Project Financing Strategy and Financial Feasibility for Geothermal Development Project in Lumut Balai, South Sumatera

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Abstract

Indonesia is located on the Ring of Fire and has a huge thermal potential of up to 29,000 MW, which is equivalent to 40% of the world's geothermal potential capacity. According to the latest records from the Geological Agency, Indonesia's geothermal potential in December 2019 was 23.9 gigawatts (GW). According to the Geothermal Authority (2019), this potential can only be used for a total potential of 8.9%, or 2,130.6. MW. Even though the government itself is targeting an increase in geothermal utilization to 7,241.5 MW or 16.8% of the total potential capacity in 2025, there is still much that has not been utilized. CNN Indonesia (2016) stated the expansion of geothermal energy as a source of renewable energies requires a long time and very high risk. Capital will return in the long term and investors will not explore much in this business. As a result, only a few investors are interested in developing geothermal energy in Indonesia. It is necessary to analyze the project financing to assess whether a geothermal project is feasible or not. In this study, data that were used are qualitative and quantitative data such as using a questionnaire given to experts, policy makers, and producers. This study identifies geothermal project feasibility and calculates the capital return estimation using project financing and capital budgeting method.

Keywords
Geothermal Project, Feasibility Study, Project Financing and Capital Budgeting

1. Introduction
Renewable energy is energy that comes from renewable energy sources, namely geothermal energy, wind, bioenergy, sunlight, water currents, waterfalls, movement of temperature differences in the ocean layers, and others, which are sustainable energy sources if managed properly (Indonesian Law No. 30 of 2007 concerning Energy). Indonesia is located on the Ring of Fire and has a huge thermal potential of up to 29,000 MW, which is equivalent to 40% of the world's geothermal potential capacity. According to the latest records from the Geological Agency, Indonesia's geothermal potential in December 2019 was 23.9 gigawatts (GW). According to the Geothermal Authority (2019), this potential can only be used for a total potential of 8.9%, or 2,130.6. MW. Even though the government itself is targeting an increase in geothermal utilization to 7,241.5 MW or 16.8% of the total potential capacity in 2025, there is still much that has not been utilized as shown on figure 1.

Geothermal energy is known as renewable energy which has been processed in Indonesia for almost 100 years. The Netherlands has drilled the first geothermal well in Kamojang since 1926, and the first geothermal power plant has been in operation since 1983. However, the expansion of geothermal energy is a problem, because it is difficult to compete with relatively cheap fossil fuel power plants. With the depletion of production and availability of fossil fuels, the development of new and renewable energy (NRE) technologies further reduces the cost of developing an NRE system and makes it possible to compete with fossil fuels (Directorate General of EBTKE, Ministry of Energy and Mineral Resources, 2020).

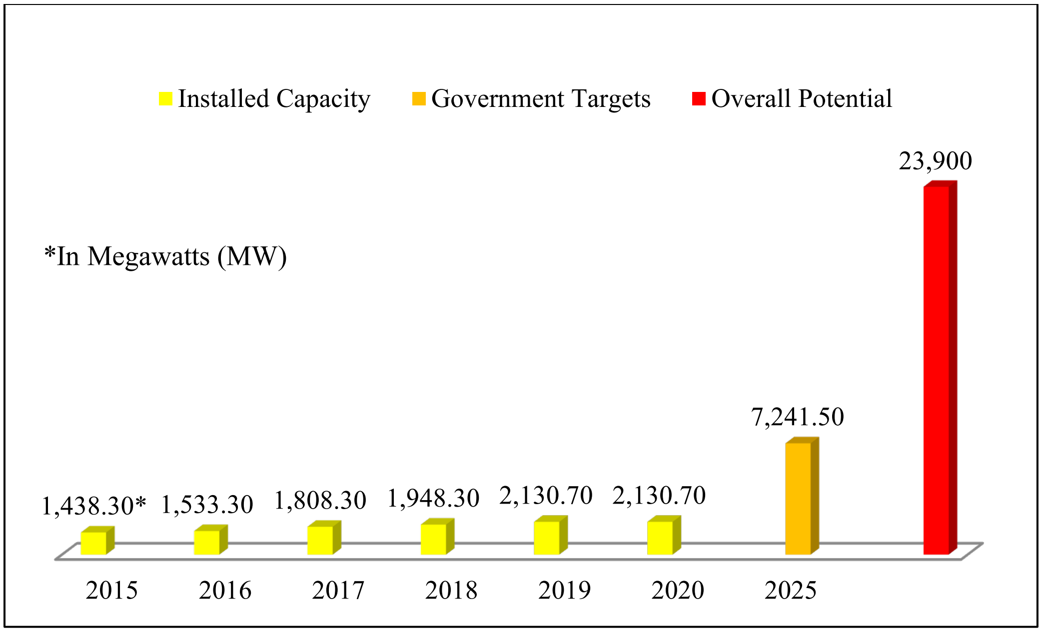

Figure 1. Installed Capacity, Government Targets and Overall Geothermal Potential in Indonesia

One of the obstacles in the development of geothermal energy today is its remote location far from residential areas, so that the economic level is less attractive. However, if oil prices continue to rise, expansion of geothermal power plants especially small scale should be considered to replace diesel power plants with subsidized fuel (WWF, 2015). Expansion of geothermal energy as a source of EBT requires a long time and very high risk. Capital will return in the long term and investors will not explore much in this business. As a result, only a few investors are interested in developing geothermal energy in Indonesia (CNN Indonesia, 2016). According to Fan (2018), there are 3 major obstacles of geothermal development in Indonesia which is technical, financial and politics challenges. The construction of a 50W geothermal power plant takes up to nine years to generate electricity. To acquire the proper goal in investing in new technological know-how there ought to nevertheless be further analysis of how a lot income will be gained with the investment. Economic feasibility evaluation is wanted to see the calculation of how a good deal income the enterprise will get due to the fact of the benefits and funding risks (Farizal et al. 2019). To build a 50 MW power plant requires around 13 production wells and 7 injection wells. Drilling one drilling hole takes at least 50 days, but this time does not include drilling rig mobilization (Gehringer and Loksha, 2012). In terms of power generation, geothermal systems operate 24 hours a day, 365 days a year, regardless of the weather. Geothermal power plant also has the ability to generate electricity greater than coal, natural gas, nuclear or hydropower in the same period (Star Energy Geothermal, 2021). Based on background above, it is necessary to analyze the project financing to assess whether a geothermal project is feasible or not. In this study, data that were used are qualitative and quantitative data such as using a questionnaire given to experts, policy makers, and producers. This study identifies geothermal project feasibility and calculates the capital return estimation using project financing and capital budgeting method.

1.1 Objectives

In this research, the objectives are assessing the feasibility of project financing strategy and financial of a geothermal power plant. By assessing the feasibility of geothermal projects, the impact on source and type of the project financing will be analyzed by the percentage of the equity, loan or debts and grants. Cash inflows and outflows over the life of the prospective project are assessed to determine whether the resulting returns meet adequate target benchmarks. This paper also suggest several future project financing plans, so the company can assess whether the projects Net Present Value (NPV), Internal Rate of Return (IRR), Profitability Index (PI), Payback Period (PP) and Discounted Payback Period (DPP) can be accepted or rejected.

2. Literature Review

2.1 Geothermal Energy

Technically, stormwater penetrates underground rock till it reaches the rock in the reservoir. This water is then heated by using the principal warmth source, magma, and turns into hot water or warm steam (thermal fluid) at a temperature range of 240-310 °C. Thermal fluid can be used to generate electrical power by using excavating and flowing thermal fluid to power turbines and turning generators to produce electrical energy. The thermal fluid is then re-injected into the reservoir thru a re-injection well to hold a heat-fluid stability so that the geothermal system is sustainable. Therefore, the geothermal fluid used for power generation is not from surface water, but from a depth of 1,500 -2500 meters. The need for clean water for households is not affected by geothermal activity, because it is obtained from geothermal reservoirs. (Directorate General of EBTKE, Ministry of Energy and Mineral Resources, 2017).

Geothermal energy has many advantages over traditional fossil fuel energy and other types of alternative energy. Geothermal energy can supply energy at a constant rate and does not depend on the weather and seasons. Geothermal energy can complement other new renewable energy sources such as hydro, wind, solar and geothermal power plants, because the atmospheric emissions produced by the construction of geothermal power plants are very low or can be ignored. Geothermal energy has a lower surface footprint than other types of energy. Finding alternatives to existing carbon-based electricity or heat generation can support government efforts to reduce greenhouse gas emissions (US Department of Energy, 2022).

2.2 Geothermal System

Generally, there are three kinds of conversion for geothermal power plants, specifically dry steam, flash and binary. Dry steam technology is the oldest technology in geothermal technology. The first geothermal power plant used to be carried out in 1904 at the Larderello dry steam field in Italy, releasing steam from the fault and the usage of it to force turbines directly. Geothermal energy plants with flash technology use steam released from high-pressure warm water in formations, surface tools or wells. The steam produced from this system is used to pressure turbines, which in turn force electricity producing equipment. In binary technology, warm water from a well is used in a heat exchanger, where it heats and vaporizes a secondary liquid with a plenty decrease boiling point than water, which in turn drives the turbine (Antonaria, 2014).

Flash System is a fluid-dominated system such as these observed all through Indonesia which are more frequent and commonly occur as high-temperature fluids below the earth's surface. This flash liquid becomes vapor in the well, or more usually on certain surface equipment (separators). Flash plants can include single, double or at least triple flash equipment. Flash steam is used in cases the place geothermal sources produce excessive temperature hot water or a aggregate of steam and warm water. The strength generation cycle comprises 29 percent of all geothermal power plants and produces 40 percentage of the total geothermal energy technology (DiPippo and Ronald, 2005).

2.3 Project Financing

The term Project Financing refers to a financing shape in which the lender has only recourse or essential to venture property and will primarily appear at how to task cash flows from a project as a supply of funds for re-payment. The terms Limited Resource Finance and Non-Resource Finance are often used interchangeably with Project Finance even though these terms describe exclusive terms of the path back to project sponsorship. The US Financial Standard or FAS forty-seven defines project financing as follows: “Large-capitalized project financing where the lender looks specially at money flows and project revenues as a source of funds for repayment and project property as collateral for loans. General credit from the project entity is normally not a substantial factor, but the entity is a company besides different belongings or because of its financing besides direct assistance to the proprietor of the entity” (Ecosecurities, CD4CDM, 2007).

2.4 Capital Budgeting

Capital Budgeting is a procedure to analyze, evaluate and decide whether the sources owned with the aid of a company will be allocated to a project or not. The Capital Budgeting system is used to make certain most desirable allocation of resources and management assistance to work in increasing income for its stakeholders (Shapiro, 2005). According to Clayman et al (2012), Net Present Value (NPV) is the present value of future cash flows after taxes minus funding spending, The Profitability Index (PI) is the present value of the future money flows of a project divided via the preliminary money funding and the Internal Rate of Return (IRR) is the cut price charge that makes the current price of future after-tax cash flows equal to investment expenditures. According to Gitman (2008), the Payback Period is typically used to evaluate the proposed investment. The payback period is the amount of time it takes a corporation to repay its initial funding in a challenge calculated from money in flows.

3. Methods

There are various steps in data processing methodology, first prepare the funding or project price data, operational and economic data. Second, put together the price of capital records and calculation of Weighted Average Cost of Capital (WACC). Third, prepare the financing shape state of affairs and the money flow. Fourth, perform the calculation of Net Present Value (NPV), Internal Rate of Return (IRR), Profitability Index (PI), Payback Period (PP) and Discounted Payback Period (DPP) and conduct the monetary feasibility testing according to Ross et al (2010) as follows: if NPV > 0 USD then the project can be accepted, if NPV < 0 USD then the project is rejected. if the Payback Period is much less than the maximum desirable payback period, then the project is acceptable. If the Payback Period exceeds the most ideal payback duration then the project may be rejected. if IRR > Required rate of return capacity the project is acceptable and if IRR < Required rate of return then the project is rejected. For PI whose cost is greater than 1, the project can be accepted due to the fact PI > 1 shows that NPV > 0, and vice versa if PI < 1 means that NPV < 0 The valuation of geothermal energy generation project the use of NPV method underestimates the value of the project as an alternative than ROV. The ROV method assesses projects based on options in the implementation of a project. In ROV strategy where we only performed the project if exceptional state of affairs occurred, we achieve better cost of the project and danger has been reduced. The end result of the find out about confirmed discount charge is the most sensitive variable in the project accompanied through income volume (Dachyar et al, 2018).

4. Data Collection

The data collected from quantitative and qualitative source, with the availability data from primary and secondary data. The Primary data was from questionnaire and direct quantitative data from PT. X. Lumut Balai Geothermal Power Plant is located in South Sumatra, Indonesia. The power plant generates the capacity for about 1x55 MW from unit 1 and soon 1x55 MW from unit 2. The exploration, development and construction period was on January 2017 to December 2022. The utilization period is on January 2023 to December 2052. Lumut Balai Geothermal Power Plant design using single flash or separated cycle system. From Table 1, it can be seen that the amount of initial investment for both steam field and power plant development are 253 million US Dollar with the steam field development costs 157 million US Dollar and power plant development costs 96 million US Dollar.

Table 1. Input Data of Initial Investment

Initial Investment				
Input Data	Dimension	Input	Qty	Total
		2	2	2
Steam Field Development				
Electricity Price	USD/kWh	0.0753		
Capital				
Land Cost, Environmental Study & Civil Work	USD	7,000,000	1	7,000,000
Exploration Drilling	USD/well	6,000,000	3	18,000,000
Development Drilling	USD/well	6,000,000	6	36,000,000
Injection Drilling	USD/well	6,000,000	7.5	45,000,000
Gathering System	USD/MW	320,000	55	17,600,000
Piping & Production Facilities		19,250,000	1	19,250,000
Support Facilities		1,000,000	1	1,000,000
Additional Production Facilities		25%		
Expense				
Detail 3G Survey	USD	2,000,000	1	2,000,000
Core Holes	USD	1,000,000	1	1,000,000
Resource Study & Modelling	USD/MW	100,000	1	100,000
Feasibility Study	USD/MW	140,000	1	140,000
O&M Upstream	USD/MW	30,000	330	9,900,000
Power Plant Development				
Capital				
Plant EPCC	USD/MW	1,600,000	55	88,000,000
Detailed Engineering	USD	200,000	1	200,000
Land Excavation & Civil Work	USD	5,000,000	1	5,000,000
Expense				
Other Cost Include Adm/Management	USD	3,000,000	1	3,000,000
				$253,190,000

Table 2 shows the first, second and third financing structure scenario without the investment after COD costs. where the first scenario using 100% equity financing, second scenario using 62% of equity financing and 38% loan financing, and the third scenario using 38% equity financing and 62% loan financing. Total of the investment is at 445.190.000 US Dollar.

Table 2. Financing Structure Scenario of Each Scenario

Financing Structure Scenario 1		Financing Structure Scenario 2		Financing Structure Scenario 3	
Equity	Loan	Equity	Loan	Equity	Loan
Steam Field Development					
$156,990,000		$156,990,000			$156,990,000
Powerplant Development					
$ 96,200,000			$ 96,200,000	$ 96,200,000	
$253,190,000	**-**	**$156,990,000**	**$ 96,200,000**	**$ 96,200,000**	**$156,990,000**
100%	**0%**	**62.00%**	**38.00%**	**38.00%**	**62.00%**

Table 3 shows the investment after the Commercial Operation Date (COD) for all of the scenario with the make up well drilling, operation and maintenance upstream for 36 years and downstream for 30 years costs at 192 million US Dollar.

Table 3. Investment After Commercial Operation Date (COD)

Investment After COD					
Steam Field					
Capital					
Make Up Well Drilling	USD/well	6,000,000	7,500,000	8	60,000,000
Expense					
O&M Upstream	USD/MW	30,000	30,000	1,650	49,500,000
Power Plant					
Expense					
O&M Downstream	USD/MW	50,000	50,000	1,650	82,500,000
					$192,000,000

Table 4 and table 5 shows the technical and financial parameter/ assumption that was used in this research. Table 6 shows the results of Weighted Average Cost of Capital (WACC) which involve the Cost of Equity and Cost of Debt calculation. With beta coefficient at 0.76, Relative Equity market volatility at 1,19, Equity market risk premium at 4.24%, Risk factor 1,88% and Country risk premium of Indonesia at 5.22% according to Damodaran (2022). Risk free rate at 2.37% and US 10 Years global bond yield at 2.37% according to US Department of Treasury (2022). And Indonesia 10 Years global bond yield at 6,75% according to Bank Indonesia (2022).

Table 4. Technical Assumption

Technical Assumption			
Input Data	**Dimension**	**Average**	**Input**
		2	**2**
Capacity Factor	%	90%	90%
Specific Steam Consumption (SSC)	ton/h/Mwe	7.5	7.5
Dryness	%	20%	0.2
Excess Steam	%	15%	15%
Output Condesate	%	25%	25%
Decline Rate	%	4%	4%
Number of Exploration Well		3	3
Exploration Well Success Ratio	%	50%	50%
Production Well Success Ratio	%	83%	83%
Make Up Well Success Ratio	%	83%	83%
Well Capacity	Mwe	10	10
Injection Capacity	ton/h	430	430

Table 5. Financial Parameter

Financial Parameter			
Input Data	**Dimension**	**Average**	**Input**
		2	**2**
Tangible Well Cost	%	44%	44%
Depreciation Period US	Year	8	8
Depreciation Period DS		25	25
Depreciation Rate	%	25%	25%
Loan Percentage for DS	%	100%	100%
Loan Period	Year	20	20
Interest	%	4%	4%
Interest During Construction	%	4%	4%
Income Tax	%	25%	25%
Discount Rate	%	10%	10%
Investment Tax Holiday	Years	6	6
Production Bonus	% of Revenue	0.50%	0.50%
Iuran Produksi	% of Revenue	2.50%	2.50%

Table 6 shows the WACC of each scenario where the WACC of scenario 1 is at 10.80%, Scenario 2 at 7.84% and Scenario 3 at 5.96%

Table 6. Weighted Average Cost of Capital of Each Scenario

WACC of Each Scenario						
Description	Scenario 1		Scenario 2		Scenario 3	
	Equity	Loan	Equity	Loan	Equity	Loan
Financing Structure	100%	0%	62%	38%	38%	62%
Cost of Equity	10.80%	-	10.80%	-	10.80%	-
Cost of Debt	-	3%	-	3%	-	3%
WACC	10.80%		7.84%		5.96%	

Figure 2 shows the steam supply of Lumut Balai Geothermal Power Plant for 30 Years of operation with the bottomline of steam supply at 55 MW

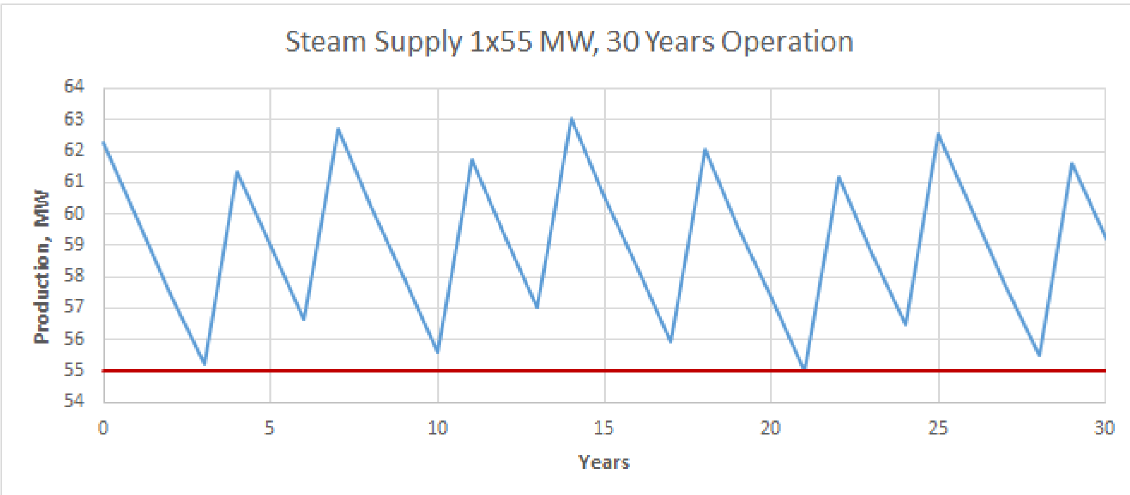

Figure 2. 30 Years Steam Supply of Lumut Balai Geothermal Plant

5. Results and Discussion

The first step is calculating the Net Present Value (NPV) to analyze the present value of the future after-tax cash flows minus the investment outlay. Second, calculating the Internal Rate of Return (IRR). Third, calculating the Payback Period and Discounted Payback Period to analyze the time required for the firm to recover its initial investment in a project. And the last step is calculating the Profitability Index (PI) to indicates the value received in exchange for one unit of currency invested. All of these calculation is shown in Table 7.

5.1 Numerical Results

According to Ross et al (2010), if NPV > 0 USD then the project can be accepted, if NPV < 0 USD then the project is rejected. if the Payback Period is less than the maximum acceptable payback period, then the project is acceptable. If the Payback Period exceeds the maximum acceptable payback period then the project may be rejected. if IRR > Required rate of return means the project is acceptable and if IRR < Required rate of return then the project is rejected. For PI whose value is more than 1, the project can be accepted because PI > 1 indicates that NPV > 0, and vice versa if PI < 1 means that NPV < 0.

Based on table 7, financing structure scenario 1 shows that the geothermal development project is unfeasible and rejected to be executed. Financing scenario 2 shows that the geothermal development project is feasible and accepted to be executed even the discounted payback period rejected. Financing structure 3 shows that the geothermal development project is feasible and accepted to be executed.

From these scenarios, if the company using financing structure scenario 3, the company will get the best economic value of the geothermal business development project because financing structure scenario 3 shows the highest NPV, IRR, PI and the smallest discounted payback period compared to other scenarios.

Table 7. Final Capital Budgeting Decision Analysis

Capital Budgeting Technique Analysis		Scenario 1		Scenario 2		Scenario 3	
Net Present Value (NPV)	USD 000	(88,418)	Reject	11,568	Accept	52,819	Accept
Internal Rate of Return (IRR)	%	-3.58%	Reject	4.93%	Accept	9.61%	Accept
Payback Period (PP)	Years	12.57	Reject	8.14	Accept	6.75	Accept
Discounted Payback Period (DPP)	Years	Undefined	Reject	11.59	Reject	7.61	Accept
Profitability Index (PI)	Index	0.62	Reject	1.96	Accept	2.86	Accept

6. Conclusion and Recommendations

Based on data analysis and discussion that had been done, it can be concluded about the feasibility study of geothermal development project as follows:

1. The capital expenditure needed for geothermal development project is the same for three financing scenario with initial investment at 253.000.000 US Dollar and investment after COD at 192.000.000 US Dollar.

2. Geothermal development project is feasible and accepted to be executed for financing scenario 2 and 3 even the discounted payback period of financing scenario 2 is rejected. The project will unfeasible if the project run by financing scenario 1 as shown in Table 7.

3. Financing structure 3 give the best economic value of geothermal business development project. The NPV of financing structure 3 is amounting to 52.819.000 US Dollar, IRR is 9,61%, Discounted Payback Period is 7,61 years and the Profitability Index is 2.86.

References

Antonaria, Rustandi, D., Armstrong, J., Brophy, P., Sikumbang, I., Nugroho, H., Primana, J. R., Sunandar., Marizi, N., Nugroho, H. T., Simamora, W. P., Sinaga, D. V. C. R., Widyastuti, N. L., Hendrawijaya, P., Mathieu, T. *Geothermal Handbook for Indonesia*, Jakarta: Directorate for Energy Resources, Mineral and Mining Ministry of National Development Planning / National Development Planning Agency (BAPPENAS), 2014.

Bank Indonesia, Investor Relations Unit, Available: https://www.bi.go.id/en/iru/default.aspx Accessed on 25 March 2022.

Clayman, M. R., Fridson, M. S., Troughton, G. H., Scanlan, M. Corporate finance: a practical approach workbook. *New Jersey: John Wiley & Sons, Inc*., 2012.

CNN Indonesia. *Without Government Intervention, Geothermal Stalls.* Available: http://www.cnnindonesia.com/ekonomi/20160107100957-85-102780/tanpa-intervensi-pemerintah-investasi-panas-bumi-tersendat/. Accessed on 19 November 2021.

Dachyar, M., Bilqist, A. R., Farizal, The Valuation of Geothermal Power Projects in Indonesia Using Real Options Valuation, *MATEC Web of Conferences* 248. 03004, 2018.

Damodaran Online, Available: https://pages.stern.nyu.edu/~adamodar/ , Accessed on 25 March 2022.

DiPippo and Ronald, Geothermal Power Plants: Principles, Applications and Case Studies. *Elsevier Advanced Technology*, London, UK, 2005.

Directorate General of New Renewable Energy and Energy Conservation (EBTKE), Geothermal Energy is Friendly to the Surrounding Environment, Jakarta: Ministry of Energy and Mineral Resources (ESDM), 2017.

Directorate General of New Renewable Energy and Energy Conservation (EBTKE), Huge Potential Unexploited, 46 Geothermal Projects Ready to Run. Jakarta: EBTKE Public Relations, 2020.

Directorate General of New Renewable Energy and Energy Conservation (EBTKE), Handbook of Energy & Economic Statistics of Indonesia. Jakarta*: Head of EBTKE Data and Information Technology Center*, 2020

Ecosecurities, CD4CDM, Guidebook to financing CDM project, 2007.

Fan, K, Accelerating Geothermal Development in Indonesia: A Case Study in the Underutilization of Geothermal Energy. *Consilience: The Journal Of Sustainable Development*, vol. 19, no. 1, 2018.

Farizal, Ariva, Dachyar, M., Rahman, A., Geothermal Power Plant Area Layout Optimization Considering Toxic Gas Dispersion, 2018 *IEEE 5th International Conference on Engineering Technologies & Applied Sciences, 22- 23 Nov 2018, Bangkok Thailand*

Gehringer, M. and Loksha, V, *Geothermal Handbook: Planning and Financing Power Generation*. Washington DC: The World Bank, 2012.

Gitman, Lawrence J. Principles of managerial finance. Pearson Prentice Hall., 2008.
Muchammad, Project Financing Strategy for Geothermal Development Project. Jakarta: Universitas Indonesia, 2015
Republic of Indonesia, Law of the Republic of Indonesia Number 30 of 2007 concerning Geothermal. Jakarta: *DPR and President of the Republic of Indonesia,* 2007.
Ross, S. A., Jaffe, J. F., Jordan, B. D., Westerfield, R. W., Modern financial management. *International Edition. New York: Mc Graw Hill*, 2010.
Shapiro and Alan, C, Capital budgeting and investment analysis. *Pearson Prentice Hall*. 2005.
Star Energy Geothermal, Geothermal Power Plant in Indonesia. Available: https://www.starenergygeothermal.co.id/id/ stories-kami. Accessed on November 20, 2021
US Department of Energy, Available: https://www.energy.gov/eere/geothermal/geothermal, Accessed on 25 March 2022.
World Wildlife Fund (WWF) Indonesia, Geothermal Training Module for Civil Society Organizations. Indonesia: WWF Indonesia, 2015.

Biographies

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