese companies a potential big threat for electricity business in Indonesia.

This is further supported by the fact that China has a low loan interest that can be used by the Chinese companies to finance their overseas project. Currently, some of the major power plant projects in Indonesia have been financed by loan from China, with one of the condition need to be fulfill is the appointment of Chinese company to do the project. The potential threat is obviously not only coming from China, with the companies from Japan and Germany also entering the competition in Indonesia.

The threat of new entrants also comes from the domestic players as they see the attractiveness of power plant sector. To compete with the foreign investor who is backed up by low interest loan, domestic players usually creates a joint venture with foreign counterparts who can provide technology and financing with them. This way, the domestic players can compete with foreign players in term of financing and technology.

However, not all domestic players seriously entered the power plant market to get a gain from investing in the power plant, some players sometimes win the tender without enough financing backing them up. This type of player usually creates gain from reselling the project to the potential investor. Even though they did not have serious intention to be the investor of power plant projects, this type of player can be a serious threat in the power plant businesses in Indonesia.

4.3 On Grid 1 MW Solar Power Plant Project

4.3.1 Background of the Project

Despite its huge potentials, solar energy have not been fully utilized in Indonesia. One of the main factors is the economic feasibility of investing in solar power plant. Most of the solar power plant currently operating in Indonesia is a nonprofit project, set up by the government, to provide electricity to rural area which is not yet reached by the available transmission and distribution system. The government itself has not seen solar as one of the main energy sources in the electricity roadmap, because of the high investment cost due to technology availability.

PT Wijaya Karya Intrade (WIN), as one of the leading producer of solar water heater products in Indonesia, believes that there is an opportunity to develop solar energy to a wider use than water heater. They see solar power energy as the future of their energy conversion business. The growing awareness of renewable energy usage and the declining trend of solar panel price, the main component of the solar power plant, means that it is only a matter of time that solar power plant will be economically feasible.

Currently, there is an investment opportunity as University of Indonesia, a leading university in Indonesia, wants to develop solar power plant to switch the energy source in some parts of their university, to a solar energy. The main objective of this program, apart from utilizing the use of solar energy, is to develop a laboratory for their engineering students to develop the solar panel technology in Indonesia.

At the present time, most of the solar panel used in Indonesia is being imported. And it is University of Indonesia's objective to develop local content in solar power industry in order to lower the investment cost of developing solar power energy and to further advance Indonesian engineer to speak louder in the world. This is in line with the objective of PT Wijaya Karya Intrade to develop solar power technology in Indonesia.

4.3.2 Cooperation Scheme

The cooperation scheme for the 1 MW on grid Solar Power Plant is quiet simple. PT Wijaya Karya Intrade will act as a contractor of the projects. Given their experience in producing solar water heater and good vendor networking with foreign supplier of solar panel technology, PT Wijaya Karya Intrade is confidence they can construct the solar power plant and maintain its operation. They will be supported by investors who will funds the project.

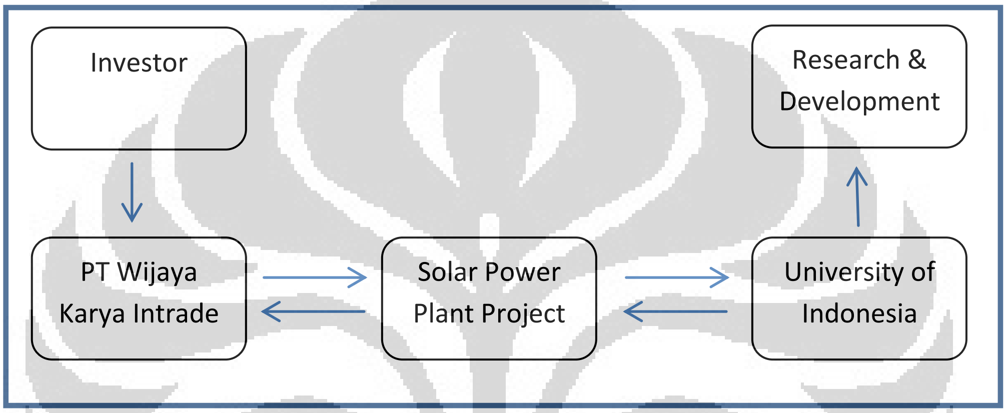


Figure 4.8. Project Cooperation Scheme

University of Indonesia will be the end user of the electricity generated by the solar power plant. Since solar power plant doesn't need any fuel cost to operate and a small amount of maintenance cost, University of Indonesia should be able to pay a lower electricity cost compare to current electricity provided by PT Perusahaan Listrik Negara. The gap between the actual electricity cost and the new cost from the solar power plant can be the savings for University of Indonesia that can be allocated as a research and development to improve the domestic technology for solar panel.

From this point of view, this cooperation scheme will be beneficial for both parties. The investor and PT Wijaya Karya Intrade will benefit from the revenue of the project while University of Indonesia will benefit from the lower electricity cost and higher research and development budget.

4.3.3 Investment Cost Breakdown

In developing solar power plant, the largest cost structure is the equipment procurement. This is because, despite the high level of technology implemented in the solar panel, the installation of the component is very practical. Unlike any other power plant, solar power plant doesn't need huge building structure, conveyors, and any other heavy equipment, which makes the installation cost is lower than the average power plant.

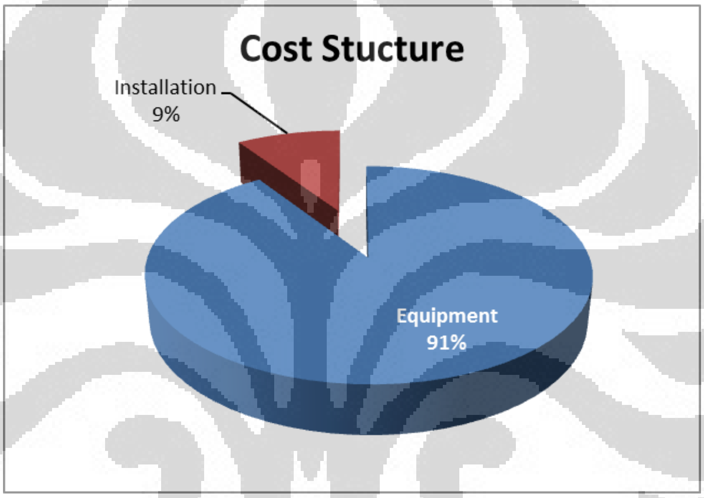


Figure 4.9. Project Cost Structure

In developing solar power plant, the important things that need to be considered are the reliability of the system. The production capacity of Solar Power Plant is very dependable to the installed capacity of the solar panel and the availability of solar energy which vary in every location. At University of Indonesia, Depok Campus, the estimation of average daily solar energy is 4.8 KWh/m^2.The calculation of power plant capacity is done by considering the energy balance which is based on the solar energy potentials, electricity demand in normal conditions, and characteristic and specification of equipment.

Based on the above factors, the main equipment that is planned to be used is as follow:

- Solar Panel Module

  Solar panel module is the main component which serves to directly convert the solar energy to become electricity. The efficiency of energy conversion is highly depends on the energy from the sun and the type of solar panel used.

  In University of Indonesia, the electricity demand in normal conditions is around 4,000 kWh per day. To fulfill that demand with the available solar energy potentials, 5,264 solar panel with the capacity of 190w per module is needed, so that the total capacity of the solar power plant is 1 MW (1,000,160 W).

- MPPT Controller

  MPPT Controller is a tool to manage the voltage of power plant operation in order to optimize the output of the solar module. The selection of MPPT control system have to be adjusted with the type and specification of the inverter used. The suggested MPPT capacity for this project is 2 x 500 kWh.

- Grid Connected Inverter

  Inverter is an electronic component which transforms one way electricity stream (DC) from the solar module to a two way electricity stream (AC) and distribute through a low voltage distribution network to fulfill the electricity demand.

  Considering the optimization of the output and to keep the sustainability of the project, especially the energy source from the sun, the inverter which is going to be used is a “Grid Export Conditioning” inverter which can operate simultaneously with the Grid/network.

Table 4.1. Main Equipment Cost

No	Description	Specification	Quantity	Unit	Unit Price	Total Price
A	**Main Equipment**					
1	Solar Panels	SST190-72M	5,264	pcs	389.88	2,052,328.32
2	Solar Brackets	ZJ21T	5,264	sets	38.62	203,295.68
3	On-grid Inverters	SD500K	2	sets	146,385.36	292,770.72
4	Connector Plugs	L432	600	sets	9.07	5,442.00
5	Anti-lightning Distribution Box	SST25KDC	44	sets	2,376.00	104,544.00
6	Anti-lightning Distribution Box	SST100KDC	11	sets	2,700.00	29,700.00
7	DC Distribution Cabinet	SST500KDC	2	sets	9,396.00	18,792.00
8	AC Distribution Cabinet	SST500KAC	2	sets	9,504.00	19,008.00
9	Monitoring Equipment	COM,IPC,Displayer	1	sets	30,246.48	30,246.48
10	Cables	4 mm2	20,000	m	3.13	62,600.00
11	Cables	10 mm2*3	4,000	m	5.58	22,320.00
12	Cables	25 mm2*3	2,000	m	16.31	32,620.00
13	Cables	95 mm2*3	500	m	83.92	41,960.00
14	Cables	150 mm2*3	500	m	78.95	39,475.00
15	Crane Span Structure	200*100 mm	24,000	m	8.10	194,400.00
16	Crane Span Structure	400*150 mm	1,000	m	19.76	19,764.00
17	Data Acquisition Box	IG BOX	1	sets	512.96	512.96
18	Data Acquisition Card	IG CARD	1	sets	203.05	203.05
19	Environment Data Acquisition Box	SENSOR BOX	1	sets	1,303.78	1,303.78
20	Irridiance Sensor	SOLAR 1000	1	sets	393.14	393.14
21	Temperature Sensor	PT 1000	1	sets	168.72	168.72
22	Grounding for Anti-lightning		1	sets	33,480.00	33,480.00
B	**Value Added Tax**					320,352.79
	Sub Total					**3,525,680.64**

Source: The company investment proposal

Apart from the amount for main equipment, there are also other components of the investment cost, which are:

- Development Cost

  Development costs are the cost use to prepare the development of the solar power plant. This includes mobilization of the equipment, logistic cost, and professional fee.

- Other Cost

  Other investment cost includes personnel training for operating the power plant, startup cost, and provision for financing.

Table 4.2, Development and Other Cost

No	Description	Specification	Quantity	Unit	Unit Price	Total Price
B	**Development Cost**					
1	Mobilization Work		1	Unit	4,487.00	4,487.00
2	Professional Fee		1	Unit	16,027.00	16,027.00
						-
C	**Other Cost**					-
	Personnel Training		1	Unit	4,487.00	4,487.00
	Provision		1	Unit	6,411.00	6,411.00
	Soft Cost		1	Unit	16,027.00	16,027.00
	Startup		1	Unit	16,027.00	16,027.00
	Sub Total					**63,466.00**

Source: The company investment proposal

Therefore, the total amount of investment will be USD 3,589,326.

4.3.4 Source of Fund

To fulfill the investment cost needed by the project, a proportion of 30% equity and 70% loan will be used by the investor. The investment for the main equipment will be in USD while the development and other cost will be in IDR. Accordingly, the amount of loan used in this project will also be in USD and IDR. The interest rate for the USD loan is 8% while the interest rate for IDR loan is estimated at 13%.

As mentioned earlier in this chapter, due to the high investment cost needed and a lower electricity tariff, investment in solar power plant is not economically feasible. However, in this project, 50% of the investment fund needed will be covered by a grant in the form of corporate social responsibility program from one of the largest energy company in Indonesia. This will make the investment fund needed by the project become half of the original amount.

The reason for the energy company to join this program for their corporate social responsibility program is because the electricity generated will be used by educational institution and it also function as a real life laboratory for the engineering student in the university. This partnership will be beneficial for both parties since the energy company will get a good reputation and the project will be feasible to be implemented.

4.3.5 Weighted Average Cost of Capital

Weighted average cost of capital is the rate of return expected by the investor and creditor in the market for the investment. The Weighted Average Cost of Capital itself consists of two major components, which is cost of borrowing/debt and cost of equity.

The cost of debt for investment was based on the bank interest rate with the assumption of 13% for loan denominated in Rupiah, and 8% for the loan denominated in US Dollar. These are the common rates applied in the banking industry. Note that when calculating WACC, the cost of debt used is after tax cost of debt.

For the cost of equity, the calculation will be done using CAPM method. In the CAPM calculation there are elements of beta (β) which is the correlation of stock returns of companies in the same industry with the return of share price index. Since the solar panel industry is a relatively new business in Indonesia, the beta used in this calculation will use the reference of beta for the electricity industry in Indonesia. A study done be Kristianto (2010) about the feasibility study of electricity in remote area, have found that the total levered beta for PT Perusahaan Listrik Negara (PLN) a prominent player in Indonesia electricity business is 0.9068. The method used in calculating the beta is adjusting bottom up beta for non-diversification by Damodaran (2002).

Since the project location is in Indonesia, the risk free rate used in this study is the rate of government of Indonesia bond. Data from the report of Bank Indonesia in 2011 showed that the Yield INDO 18 (10 years US$ GoI Bond) is at 7.15% (Bank Indonesia, 2010). For the risk premium, this study will use country risk premium for Indonesia which is 4.13% (Damodaran Online, 2010).

The proportion of equity and loan is assumed to be 30% equity and 70% loan. Therefore, the Weighted Average Cost of Capital of the project is 6.60%.

Table 4.3. Calculation of WACC

	Description	Portion	Amount
After Tax Cost of Debt	Kd(1-T)		
US Dollar		67.76%	6.00%
IDR		2.24%	9.75%
Equity			
Risk Free Rate (Rf)	7.15%		
Beta	0.9068		
Risk Premium (Rp)	4.13%		
Cost of Equity	Rf+(Beta.Rp)	30.00%	11.28%
Total		100%	
WACC			6.60%

4.3.6 Interest During Construction

During the construction period, the interest expense will be allocated to Interest During Construction (IDC), an expense which payment will be deferred until the project's revenue is generated. The period of IDC in this project is 1 year, adjusted to the construction period of the solar power plant project. The total amount of IDC for this project is USD 87,996. This is in proportion with the 13% interest rate for the loan in IDR and 8% for the loan in USD.

4.3.7 Working Capital

Apart from the investment fund, the project also needs a working capital. This is because in the early period of production, the revenue of the project still cannot be achieved due to payment contract. The days of receivable for this project is 60 days, which means in the first two month there will be no revenue stream to the project while at the same time the cost of production will continue to occur. To fulfill the need of cost of production, a working capital loan is needed. The amounts of working capital for this project are USD 118,469, equal to the amount of receivable for the first two month of operation.

4.3.8 Project Assumptions

To develop the projected income statement, cash flow, and the financial performance of the 1 MW on grid Solar Power Plant, a set of project assumptions is needed. Some of the key assumptions in this project are:

- Projection Period is 30 years

  The average life of solar panel, the main equipment of solar power plant, is 30 years. In line with that, in this project, the production period is assume to be 30 years. Due to its unique production system, the solar panel could actually producing more than 30 years, but in this study, the author will use the conservative approach.

- Production capacity is 1 MW per hour

  The total production capacity installed in this project is 1 MW per hour. And since the sun does not shine all day long, the average production of solar power plant is 8 hours a day. If we assume that there are 365 days in a year, than the annual production of the solar power plant is 1 MW x 8 x 365, which equals to 2,920 MW.

- Labor Cost

  The amount of labor cost for the project is USD 30,030 per year, as presented in Table 4.4

Table 4.4. Labor Cost

LABOR COST	In Rp	In USD
Overhead per man-month (ave.)	3,000,000	334
(incl. salary, bonus, PPh, life/health insurance, allowance)		
Number of Plant Operators		6
Overhead per month (ave.)		2,002
Number of Month Salary		15
Annual Cost		**30,030**

The labor cost will increase 6% annually. The annual 6% increase is adjusted to the annual inflation rate in Indonesia. This is based on the common practice that the increase in salary is based on the inflation rate of the country.

- The amount of electricity sold is 99% of the total electricity produced
  The amount of electricity produced by the solar power plant will be 99% sold to the end user, in this case University of Indonesia. The reasoning behind this is that in power plant projects, the investor will usually have a Power Purchase Agreement (PPA) with the end user to ensure the stability and the certainty of the investor's revenue stream. The 1% loss is to accommodate system loss which normally happens in power plant operations.

- Electricity Tariff
  The electricity tariff of a power plant is usually consists of five components, which is commonly used by PT PLN to determine the tariff for power plant. The components are Capital (Component A), Operational (Component B), Fuel Cost (Component C), Salary and Wages (Component D), and Transmission (Component E). In this project, the fuel for the power plant is solar, which is actually free, so the Component C will be zero. Component E will also be zero since there are no new transmissions built in the project.

  Tariff increase will only applied to component B and D, because it is link to operational cost and salary, which increase annually in line with the inflation rate. On the other hand, component A will not increase in annual basis, since it is link to capital, which only occurs in the beginning of the project.

Table 4.5. Electricity Tariff

Levelized Tariff		**US$**	**Rp**
Component A	C US$/kWh	3.3706	303.0486
Component B	C US$/kWh	8.4282	757.7799
Component C	C US$/kWh	0.0000	0.0000
Component D	C US$/kWh	0.1635	14.7008
Component E	C US$/kWh	0.0000	0.0000
Total Levelized Tariff	C US$/kWh	11.9623	1075.5293

- Operation and Maintenance Cost

  The annual operation and maintenance cost is USD 9,696. Identical with the increase in operator's salary, the operation and maintenance cost will also increase 6% annually. The increase will be adjusted to the general inflation rate in the country.

- The exchange rate is IDR 8,991/USD

  The exchange rate amount is based on Bank Indonesia rate for 2010. The exchange rate of IDR per USD is showing a positive trend as mentioned in the previous sub chapter about Indonesia Macro economy.

- Account Receivable Turn Over is 60 days.

  The tariff of electricity usage will be invoiced in the end of each month. The end user will have 60 days after the invoice date to process and evaluate the invoice before the payment being made. This means the cost of electricity for this month will be paid in the following month.

- Depreciation

  The assumption for depreciation cost method is straight line, where the annual depreciation cost is equal to the book value of the equipment divided by the age of the equipment. The depreciation is started when the power plant is start producing electricity, or in the first year of operation.

4.3.9 Projected Income Statement

After analyzing the production capacity of the power plant, electricity tariff, and operational cost, the next step is to analyze the projected income statement. The highlight of projected income statement can be seen in table 4.6.

Sales

There are no sales yet in year 0 since it was still in construction period. Sales are started in year 1 with the amount of USD 710,816. In the following years, the sales were increasing at an average growth of 2.5% annually. There is no increase in production capacity, the increase in sales is caused by the annual increase of the tariff component.

Net Operating Income

The net operating income for the first 10 years of operation is relatively stable at USD 401,191. However, in the 11^{th} year, the net operating income is decreasing significantly to USD 212,495. This is caused by the decrease in component A of electricity tariff.

Net Profit

The net profit margin for the first year of operation is 25.43%. This amount is growing steadily until the 10^{th} year. Similar to the net operating income, the net profit margin is decreasing in 11 year due to decrease in electricity tariff. Despite the tariff reduction, the fixed operating expenses is continue to rise in line with the inflation rate, this will further reduce the net profit margin of the project.

Table 4.6. Projected Income Statement

Laporan Rugi Laba	1	2	3	4	5	6	7	8	9	10
REVENUE	710,816	727,154	744,403	762,614	781,843	802,150	823,596	846,246	870,172	895,446
NET OPERATING INCOME	401,191	401,191	401,191	401,191	401,191	401,191	401,191	401,191	401,191	401,191
EARNING BEFORE INT & TAX	280,046	280,046	280,046	280,046	280,046	280,046	280,046	280,046	280,046	280,046
EARNING BEFORE TAX	157,459	166,347	178,197	193,009	213,747	237,447	261,147	276,729	280,046	280,046
NET PROFIT	118,094	124,760	133,648	144,757	160,310	178,085	195,860	207,546	210,034	210,034
Laporan Rugi Laba	11	12	13	14	15	16	17	18	19	20
REVENUE	733,451	761,662	791,470	822,968	856,254	891,433	928,615	967,916	1,009,460	1,053,379
NET OPERATING INCOME	212,495	212,495	212,495	212,495	212,495	212,495	212,495	212,495	212,495	212,495
EARNING BEFORE INT & TAX	91,350	91,350	91,350	91,350	91,350	91,350	91,350	91,350	91,350	91,350
EARNING BEFORE TAX	91,350	91,350	91,350	91,350	91,350	91,350	91,350	91,350	91,350	91,350
NET PROFIT	68,512	68,512	68,512	68,512	68,512	68,512	68,512	68,512	68,512	68,512
Laporan Rugi Laba	21	22	23	24	25	26	27	28	29	30
REVENUE	1,099,810	1,148,901	1,200,807	1,255,694	1,313,735	1,375,116	1,440,033	1,508,692	1,581,315	1,658,132
NET OPERATING INCOME	212,495	212,495	212,495	212,495	212,495	212,495	212,495	212,495	212,495	212,495
EARNING BEFORE INT & TAX	91,350	91,350	91,350	91,350	91,350	91,350	91,350	91,350	91,350	91,350
EARNING BEFORE TAX	91,350	91,350	91,350	91,350	91,350	91,350	91,350	91,350	91,350	91,350
NET PROFIT	68,512	68,512	68,512	68,512	68,512	68,512	68,512	68,512	68,512	68,512

4.3.10 Projected Statement of Cashflow

The next step is to analyze the projected statement of cash flow. The highlight of the projected statement of cash flow can be seen in table 4.7. In this study, the statement of cash flow consists of 2 main components, which is cash from operating activities, and cash flow from non-operating activities. Cash flow from operating activities includes all the income from operation and the expense related to the operation of the power plant, while cash flow from non-operating activities includes all cash flow from any source other than operation, mainly from financing and investing activities.

The cash balance during the construction period is zero. The project needs a significant amount of cash flow to fund the construction, but it is already been covered by the equity and loan. In the 2nd year, the ending cash balance increase significantly. This is because in the first year, the revenue received is only the revenue for 10 months due to the 60 days in receivables. In the second year, the revenue is already 12 months, which makes it much larger than the first year.

Another significant increase in cash balance happens in the 8th and 9th year. This increase caused by the ending of loan repayment period, which makes the cash flow for interest expense is no longer exist. Apart from this two events, the ending cash balance is growing steadily throughout the project's life.

Table 4.7. Projected Statement of Cash Flow

STATEMENT OF CASHFLOW	1	2	3	4	5	6	7	8	9	10
CASH FROM OPERATING ACTIVITIES	242,943	356,467	353,353	349,489	344,135	338,031	331,916	328,234	327,192	326,968
CASH FLOW FROM NON-OPERATION ACTIVITY	(75,901)	(258,510)	(246,660)	(304,461)	(356,337)	(332,637)	(308,936)	(86,246)	-	-
SURPLUS / (DEFISIT)	167,042	97,957	106,692	45,028	(12,201)	5,394	22,979	241,989	327,192	326,968
BEGINNING CASH BALANCE	0	167,042	264,998	371,691	416,719	404,518	409,912	432,891	674,880	1,002,072
ENDING CASH BALANCE	167,042	264,998	371,691	416,719	404,518	409,912	432,891	674,880	1,002,072	1,329,040
STATEMENT OF CASHFLOW	11	12	13	14	15	16	17	18	19	20
CASH FROM OPERATING ACTIVITIES	216,657	184,956	184,690	184,408	184,110	183,795	183,461	183,108	182,734	182,338
CASH FLOW FROM NON-OPERATION ACTIVITY	-	-	-	-	-	-	-	-	-	-
SURPLUS / (DEFISIT)	216,657	184,956	184,690	184,408	184,110	183,795	183,461	183,108	182,734	182,338
BEGINNING CASH BALANCE	1,329,040	1,545,697	1,730,653	1,915,343	2,099,752	2,283,862	2,467,657	2,651,118	2,834,226	3,016,960
ENDING CASH BALANCE	1,545,697	1,730,653	1,915,343	2,099,752	2,283,862	2,467,657	2,651,118	2,834,226	3,016,960	3,199,298
STATEMENT OF CASHFLOW	21	22	23	24	25	26	27	28	29	30
CASH FROM OPERATING ACTIVITIES	181,919	181,476	181,007	180,510	179,984	179,428	178,839	178,215	177,554	176,855
CASH FLOW FROM NON-OPERATION ACTIVITY	-	-	-	-	-	-	-	-	-	-
SURPLUS / (DEFISIT)	181,919	181,476	181,007	180,510	179,984	179,428	178,839	178,215	177,554	176,855
BEGINNING CASH BALANCE	3,199,298	3,381,218	3,562,694	3,743,701	3,924,211	4,104,196	4,283,623	4,462,462	4,640,677	4,818,231
ENDING CASH BALANCE	3,381,218	3,562,694	3,743,701	3,924,211	4,104,196	4,283,623	4,462,462	4,640,677	4,818,231	4,995,086

4.3.11 Projected Balance Sheet

Based on the project assumption and projected income statement, we can do the projection of project's balance sheet. The highlight of the balance sheet can be seen in table 4.8.

Asset

In the first year of operation, the amount of total asset is USD 3,546,375; this is equal to the amount of main equipment of the solar power plant. Until the 8th year of operation, the amount of total asset is relatively stable, this is because the increase in cash balance and account receivable is being offset by the increase in accumulated depreciation of the equipment.

The significant increase of the total asset started in the 9th year. The reasonable explanation of this increase is the end of loan period in year 8. This makes the cash balance in the years that follow become larger due to the disappearance of interest expense.

Cash

As stated earlier, the cash balance of the project is relatively stable until the 8th year, when the loan period is ended. After that, the cash balance is increasing significantly.

Account Receivable

The account receivable occurs because of the 60 day term of payment. The term of payment have made the payment for the last two month of the year will not be received until the next year, which will become the account receivable for the year. The amount of account receivable is growing steadily throughout the projects life, in line with the growth of electricity tariff.

Table 4.8. Projected Balance Sheet

ASSET	1	2	3	4	5	6	7	8	9	10
CURRENT ASSET	285,511	386,191	495,758	543,821	534,825	543,604	570,157	815,921	1,147,101	1,478,281
FIX ASSET	3,513,225	3,392,080	3,270,934	3,149,788	3,028,643	2,907,497	2,786,351	2,665,205	2,544,060	2,422,914
TOTAL ASSET	**3,798,736**	**3,778,270**	**3,766,692**	**3,693,610**	**3,563,467**	**3,451,100**	**3,356,508**	**3,481,126**	**3,691,161**	**3,901,195**
LIABILITY	**1,462,576**	**1,317,350**	**1,172,124**	**954,285**	**663,833**	**373,381**	**82,929**	**0**	**0**	**0**
EQUITY	**2,336,160**	**2,460,920**	**2,594,568**	**2,739,324**	**2,899,635**	**3,077,720**	**3,273,580**	**3,481,126**	**3,691,161**	**3,901,195**
TOTAL LIABILITY & EQUITY	**3,798,736**	**3,778,270**	**3,766,692**	**3,693,610**	**3,563,467**	**3,451,100**	**3,356,508**	**3,481,126**	**3,691,161**	**3,901,195**
ASSET	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
CURRENT ASSET	1,667,939	1,857,597	2,047,255	2,236,913	2,426,571	2,616,229	2,805,887	2,995,545	3,185,203	3,374,861
FIX ASSET	2,301,768	2,180,623	2,059,477	1,938,331	1,817,186	1,696,040	1,574,894	1,453,748	1,332,603	1,211,457
TOTAL ASSET	**3,969,707**	**4,038,220**	**4,106,732**	**4,175,244**	**4,243,757**	**4,312,269**	**4,380,781**	**4,449,294**	**4,517,806**	**4,586,318**
LIABILITY	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
EQUITY	**3,969,707**	**4,038,220**	**4,106,732**	**4,175,244**	**4,243,757**	**4,312,269**	**4,380,781**	**4,449,294**	**4,517,806**	**4,586,318**
TOTAL LIABILITY & EQUITY	**3,969,707**	**4,038,220**	**4,106,732**	**4,175,244**	**4,243,757**	**4,312,269**	**4,380,781**	**4,449,294**	**4,517,806**	**4,586,318**
ASSET	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
CURRENT ASSET	3,564,519	3,754,177	3,943,835	4,133,493	4,323,151	4,512,809	4,702,468	4,892,126	5,081,784	5,271,442
FIX ASSET	1,090,311	969,166	848,020	726,874	605,729	484,583	363,437	242,291	121,146	-
TOTAL ASSET	**4,654,831**	**4,723,343**	**4,791,855**	**4,860,368**	**4,928,880**	**4,997,392**	**5,065,905**	**5,134,417**	**5,202,929**	**5,271,442**
LIABILITY	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
EQUITY	**4,654,831**	**4,723,343**	**4,791,855**	**4,860,368**	**4,928,880**	**4,997,392**	**5,065,905**	**5,134,417**	**5,202,929**	**5,271,442**
TOTAL LIABILITY & EQUITY	**4,654,831**	**4,723,343**	**4,791,855**	**4,860,368**	**4,928,880**	**4,997,392**	**5,065,905**	**5,134,417**	**5,202,929**	**5,271,442**

Liabilities

The amount of liabilities in the first year is equal to the amount of the investment loan plus the interest during construction and working capital loan, which is amounting to USD 1,325,216. The liabilities only exist until the 8th year, when the loan period is over. There is no expansion plan for the project, which makes it reasonable why there hasn't been any new loan in the rest of the project's life.

4.3.12 Feasibility Study

The method used in analyzing the feasibility of this project is Net Present Value (NPV), Internal Rate of Return (IRR), and payback period. The analysis should be based on the projection of free cash flow to the project. The highlight of the free cash flow to the project can be seen in table 4.9.

Based on the projection of free cash flow of the solar power plant project, the following parameters of feasibility study are obtained.

Table 4.9. Feasibility Parameters

Project IRR	10.86%	Accept
Equity IRR	14.86%	Accept
NPV	1,053,039	Accept
Payback Period	9.03	Accept
Profitability Index	1.53	Accept
Breakeven Sales	551,236	Accept

For a 1 MW Solar Power Plant, the NPV generated with the WACC of 6.60% is USD 1,053,039. It means that the investment can generate a stream of income for the next 30 years which equal to the present value amount of USD 1,085,379.

The internal rate of return (IRR) of the project is 10.86%; higher than the WACC which is 6.60%. This shows that with the present conditions, the project can offer an investment opportunity which is higher that the weighted average cost of capital.

Table 4.10. Project's Feasibility

Komponen	**-1**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Net Income	(7,676)	118,094	124,760	133,648	144,757	160,310	178,085	195,860	207,546	210,034	210,034
Bunga Bank (1-Tax)		91,629	84,963	76,076	64,966	49,413	31,638	13,863	2,488	-	-
Beban Depresiasi & Amortisasi		121,146	121,146	121,146	121,146	121,146	121,146	121,146	121,146	121,146	121,146
Outlay	(1,986,662)										
Proceed	**(1,993,924)**	**330,869**	**330,869**	**330,869**	**330,869**	**330,869**	**330,869**	**330,869**	**331,180**	**331,180**	**331,180**
Akumulasi NCF	**(1,994,338)**	**(1,663,469)**	**(1,332,600)**	**(1,001,731)**	**(670,862)**	**(339,993)**	**(9,124)**	**321,745**	**652,925**	**984,105**	**1,315,285**
Komponen		**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Net Income		68,512	68,512	68,512	68,512	68,512	68,512	68,512	68,512	68,512	68,512
Bunga Bank (1-Tax)		-	-	-	-	-	-	-	-	-	-
Beban Depresiasi & Amortisasi		121,146	121,146	121,146	121,146	121,146	121,146	121,146	121,146	121,146	121,146
Outlay											
Proceed		**189,658**	**189,658**	**189,658**	**189,658**	**189,658**	**189,658**	**189,658**	**189,658**	**189,658**	**189,658**
Akumulasi NCF		**1,504,943**	**1,694,601**	**1,884,259**	**2,073,917**	**2,263,575**	**2,453,233**	**2,642,891**	**2,832,550**	**3,022,208**	**3,211,866**
Komponen		**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Net Income		68,512	68,512	68,512	68,512	68,512	68,512	68,512	68,512	68,512	68,512
Bunga Bank (1-Tax)		-	-	-	-	-	-	-	-	-	-
Beban Depresiasi & Amortisasi		121,146	121,146	121,146	121,146	121,146	121,146	121,146	121,146	121,146	121,146
Outlay											
Proceed		**189,658**	**189,658**	**189,658**	**189,658**	**189,658**	**189,658**	**189,658**	**189,658**	**189,658**	**189,658**
Akumulasi NCF		**3,401,524**	**3,591,182**	**3,780,840**	**3,970,498**	**4,160,156**	**4,349,814**	**4,539,472**	**4,729,130**	**4,918,788**	**5,108,446**
Total PV Proceed	3,047,327										
Total PV Outlay	(1,994,288)										
NPV	1,053,039										
Profitability Index	1.53										
Payback Period *)	9.03										
IRR (Current Year)	10.86%	10.49%	10.60%	10.70%	10.78%	10.86%	10.92%	10.98%	11.03%	11.07%	11.11%
IRR Equity	14.86%	14.47%	14.60%	14.70%	14.79%	14.86%	14.93%	14.98%	15.03%	15.06%	15.10%

The payback period of the project is 9.03 years, which means that the money spent on the capital investment of the project will be recovered in 9 years, which is good considering the average payback period of power plant projects which ranging from 10-15 years.

The positive amount of NPV and the IRR which is higher than the WACC, and the payback period of the project, shows that the project is economically feasible.

4.4 Scenario Analysis

Scenario analysis is done to get the bigger picture of the risk involved in this project. In this study, the scenario analysis is based on the three most critical factors in solar power plant investment, which are availability factor, interest rate, and capital expenditure.

4.4.1 Availability Factor

The availability factor of a power plant is the real production capacity of the power plant. Due to system loss or distribution loss, power plants are mostly do not produce electricity as much as their total capacity. This will affect the revenue stream of the power plant project as the revenue received will be based on the electricity sold to the user. The following table will describe the scenario analysis based on the availability factor of the power plant.

Table 4.11. Scenario Analysis based on Availability Factors

Availability Factor	Project IRR	Equity IRR	NPV	Payback	Decision
75.0%	8.02%	9.38%	397,717	10.73	Reject
80.0%	8.64%	10.53%	534,242	10.30	Reject
85.0%	9.24%	11.68%	670,767	9.92	Accept
90.0%	9.83%	12.82%	807,293	9.57	Accept
95.0%	10.41%	13.96%	943,818	9.26	Accept
99.0%	10.86%	14.86%	1,053,039	9.03	Accept

The best case scenario for the availability factor in this project is 99%, which is the availability factor used in this study. The reason this study used the best case scenario is because the technology of solar power plant directly transform the solar energy to become electricity, which makes it very efficient. This is different with coal fired or other type of power plant which need a multi-step production process and creates a higher risk of system loss.

Based on the best case scenario, this project will generate project IRR of 10.86%, higher than the WACC which is 6.60%. The equity IRR is also higher than the cost of equity, 14.86 % compare to the cost of equity which is 11.28%. The NPV generated in the best case scenario also showing a positive value, USD 1,053,039, with the payback period of 9.03 years. Based on those parameters, in the best case scenario, this project is highly feasible.

The worst case scenario of the availability factor in this project is 75%, which is considered very poor in the power plant sectors. However, the worst case scenario of this project can still produce a satisfactory value on some of the investment parameters. The project IRR is 8.02% which is still slightly higher than the WACC. The NPV generated in the worst case scenario also still showing positive value, USD 397,717 with the payback period of 10.73 years. The only negative value of the worst case scenario is the equity IRR, 9.38% which is lower than the cost of equity, 11.28%.

From the scenario analysis based on availability factor, it can be concluded that this project is a feasible project since it still can generate a positive value in project IRR and NPV in the worst case scenario, with the equity IRR being the only negative value. This means that from the availability factors point of view, the only risk that should be bear by the investor is the risk of negative equity IRR.

4.4.2 Interest Rate

The second crucial factor which will be used in the scenario analysis is the interest rate, since a large part of the investment in this project is financed by debt. The scenario analysis will use the USD interest rate instead of IDR interest rate since most of the debt used in this project are denominated in USD. The following table will describe the scenario analysis based on the interest rate of the USD loan.

Table 4.12. Scenario Analysis based on USD interest rate

Interest Rate	Project IRR	Equity IRR	WACC	NPV	Payback	Decision
2.0%	10.84%	18.24%	4.31%	1,938,276	9.04	Accept
4.0%	10.84%	17.08%	5.07%	1,604,372	9.03	Accept
6.0%	10.85%	15.95%	5.84%	1,311,353	9.03	Accept
8.0%	10.86%	14.86%	6.60%	1,053,039	9.03	Accept
10.0%	10.87%	13.81%	7.36%	824,311	9.02	Accept
12.0%	10.87%	12.81%	8.12%	620,915	9.02	Accept

Based on the USD interest rate, this study uses a conservative approach by setting the USD interest rate at 8%. This conservative approach have generated a positive outcome for all parameters with a positive NPV and project IRR and equity IRR higher than WACC and cost of equity respectively. It should be noted that by changing the USD interest rate, the WACC of the project will also change, which is why there is a WACC column in the above table.

The best case scenario for this project based on the USD interest rate is 2%. With this scenario, the WACC of the project become as low as 4.31%. Compared to the WACC, the project IRR of 10.84% is far higher, which means that the project is very favorable. The equity IRR is also high, 18.24%, compared to the cost of equity which is 11.28%. The NPV based on the best case scenario showing a positive value of USD 1,938,276 with the payback period of 9.04 years.

The worst case scenario based on the USD interest rate is when the interest rate becomes as high as 12%. Under this scenario, the WACC become as high as 8.12%. Despite the increase in the WACC, the project IRR still show a favorable result, 10.84%, higher than the WACC. The equity IRR, however, showing a decreasing value to become 12.81%, but still slightly higher than the cost of equity. Under the worst case scenario, the NPV also still generate a positive value of USD 620,915 with the payback period amounting to 9.02 years.

From the scenario analysis based on the USD interest rate, it can be concluded that this project is a feasible project since it still can generate a positive value in project and equity IRR and NPV even in the worst case scenario. The parameter which is most sensitive to the change in USD interest rate is equity IRR, with the value ranging from 12.81% in the worst case scenario, and 18.24% in the best case scenario.

4.4.3 Investment Value / EPC Cost

The investment value for the solar power plant project, especially the EPC cost, is also a crucial factor in the investment analysis. Considering the high technology being used and the small amount of manufacturer available in the market, the price of solar panel, the main equipment for solar power plant, can be fluctuated and will give high impact on the EPC cost. The following table will describe the scenario analysis based on investment value / EPC Cost of the project.

Table 4.13. Scenario Analysis based on the EPC Cost

EPC Cost	Project IRR	Equity IRR	NPV	Payback	
2,724,528.67	12.74%	18.65%	1,300,473	8.19	Accept
2,884,795.07	12.06%	17.26%	1,217,995	8.47	Accept
3,045,061.46	11.43%	16.00%	1,135,517	8.75	Accept
3,205,327.85	10.86%	14.86%	1,053,039	9.03	Accept
3,525,860.64	9.83%	12.88%	888,083	9.57	Accept
3,846,393.42	8.94%	11.21%	723,127	10.10	Reject

The scenario analysis using the EPC cost of the project will use the actual EPC cost as the base case for the scenario, with the fluctuation of 5-10% from the actual value. The actual EPC cost itself has generated a positive outcome with the positive NPV and both the project IRR and equity IRR are higher than the WACC and cost of equity.

The best case scenario based on the EPC cost assumes that the EPC cost is 85% from the original value. In this case, the project will undoubtedly generate a positive outcome. The project IRR, 12.74%, is higher than the WACC which is 6.60%. The equity IRR also generates a higher value, 18.65%, compared to the cost of equity which is 11.28%. The NPV value under the best case scenario is showing a positive value, USD 1,300,473 with the payback period of 8.19 years.

For the worst case scenario, it is assumed that the EPC cost of the project is 20% higher than the original cost. Under the worst case scenario, the only negative outcome from the parameters is the equity IRR, with the value of 11.21%, slightly lower than the cost of equity of 11.28%. The project IRR is showing a higher value compared to the WACC, 8.94% compared to 6.60%. The NPV is also showing a positive amount of USD 723,127 with the payback period of 10.10 years.

The scenario analysis based on EPC cost concludes that there is a risk of negative IRR to equity under the worst case scenario, despite the positive outcome which is still generated from the other parameters. Both the project IRR and equity IRR is sensitive to the change in EPC cost with the range around 4% for the project IRR and 7% for the equity IRR. This means that from the EPC Cost point of view, the investor should put attention in both IRR to make sure that the change in EPC cost won't affect the positive outcome of the IRR.

CHAPTER 5
CONCLUSION & SUGGESTION

5.1 Conclusion

After analyzing the financial aspect of feasibility study of 1 MW on grid solar power plant project, we can conclude the following points:

- The solar energy industry in Indonesia is attractive. The regulation in the electricity industry have make it easier for the investor to invest, with the government allowing private parties to involved in the electricity investment. The electricity tariff has also been increased last year which make the investment in the industry become more favorable. The market potential for the electricity industry in Indonesia is also attractive with the national average of electrification ratio still around 60% and the announcement of fast track program phase II with the larger portion of private contributions in the power plant investment.

- The investment in 1 MW on grid solar power plant is considered economically feasible with the positive outcome in all investment parameters. The NPV for the project is USD 1,053,039 while the project IRR and equity IRR generates a value of 10.86% and 14.86% respectively, higher than the projects WACC (6.60%) and the cost of equity of the project (11.28%). However, it should be noted that 50% of the EPC cost is covered by grant from corporate social responsibility fund of the energy company. Without the investment grant, it is unlikely that the project will generate a positive outcome. This is due to the high technology used in the solar power plant project with a high procurement cost which is not supported with the higher electricity tariff.

5.2 Limitation

The limitations of this study are:

- This study only considers the financial aspects of the project's feasibility study. It will generate a more reliable result if the study is done more comprehensively by involving cross faculty members so that other aspects such as risk and technology aspects.

- The project that being analyzed is a small scale project with the financing aid in the form of CSR grant from an energy company. It would be different circumstances if it is a purely commercial and large scale project.

5.3 Suggestion

From the financial aspect of feasibility study of 1 MW on grid solar power plant project, the study brings benefit and recommendation to the following parties

- The author. The experience of doing financial feasibility study of the projects has improve the capabilities of doing analysis on investment opportunities outside of the power plant business. For the next project, it is highly recommended that the author construct a template for doing business analysis which will give more simplicity in doing investment analysis.

- The academics. The discussions of solar panel technology have long been focused on the technological aspect. However, it needs more than the technological aspect to implement the technology in the real world, a comprehensive study in financial aspect is also needed. This study is aiming to provide a trigger for the academics to do a comprehensive research on project financing for solar power plant to make it more feasible to be used in a wider use.

- The company. The company is currently active in pursuing investment opportunities in power plants, but never involved in solar power plant projects. This study is expected to give a new perspective for the company about investment in electricity sector, especially in solar power plants.

- Subsequent study. This study is put the emphasis on financial aspects of feasibility study. To make the study more comprehensive, it is highly recommended that the study did not focus only on the financial aspects. In the subsequent study, it would give a higher value added if a cross faculty study is done so that the study will have a good emphasis on financial aspects as well as the technical aspects.

REFERENCE

Bank Indonesia. *Laporan Perekonomian Indonesia*. 2010

Frantzis, L., Graham., S., Katofsky, R., & Sawyer, H., (2008). *Photovoltaic Business Model*. A National Laboratory of the U.S. Department of Energy.

Gitman, J. Lawrence (2009). *Principles of Managerial Finance*. Prentice-Hall

Kristianto, Ardi Nugroho (2010). *Studi Kelayakan PLTS Pulau Birao.* FEUI

Ministry of Energy and Mineral Resources Republic Indonesia. (2011). Photovoltaic Solar Energy Utilization in Indonesia. www.esdm.go.id

Ministry of Energy and Mineral Resources Republic Indonesia. (2011). *Peran energi surya dan angin dalam mendukung visi 25/25 dan kemandirian energi*. Paper presented at the seminar of the Indo Solar-Wind, Jakarta.

Ministry of Energy and Mineral Resources Republic Indonesia. (2011). REFF-Burn: Inisiatif Energi Bersih Sektor Energi. *Energi Hij@u.*

Porter, M., E., (2008). *The Five Competitive Forces That Shape Strategy.* Harvard Business Review.

PT PLN (Persero). *Electricity Supply Plan (RUPTL)*. 2010-2019.

PT Wijaya Karya (Persero) Tbk. *Annual report*. 2009.

Retnanestri, M., Outhred, H., & Healy, S., (2003). *Off-grid Photovoltaic Application in Indonesia: An Analysis of Preliminary fieldwork Experience*. The University of New South Wales.

Republic of Indonesia, Act. No. 30/2009 about Power Generation Business. 2009

Republic of Indonesia, Presidential Decree No. 8/2011 about Electricity Tariff. 2011

Ross, Stephen, A., (2007). *Modern Financial Management*. McGraw-Hill

Damodaran Online. www.stern.nyu.edu/~adamodar.

Clean Energy Ideas. (2010). www.clean-energy-ideas.com

Green Rhino Energy. (2010). The solar value chain, Key Success Factors. www.greenrhinoenergy.com

SPI Cooler Planet. (2011). What are solar panels?. www.solarpanelinfo.com