CHAPTER II

LITERATURE REVIEW

1. Theoretical Framework

1.1. Economic Growth, Infrastructure, and Renewable Energy

Economic growth is the continuous increase in the production of economic goods and services over time. It may be represented in nominal (inflation-adjusted) or real (price-adjusted) terms. Economic growth is often assessed in aggregated market value terms for newly created goods and services. It is often quantified by aggregating market value estimates, such as GDP (Potters, 2021).

Infrastructure investment and economic development have a long-term association. (Khan et al., 2020). Infrastructure facilitates the development of new economic activities, which results in economic growth. Infrastructure also improves the overall quality of life and creates opportunities for reducing inequalities and poverty incidence. Sufficient infrastructure would enable more economic investment, stimulate demand for jobs, and boost income, which would drive further economic activity. Additionally, it promotes human capital development by offering access to healthier lifestyles and improved education. (Damuri, 2017).

One of the most crucial infrastructures is energy because it drives other infrastructure sectors. Energy infrastructure facilitates large-scale energy transmission from producer to consumer and the direction and manages the energy stream (DBW, 2020). There are two types of energy generation sources: non-renewable and renewable.

Renewable energy infrastructure generates power produced by natural processes that are constantly replenished and cause lower environmental effects—such as sources as biofuels, wind, hydroelectricity, geothermal, tides, sunlight, and water waves. The opportunity of developing renewable energy infrastructure is the rising concern over energy supply, ecological threat, and technical advancement. (Donovan, 2015). In Indonesia, the environmental impact indicators of renewable energy projects are the amount of GHG emissions avoided/reduced, renewable electricity production, and the capacity of renewable power plants installed or rehabilitated (MOF, 2020)

Renewable energy has distinct characteristics as an investment type. Renewable energy is capital-intensive, similar to traditional energy exploration. It needs a significant investment cost in an upfront payment. Renewable energy produces goods that are either expensive to transport or difficult to store. Not to mention, renewable energy covers a broad spectrum of technologies, each with a particular value chain that frequently has little in common. Some renewable energy relies on highly centralized energy networks to stay afloat, creating a competitive threat with other types of renewable energy. Each renewable energy technology's market readiness and economic competitiveness are also different (Donovan, 2015).

1.2. Geothermal Energy Infrastructure

The geothermal power plant generates electricity with steam. The steam spins a turbine, which turns a generator, which generates electricity. Conventional diesel power plants utilize fossil fuels to generate steam. Geothermal power plants, on the other hand, utilize steam generated by hot water reservoirs a few miles or more beneath the Earth's surface. Geothermal power plant types are dry steam, flash steam, and binary cycle (Geothermal Electricity Production, n.d.).

Geothermal projects have some specific characteristics. First, the high initial capital demand (a mid-range estimation is close to US$ 4 million per MW), along with the comparatively long time-lag between investment and return, results in high exposure to financing costs. Additionally, unlike wind, solar, or even hydropower, a substantial portion of the initial expenditure is needed for exploration to ascertain the resource's viability. The uncertainty in the exploration phase can be very high (ESMAP, 2012).

Before the actual operating process begins, a geothermal energy project embodies the following implementation phases: preliminary survey; exploration; test drilling; project evaluation and planning; field development/full-scale drilling; construction; and start-up and commissioning. Test drilling could account for up to 15% of total capital costs and the feasibility is uncertain (ESMAP, 2012).

Usually, geothermal power plant projects require between five and ten years to be completed. Therefore, due to the lengthy development period, geothermal energy is not a quick fix for every country's power supply issues. Instead, it should be incorporated into a long-term electricity strategy and policy (ESMAP, 2012).

Indonesia's geothermal mining potential and working area have not been fully utilized. According to the Geological Agency's data, Indonesia has 23.9 GW potential geothermal reserves, and 2.13 GW of it has been utilized. Out of the 252 proposed geothermal sites, the surveyed and reserve-developed locations are 31%. Most locations, especially those in remote areas, are still undergoing preliminary surveys to ascertain potential resources. Around 80% of Indonesia's geothermal locations are associated with active volcanic systems (Wahyuningsih, n.d.).

1.3. Renewable Energy Infrastructure Financing

Collecting capital to finance the heavy initial outlay of power plants may be an obstacle in renewable energy/RE infrastructure. In the long term, RE will create a radical shift in energy and economy. However, in the short term, RE projects may raise confusion regarding the predictability of return. Strategic investors (project developers) are essential stakeholders, but the more significant portion of investment should come from financial investors (equity or liability holders) (Donovan, 2015).

Government bonds are the recommended match for renewable energy projects. Large financial investors tend to prefer financial investment rather than tangible assets investment like power plants. Financial assets offer scale to absorb large capitals and liquidity, while infrastructure development is a single project and must wait for a subsequent buyer. However, government bonds can absorb far greater funds and is liquid. With government bonds as the financing instrument, RE projects can manifest into financial assets in the form of asset-backed securities (Donovan, 2015). Green bonds are an attractive option to achieve eco-friendly investments without compromising returns-generating objectives. However, the green bond must become more affordable and universal, requiring government intervention (BlackRock, 2016).

There are several funding schemes for RE infrastructure other than private development in Indonesia. Public-private partnership/PPP (KPBU) is applicable for this case with supported-build-operate-transfer/SBOT and availability payment/AP model. The GOI also cooperates with the state/regional-owned company (BUMN/D), including an assigned state equity participation (PMN). There are also joint venture schemes to reduce the need for PMN. Finally, the state/regional budget (APBN/D) also contributes to RE infrastructure funding.

In Indonesia, the Government has formulated fiscal initiatives for green infrastructure in the National Budget/APBN context. From the budget income sector, GOI facilities include tax holiday, tax allowance, import duty exemption, VAT deduction, income tax borne by the Government, and land and building tax deduction. From the budget spending sector, GOI utilizes Climate Budget Tagging/CBT at national and regional levels to track the contribution of the national budget for handling climate change. From the budget financing sector, MOF innovated with Green Sukuk instrument (BKF, 7th Sharia Session "Mengenal Green Sukuk Lebih Dekat", 2020).

Additionally, there is also funding for geothermal projects and other funding. The funding facility designated for geothermal includes PISP (Geothermal Sector Infrastructure Financing), GEUDP (Geothermal Exploration Upstream Development Project), and GREM (Geothermal Resource Risk Mitigation). While other funding facilities are derived from SDG Indonesia One, subsidized loans through PT SMI, Green Bond, and Green Sukuk. (Harris, 2021)

1.4. Sharia-Compliant Infrastructure Financing

Islamic financing schemes are potential sources of funds for projects, especially social and philanthropical ones. There are several Islamic business agreements/akads and schemes explained as follows.

1.4.1. Wakalah

Wakalah is the delegation of authority from one person as the first party to another as the second party. Wakalah has been applied for project-based sukuk in Indonesia and other countries, including green sukuks (Mat Rahim & Mohamad, 2018). One of the *fiqh* (Islamic legislation) of wakalah is Qur'an *surah* Al-Kahf verse 19 about the Seven Sleepers legend, one of them is delegated with some money to purchase food in the market. In Indonesia, wakalah is regulated in DSN-MUI Fatwa No: 95/DSN-MUINII/2014 about SBSN Wakalah.

1.4.2. Ijarah

Ijarah is to a contract for the employment of people, the renting/leasing of services, or the usufruct of a property for a set length of time and price. One of the *fiqh* of ijarah is a Qudsi hadith narrated by al-Bukhari, Ahmad, Ibnu Majah from Abu Hurairah that people who do not pay for other people's right for the service given are the enemy of God. In Indonesia, ijarah is regulated in DSN-MUI Fatwa No: 76/DSN-MUI/ VI/2010 about SBSN Ijarah Asset to be Leased.

1.4.3. Murabahah

Murabaha, also known as cost-plus finance, is an Islamic financing arrangement in which the buyer and seller agree on the asset's cost and markup. . One of the *fiqh* of murabahah is Qur'an surah An-Nisa' verse 29 that buying and selling with a genuine mutual agreement is allowed. In Indonesia, murabahah is regulated in DSN-MUI Fatwa No: 04/DSN-MUI/IV/2000 about Murabahah.

1.5. Green Sukuk for Project Financing

Green Sukuk is one of sovereign sukuk (SBSN) innovations that accelerate green infrastructure development by using GI as the underlying assets. In Indonesia, projects funded with Green Sukuk follow the Climate Budget Tagging system (BKF, 7th Sharia Session "Mengenal Green Sukuk Lebih Dekat", 2020).

There are several forms of Sukuk. Sukuk is issued by the Government of Indonesia (sovereign) or by designated issuing companies (private), and the current Green Sukuk is the sovereign type. Sukuk can be traded in primary and secondary markets based on the sukuk types. One of the current Green Sukuk types, which is the global sukuk, is tradable in the secondary market (Amin, 2016; BKF, 7th Sharia Session "Mengenal Green Sukuk Lebih Dekat" [Video], 2020).

Sukuk is issued based on contracts/akad to ensure sharia law compliance. There are several akad of sukuk: ijarah or ownership Sukuk of the leased property; mudharabah or investment; musyarakah or partnership; istishna' or craftmanship in exchange for a commodity to be manufactured; wakala or agency; and other or combined contracts as long as in compliance with sharia. The contracts of Green Sukuk are mudharabah, ijarah, and wakala (Amin, 2016; IIFM, 2020).

Sovereign sukuk for project financing differs into two sub-categories: the Project Underlying Sukuk/PUS and the Project Financing Sukuk/PFS. In the PUS, the infrastructure project is specified in APBN. The proceeds from the issuing of the State Sukuk are used to revolve the initial payments from other state revenues (rupiah murni, i.e., taxes). On the other hand, in PFS, the project proposals are first proposed to Bappenas and MOF before being registered in APBN. As a result, the project's funding is entirely derived from the sovereign sukuk (earmarked) (Hariyanto, 2017). Green Sukuk belongs to both PUS and PFS (BKF, 7th Sharia Session "Mengenal Green Sukuk Lebih Dekat" [Video], 2020).

1.6. Capital Budgeting Theory

In the capital budgeting process, entities should identify promising investment opportunities. Then, investment projects are classified into revenue-enhancing investments, cost-reduction investment (i.e., new machines to substitute the obsolete ones), and mandatory investment (i.e., government project) (Titman, Keown, & Martin, 2018).

After the potential investments are identified, entities should evaluate the projects' value-creating potential or value proposition. The evaluation considers investment decision criteria as follows (Titman, Keown, & Martin, 2018).

1. Net Present Value (NPV) is the difference between the present value (discounted) of cash inflows and cash outflows (discounted cash flow/DCF). The cash flow used to calculate project NPV is the expected value of future cash flows, a probability-weighted average of all possible cash flows.
2. Profitability Index (PI) is a cost-benefit ratio calculated by dividing the current value of potential cash flows by the initial investment expenditure.
3. Internal Rate of Return (IRR) is the interest rate on a project at zero NPV.
4. Modified Internal Rate of Return (MIRR) modifies project cash flows by discounting potential negative cash flows and includes them in the initial outlay.
5. Payback Period (PP) is the number of years needed to recover the investment's initial cash outlays.
6. Discounted Payback Period (DPP) calculates the payback period using discounted cash flows.

After evaluating the investment decision criteria, a project risk analysis should be conducted before the final decision. The reason is that cash flows from projects are uncertain and can differ from the figures used to calculate the NPV and other parameters. Another reason is that forecasts are subject to prejudice, either being too optimistic or cynical (Titman, Keown, & Martin, 2018).

Tools for analyzing risks in project cash flows include Sensitivity Analysis, Scenario Analysis, and Simulation Analysis (Titman, Keown, & Martin, 2018).

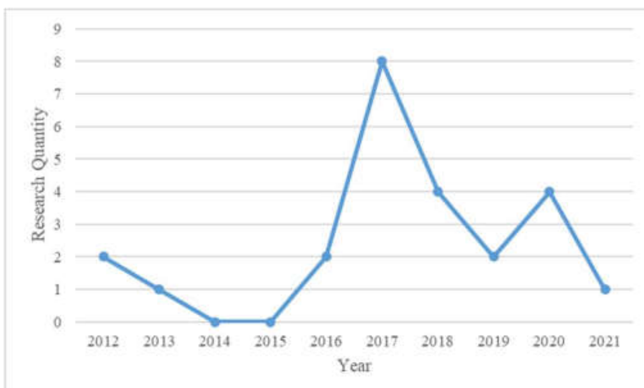
1. Sensitivity Analysis is used to determine the impact of each value driver on an investment's NPV. The value drivers are project income (i.e., market share, market size, and price) and project costs (i.e., variable and cash fixed costs other than depreciation).
2. Scenario Analysis is conducted to simultaneously evaluate the effect of estimation change in multiple value drivers of NPV.
3. Simulation Analysis generates thousands of financial indicator values, resulting in thousands of values for each value driver. The different values are the result of each value driver in a respective probability distribution.

Monte Carlo Simulation/MCS is one of the tools for simulation analysis. MCS selects random samples of the appropriate model input data using probability distribution functions. MCS then runs a large number of simulations to produce values for model output variables. This method is repeated until the distribution of values is obtained and converted into probability distribution functions for risk evaluation (Arnold & Yildiz, 2015).

2. Previous Research

To summarize and disseminate research findings and identify research gaps in the existing literature, scoping review is conducted (Pham et al., 2014). Figure 3 shows previous research regarding legal and financial analysis with objects of Green Sukuk and green infrastructure, especially renewable energy power plants. The researcher uses those literature as the reference of the analyses.

Figure 3 Relevant Previous Research

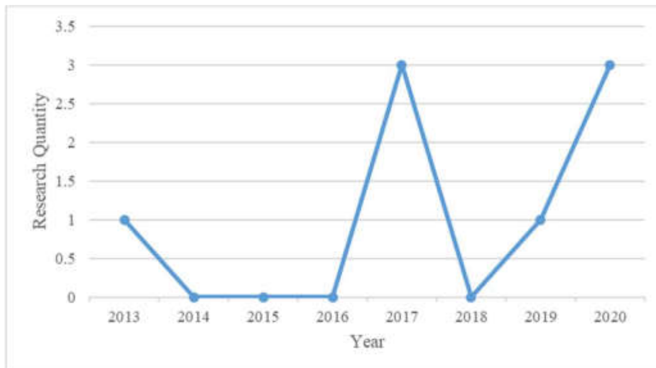


Source: developed by the researcher

2.1. Legal Analysis and Green Sukuk

Research about the legal nature of SBSN for infrastructure financing was increasing in 2017, followed by the specific instrument of Green Sukuk after the first issuance in 2018, as shown in Figure 4. Some publications describe the potential of the instrument, some dive deeper with law analysis but with POJK, and some analyze the legal aspect more precisely using public finance regulations (see Table 2).

Figure 4 Legal Analysis and Green Sukuk Research



Source: developed by the researcher

Yunan, Pramudya, Sutjahjo, Tambunan, & Rangkuti (2013) conducted a geothermal power plant case study in Darajat, Garut, Indonesia, to construct geothermal development conceptual model. The conceptual schema shows that regulation, management systems, financial support, and institutional actors are crucial for geothermal project development. The regulation aspect should be conducted with a legal review of associated regulations. While the financial factor is determined using NPV and IRR that show positive results. However, the context of this research is **general geothermal financing sources**, **not limited to SBSN nor Green Sukuk**.

Table 2 Legal Framework and Green Sukuk Research

No	Researcher	Year	Topic	Financing Source	Data Source
1	Surachman & Handayani	2017	legal feasibility analysis	SBSN	UU 19/2008; PP 56/2011; Fatwa 76/2010; Fatwa 95/2014; Fatwa 1/2012

2	Meilani	2017	legal feasibility analysis	Green Sukuk	GS Framework
3	Abubakar & Handayani	2020	legal feasibility analysis	Green Sukuk	GS Framework; POJK 51/2017; POJK 18/2015
4	Ramadhan & Wirdyaningsih	2020	legal feasibility analysis	Green Sukuk	POJK 3/2018, POJK 60/2017
5	Santoso	2020	potential exploration	Green Sukuk	Fatwa 32/2002; GS Allocation and Impact Report
6	Puthiyapurayil	2019	potential exploration	Sukuk	MOF's sukuk for infrastructure report
7	Nopijantoro	2017	potential exploration	SBSN	UU 19/2008; PP 56/2011
8	Yunan	2013	legal analysis for geothermal development model	-	-

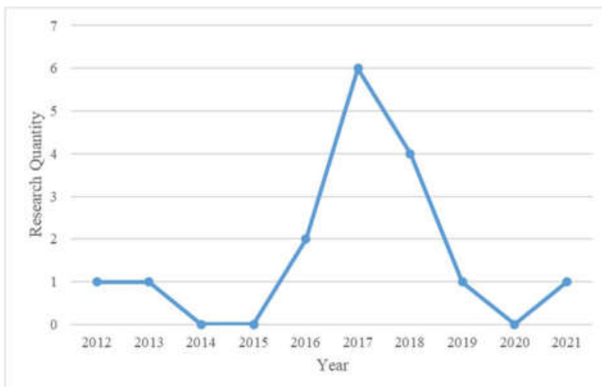
Source: developed by the researcher

Previous researches about the **legal evaluation** of **Green Sukuk** encompass *sharia* compliance and green aspects. Abubakar & Handayani (2020) use a normative legal framework to explain Green Sukuk's legal standpoint. The *sharia*-compliance aspect is regulated in the National Sharia Council's Fatwa. Meanwhile, the sustainable aspect is regulated in the Regulation of the Financial Service Authority (POJK) No. 51 of 2017 on Sustainable Finance and Financial Services Authority Regulation No.18/POJK.04/2015. Ramadhan & Wirdyanigsih (2020) conducted a similar approach to examine if a new regulation is needed on green sukuk. The research employed a juridical-normative approach. The researchers also refer to OJK Regulation 3/POJK.04/2018 regarding the *sharia* compliance and OJK Regulation No. 60/POJK.04/2017 regarding green bonds. However, the current existing Green Sukuk type is only sovereign sukuk managed by the central Government. Therefore, POJK intended for the private sector might not be suitable to evaluate Green Sukuk.

2.2. Financial Analysis and Green Infrastructure

Research about financial analysis for green infrastructure projects peaked in 2017, as shown in Figure 5. Most of the proxies used to evaluate the feasibility are NPV and IRR, but few of them conducted Monte Carlo Simulation (see Table 3). There is some research with the object of a small-scale geothermal power plant, but the financing source is not Green Sukuk or other sharia finance.

Figure 5 Financial Analysis and Green Infrastructure Research



Source: developed by the researcher

Several studies tested **the financial and legal aspects** of **SBSN or Green Sukuk** for **general and renewable energy infrastructure**. For example, Meilani (2017) tested the feasibility of Green Sukuk to finance hydroelectric power plant projects by PT. Indonesia Power, the largest supplier of electrical resources for the Java-Bali system. The evaluation indicates that the proposal is viable, as shown by the optimistic NPV, IRR, and B/C ratios values. From the legal viewpoint, hydropower construction is one of the eligible projects of Green Sukuk, which is renewable energy.

Surachman and Handayani (2017) analyzed the feasibility of Indonesia's sovereign Sukuk as a financial strategy of renewable energy infrastructure. They take the Muara Laboh geothermal power plant project as the case study object. The legal evaluation method is a literature review of related regulations and Sukuk administrator and issuer interviews. Meanwhile, the financial evaluation was done by performing DCF, NPV, and IRR analysis and strengthening them with a Monte Carlo Simulation. The research concludes that Sukuk financing for Muara Laboh geothermal power plant is feasible.

Table 3 Financial Analysis and Green Infrastructure Research

No	Researcher	Year	Object	Location	Financing Source	Methodology
1	Surachman & Handayani	2017	Geothermal Muara Laboh	Indonesia	SBSN	NPV, IRR, MCS
2	Insani	2019	Geothermal (small-scale)	Indonesia	General	NPV, IRR, PP
3	Yunan	2013	Geothermal Drajat	Indonesia	General	NPV & IRR
4	Meilani	2017	Hydro	Indonesia	Green Sukuk	NPV, IRR, CBA
5	Morea & Poggi	2016	Solar	Italy	Sukuk	ADSCR, ALLCR, NPV, IRR, sensitivity
6	Morea & Poggi	2017	Wind	Italy	Green Sukuk	NPV, ADSCR, ALLCR
7	Semelane	2021	Solar	South Afica	General	IRR, sensitivity
8	Rafique	2018	Solar	Pakistan	General	IRR

Source: developed by the researcher

Previously, Surachman and Setiawan (2016) also analyzed municipal bonds to finance infrastructure projects. The object of the case study is Jakarta MRT Phase 1. The research used DCF, NPV, and IRR for the financial analysis, followed by Monte Carlo Simulation. The municipal government’s financial capacity is also analyzed using the local Government's budget and audit report analyses. In addition, a literature study of related regulations was conducted to evaluate the legal aspect. From the Green Sukuk Framework point of view, electrical transportation like MRT is included in the eligible project for the Renewable Transportation category. The result suggests that municipal bonds are feasible to finance the Jakarta MRT project.

Researches about **sukuk** application for **renewable energy infrastructure** have also been conducted in **other countries**. For example, Morea & Poggi (2016) investigated PV systems' energy and economic performance in Italy using sukuk as the financing instrument. They conduct the analysis using ADSCR, ALLCR, NPV, and IRR with parameters and Sensitivity Analysis. The breakeven points show that the practical use of *sharia*-compliant sukuk depended on the solar data and energy prices. However, sukuk is resilient and sustainable because each financial transaction must be tied to a tangible and identifiable asset.

Furthermore, Morea & Poggi (2017) present the technological, electricity, and economic feasibility case study of mini-wind power systems in Italy. The findings demonstrated the critical role of incentives and the viability of *sharia*-compliant sukuk in providing wind energy investment. Although the NPV, ADSCR, and ALLCR results are negative in sukuk and conventional bonds scenarios, the sukuk case demonstrated better bankability metrics.

Most other researchers evaluate the **financial feasibility** of **renewable energy** projects across countries, but **not in the context of sukuk**. (Kim et al., 2018) conducted feasibility analysis of renewable energy systems in environmental basic facilities (EBFs) of Busan, South Korea. Photovoltaic (PV), small hydro, and wind power projects are evaluated using the B/C ratio, NPV, and IRR. Renewable electricity is commercially viable in all object locations as nearly all NPVs are positive. Additionally, the research concludes that government-supported and private investment funding mechanisms are more commercially viable than self-investment for implementing clean energy in Busan's EBFs.

Cucchiella et al. (2012) analyzed environmental and economic evaluations of grid-connected solar PV in Europe. The economic analysis is conducted with IRR, NPV, discounted payback period, and discounted aggregate C/B. In addition, they run a Sensitivity Analysis to identify a critical variable in the project. The results demonstrated a positive NPV. Opposite with Kim et al. (2018), this research concludes that self-financing is the most preferred option.

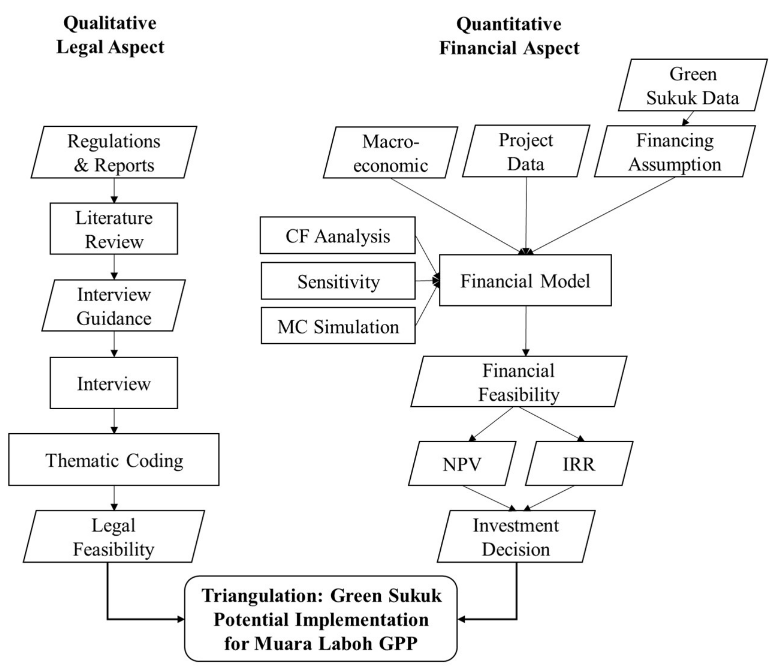
Some studies analyze **the cost and financial feasibility of a small-scale geothermal power plant in Indonesia**. Insani (2019) conducted an economic feasibility test on steam system small-scale geothermal. The scenarios include 5, 7, and 10 MW net capacity and feed-in tariff based on the regions throughout the country. NPV, IRR, and Payback Period/PP are employed in the cash flow model. The result shows that only the scenario with a 10 MW power plant shows feasible parameters.

Windaru & Budiman (2020) analyzes the cost required to build a small-scale geothermal power plant. They applied three scenarios that may affect the development cost: business as usual/BAU, Tingkat Kandungan Dalam Negeri/TKDN, and Clean Development Mechanism/CDM. The research provided the detailed development cost of a geothermal power plant that can be useful as a benchmark or comparison in this research.

3. Research Design

The research design of this research is as follows.

Figure 6 Research Conceptual Framework



Source: processed by the researcher