RENEWABLE ENERGY FINANCING AND SUSTAINABLE DEVELOPMENT: EVIDENCE FROM THE INDONESIAN ELECTRICITY SECTOR

A Thesis

Submitted to the Master of Finance in Sustainable Finance Study Program at the Faculty of Economics and Business in partial fulfillment of the requirements for the degree of

Master of Finance in Sustainable Finance (M.Fin.SF)

by:

Asaad Belal Yahya Mohammed Othman

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UNIVERSITAS ISLAM INTERNASIONAL INDONESIA
DEPOK
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ABSTRACT

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The transition toward renewable energy is essential for achieving sustainable development, improving energy security, expanding clean electricity access, and reducing greenhouse gas emissions. Although Indonesia has substantial renewable energy potential and ambitious energy transition targets, renewable energy deployment in the electricity sector remains limited. This condition is mainly influenced by financing gaps, regulatory uncertainty, weak project bankability, institutional fragmentation, fossil fuel lock-in, and infrastructure constraints. Therefore, this thesis examines how renewable energy financing contributes to sustainable development outcomes in Indonesia's electricity sector and identifies policy measures needed to strengthen renewable energy investment. This study adopts a pure qualitative research design using the Method for Analysis of Empirical Evidence in Management (MAEEM). Data were collected through semi-structured interviews with key stakeholders, including representatives from MEMR, PLN, OJK, and an academic/ADB expert, supported by official policy, financial, and institutional documents. The analysis was conducted through keyword identification, coding, theme development, and conceptual model formation. Instead of measuring statistical causality, this study interprets the mechanisms through which financing, regulation, institutional capacity, and infrastructure influence renewable energy development in Indonesia. The findings show that renewable energy financing in Indonesia is supported by public finance, private investment, concessional loans, blended finance, green bonds, green sukuk, and international climate finance. However, the scale of investment remains insufficient to meet national renewable energy targets. High perceived risks, unstable regulations, unclear procurement processes, limited domestic financial participation, and inadequate grid readiness continue to weaken project bankability and slow project realization. The study concludes that renewable energy financing can contribute to sustainable development through investment growth, job creation, improved energy access, welfare enhancement, emission reduction, and reduced fossil fuel dependence, but these benefits require stronger policy certainty, better institutional coordination, effective risk-mitigation instruments, improved PLN procurement and power purchase agreements, expanded blended finance, and grid modernization.

Keywords: *Renewable energy financing, Sustainable development, Green finance, Renewable energy investment, Indonesian electricity sector, Energy transition, Blended finance.*

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ABBREVIATION DIRECTORY

ADB	:	*Asian Development Bank*
CE	:	*Circular Economy*
CO_2	:	*Carbon Dioxide*
ESG	:	*Environmental, Social, and Governance*
EMT	:	*Ecological Modernization Theory*
FDI	:	*Foreign Direct Investment*
FiT	:	*Feed-in Tariff*
GDP	:	*Gross Domestic Product*
GHG	:	*Greenhouse Gas*
IEA	:	*International Energy Agency*
IEEFA	:	*Institute for Energy Economics and Financial Analysis*
IESR	:	*Institute for Essential Services Reform*
IFC	:	*International Finance Corporation*
IPP	:	*Independent Power Producer*
IRENA	:	*International Renewable Energy Agency*
JETP	:	*Just Energy Transition Partnership*
MAEEM	:	*Method for Analysis of Empirical Evidence in Management*
MEMR	:	*Ministry of Energy and Mineral Resources*
MIGA	:	*Multilateral Investment Guarantee Agency*
NRE	:	*New and Renewable Energy*
OECD	:	*Organisation for Economic Co-operation and Development*
OJK	:	*Financial Services Authority / Otoritas Jasa Keuangan*
PLN	:	*Perusahaan Listrik Negara*
PPA	:	*Power Purchase Agreement*
PPP	:	*Public–Private Partnership*
PV	:	*Photovoltaic*
RE	:	*Renewable Energy*
RUEN	:	*National Energy Plan / Rencana Umum Energi Nasional*
RUPTL	:	*Electricity Supply Business Plan / Rencana Usaha Penyediaan Tenaga Listrik*
SD	:	Sustainable Developme*nt*
SDGs	:	*Sustainable Development Goals*
UNDP	:	*United Nations Development Programme*

CHAPTER 1
INTRODUCTION

1.1 Background of the Study

A global energy transition is indispensable when it comes to sustainable development. International agreements, such as the Paris Agreement and the United Nations Sustainable Development Goals, highlight the urgent need to deploy renewable energy (RE) as well as to shift finance to clean energy technologies. Despite this, investments are still inadequate. The investment needed to reach SDG 7 (universal access to affordable, reliable and sustainable energy) is estimated at USD 1 billion to USD 1.3 trillion per year, while the current annual flows range from USD 500 billion to USD 800 billion (United Nations Department of Economic and Social Affairs, 2025). This gap suggests that USD 500–750 billion more needs to be invested each year to realize climate and development goals (International Renewable Energy Agency (International Renewable Energy Agency (IRENA, 2023).

The World Commission on Environment and Development (WCEW) is the source of the concept of sustainable development. The Commission on the Future of International Action (CFIA) in Our Common Future (WCED, 1987) has defined sustainable development as the development that sustains the needs of the present without endangering the ability of future generations to sustain their own needs. It emphasizes the connections between economy, society and the environment. It also was the precursor to subsequent sustainability frameworks such as the Triple Bottom Line (TBL), a model that illustrates sustainability in terms of economic, social and environmental performance (Elkington & Elkington John, 1999).

Sustainable development aims at meeting economic, social and environmental needs without harming the interests of future generations (World Commission on Environment and Development [WCED] 1987). This concept focuses on the interdependency of long-term prosperity, social equity and environmental sustainability (also known as the triple bottom line of people, planet and profit). In energy, sustainable development emphasizes the transition to renewable energy sources that offer increased energy access, economic growth and less environmental degradation. The operating directions for these goals are the United Nations Sustainable Development Goals (SDGs) which are operationalizing the clean energy financing to SDG 7, decent work and economic growth to SDG 8, and climate action to SDG 13, with measurable economic, social, and environmental outcomes in Indonesia (Judijanto et al., 2024).

The term sustainable development outcomes are used to describe the economic, social and environmental consequences of financing renewable energy in the electricity sector in this study. Financing of renewable energy can provide the economic impetus for investment, jobs, economic development and energy security. In the social field, it can contribute to the access to electricity, mitigate energy poverty, and support welfare in unserved and rural areas. It can lower fossil fuel consumption, emissions of greenhouse gasses, and pollutants from electricity generation in the area. Hence, financing for renewable energy is an important medium to connect investment flows and Indonesia's development goals with the Sustainable Development Goals (SDGs) (Rahman et al., 2024).

Fill the investment gap in renewables is essential to both climate and development goals. Any amount of renewable energy capacity added, no matter how small, brings long-term benefits such as cleaner air, better energy security, and new industries and jobs for the economy. For instance, a UNDP study estimates that by 2030, if the global renewable energy capacity is tripled, global GDP is projected to increase by around USD 1.3 trillion by 2060 and electricity access is expected to grow across the glob (Wang et al., 2025). Expansion of renewable energy can be done alongside and with increased social inclusion, including through a just transition, to drive energy access, social development and climate action simultaneously. The investments in renewable energy and energy efficiency today generate millions of jobs and make an important contribution to a country's GDP growth (Atstāja, 2025; Bang et al., 2016). But mobilization of the large capital is necessary to realize these benefits, and these benefits only can be realized through public funding. Investing in renewables is at the heart of SDG 7 financing and private financing can help to fill the SDG 7 financing gap, but investment in renewables is not yet at scale (Nepal et al., 2024).

Many of these problems are present in Indonesia. It still heavily relies on the fossil fuel-based energy industry, including the largest emitter of CO_2 in the country, coal-fired power plants (Rishanty et al., 2023a). Indonesia has a high potential for renewable energy resources such as hydropower, geothermal and solar energy, but the transition is still slow. The government wants to boost renewables' contribution to generating electricity to 23% by 2025 through the National Electricity Plan (RUEN) and the supply plan of the state electricity utility (RUPTL). The targets have been revised more recently under the Just Energy Transition Partnership (JETP) with Indonesia setting higher targets for renewables share up to 2030 and moving towards a net-zero target in the power sector before 2060. The government has also expressed its ambition to achieve fully clean electricity by 2035 (Iea, 2022; IESR et al., 2023).

In spite of ambitious policies, the deployment of renewable energy (RE) in Indonesia is still limited. Renewables make up just around 15% of the total power capacity, and on-grid solar and wind generation each account for less than 1% of the total (*Asia-Climate-Pledges-Country-Profiles-2025-Indonesia, 2025*). Institutional and economic impediments such as slow infrastructure development, permitting delays, and an evolving policy landscape hamper project development. Funding issues also play a key role, because the investors see high risk as the result of the bureaucracy, the volatility of the currency and the contractual terms (take-or-pay PPAs, local content requirements). The private renewable investment in Indonesia in 2023 amounted to USD 1.5 billion or a total of 574 MW of new capacity, which is far less than the capacity of other countries in the region, such as Vietnam, that had been added during the same period (*IEEFA ,2024*). To meet the 2025 renewable goal (without large hydro) it would have needed around USD 44 billion in cumulative investment so far, showing significant underinvestment (Organisation for Economic Co-operation and Development (OECD, 2021a).

The financial issues of renewable energy in Indonesia are confronted by several challenges. Furthermore, regulatory adjustments have lowered investors' confidence, such as the requirement of 51% domestic ownership, high local content requirements, tariff ceilings, and restrictions on project transfers (OECD, 2021a). State-owned utility PLN's tight control over power generation leads to conflicts in tenders. Low levels of funding for the private sector are available, as indicated in the available data. There are public and development banks which support some projects, but the amount is still not sufficient. Funding is difficult to mobilize, according to the Just Energy Transition Partnership (JETP) which estimates that US$97 billion is required to achieve Indonesia's 2030 climate goals. Indonesia has huge potential, but advancement is still hampered by financial, policy and institutional challenges (*CAT ,2019*, n.d.; Dwi Prio Christianto et al., 2025).

The lack of renewable energy growth in Indonesia is mainly caused by financial and regulatory factors and structural over-supply of electricity supply, especially because of the dominance of fossil fuels. Coal and other fossil fuel infrastructure development has led to over investment causing a lack of flexibility in the power grid to accommodate new renewable sources. This further contributes to fossil fuel lock-in, due to the presence of existing coal based generation and long-term planning that makes renewable deployment more difficult than it could be, despite their high potential (Hersaputri et al., 2024). But empirical evidence indicates that continued reliance on coal leads to oversupply, which has implications for renewable energy investors' uncertainty and for sustainable finance efforts.

The solution to overcome the dominance of fossil fuels and oversupply of energy is crucial in the development of renewable energy in Indonesia (Muyasyaroh, 2024).

The investment of renewable energy in Indonesia is still limited. Only USD 1.8 billion has been raised up to H1 2023 (Sinar, 2023), and according to the IEEFA reports, the target of USD 1.5 billion is just reached after seven years in 2023 with 574 MW of capacity (*IEEFA ,2024*). An estimated $285 billion is required for the national budget to keep Indonesia on track to reach its 2030 climate goals, representing a $146 billion gap in private financing. Low feed-in tariffs, high borrowing costs, stringent collateral requirements, complicated regulations and policy uncertainty are barriers that all contribute to making investments perceived as risky. While there is a great deal of renewable energy potential, there is a lack of funding that enables access to energy, development and environmental improvement.

The above discussion shows a critical research gap. Many studies explain Indonesia's renewable energy targets, policy challenges, and investment barriers. However, fewer studies examine how renewable energy financing mechanisms shape sustainable development outcomes in the Indonesian electricity sector. This study addresses that gap by analyzing how financing barriers, policy conditions, institutional capacity, and investment risks affect renewable energy development and its economic, social, and environmental outcomes.

1.2 Problem Statement

Indonesia is in a quandary regarding the utilization of renewable energy.Indonesia has a dilemma of solar renewable energy potential, which is very large, but implementation is slow. The country continues to rely largely on coal and gas for energy generation, putting the country at the mercy of the volatile price of fossil fuels and the carbon emission involved. High renewable targets (23% of power by 2025 and 2060 to become a net-zero) (Iea, 2022) have been followed by reality of RE investment and construction. The root cause of this poor performance is due to various issues that are interlocked. On the financial front, most projects find it hard to get capital. The banks and investors demand high returns or they do not invest in such projects because the perceived risk is high, meaning there are regulatory u-turns, fluctuation in exchange rates etc. As an illustration, the researchers of International Institute of Energy Economics (IEEFA) observe that with the generous provisions regarding IPPs, poor policies and low enforcement of regulations have put off investors in solar and wind (*IEEFA ,2024*). Onerous conditions (minimal local ownership, fixed PPAs, high local content) increase expenses and decreases rates of returns (OECD, 2021a). In the meantime, due to institutional limitations such as complicated land purchase

and slow processing of permits, projects are further postponed. In other words, access to finance is low and investors have a high risk perception (IRENA, 2023).

While there are policy, market and technical barriers documented in the literature, few studies have examined the empirical relationship between the amount of investments and development outcomes. The implications of more funding for renewable energy to SDGs and national goals are not yet known. In this study, the results of this empirical gap are analyzed to see how the financing of renewable energy translates into the promotion of sustainable development effects in the electricity sector in Indonesia.

1.3 Research Questions

To operate the objectives, the study poses the following research questions:

1. How is renewable energy currently financed in Indonesia?
2. How does renewable energy financing contribute to sustainable development outcomes?
3. What policy frameworks and measures can strengthen RE financing in Indonesia?

1.4 Objectives of the Study

Aim: This thesis will carry out an assessment of the role played by the financing of renewable energy in the achievement of sustainable development in the electricity sector of Indonesia. To this end, the paper will discuss financing mechanisms, barriers and impacts around the RE projects and how they fit in the development objectives.

To achieve this, the study will be guided by the following objectives:

1. Objective 1: Analyze current renewable energy financing mechanisms in Indonesia. This includes mapping sources of funding (public, private, domestic, international), financial instruments (loans, equity, bonds), and institutional actors (banks, development agencies, PLN etc.).
2. Objective 2: Examine how renewable energy financing contributes to sustainable development outcomes in Indonesia, including economic, social, and environmental impacts.
3. Objective 3: Recommend strategies to improve financing flows for renewable energy in Indonesia. Based on the analysis, propose policy and institutional reforms (e.g. risk guarantees, blended finance, tariff reforms) that could mobilize more capital while ensuring equitable development benefits.

1.5 Significance of the Study

This paper is of both theoretical and practical value. It will, on a theoretical level, contribute to literature in the field of sustainable finance and development economics by looking at the relation between the flows of financial resources for clean energy and development

outcomes. Although previous research examines the energy policies and energy transitions goals in Indonesia, there is limited research that investigates renewable energy investment as an economic variable that affects the growth and welfare of the country. This thesis brings together finance and SDGs with empirical evidence that private funds can support low carbon growth and adds a country level case study to the existing analyses on finance development nexus, such as SDG financing reports (IRENA, 2023).

The results are practically used to guide policy makers, investors and development agencies. If there is clearly a positive energy access, employment or environment outcome, then even initiatives such as blended finance, risk guarantees or market reforms could be justified and the financing gaps can be identified as underutilized. Recommendations will help the government and financial sector to maximize the impact and social and economic benefits while striking a balance on instruments to meet renewable targets optimally. The research is also in line with international and national priorities, including SDG 7, SDG 8, and SDG 13, and Indonesia's 2060 target of achieving a zero-carbon economy, as well as JETP roadmap which will direct investment flows to ensure a just energy transition in ASEAN and the global clean energy market.

1.6 Research Limitations

The scope of this study is defined as follows:

- Focus: The study addresses renewable energy initiatives in the Indonesian electricity industry, including solar power generation, hydro power generation, wind power generation, geothermal power generation, and biomass power generation. These are the main technologies proposed in the modern power schemes.
- Exclusions: The research is not inclusive of energy efficiency, electrification of end-use beyond the power grid (e.g. electric vehicles), or other sectors such as transport and industry. It also lacks wider fossil fuel shifts (e.g. coal-to-gas switching of fuel).
- Timeframe: The focus of policy analysis and empirical data is around the 2015-2025 period. This includes the latest policy of the administration, and it will enable the evaluation of the first ten years of renewable targets and energy plans of Indonesia.
- Geography: Although there are some mentions of larger climate finance projects (e.g. JETP), the discussion is narrowed down to Indonesia. It cannot be compared between countries.

Limitations include availability and quality of data on financing flows. In contrast to the OECD countries, there is a low level of public disclosure of the investment of the energy industry by Indonesians, and most transactions remain secret. To address this, the research will rely on the most available datasets of agencies (e.g. PLN, MEMR, OJK) and organization (CPI, IRENA, World Bank, etc.) with the support of case studies. Although this is the case, some deals in the lending of money privately or equity might be missed. With this understanding, conclusions will be made in a cautious manner, and points where estimates or proxies have been made.

CHAPTER 2
LITERATURE REVIEW

2.1 Theoretical Framework

2.1.1 Sustainable Development Theory

In 1987, the Brundtland Commission made the sustainable development (SD) development a popular concept, which can meet the needs of the present without compromising the future generations. This report presented the concept of how economic growth can and should be balanced in terms of social inclusion and environmental protection. Over time, SD has been generally redefined as a "triple bottom line" of environmental, social and economic goals. Elkington's formulation of success is financial profit along with people (social results) and planet (environmental performance). It has continued to be a three pillars approach, with the UN Sustainable Development Goals (SDGs) broadening the scope to 17 goals that are now more specific (such as climate action, gender equality, institutions, etc.). These pillars are incorporated in the SDGs themselves; SDG7 (Affordable and Clean Energy), SDG8 (Decent Work and Economic Growth) and SDG13 (Climate Action) are closely related to the development of renewable energy (Purvis et al., 2019).

Renewable energy contributes to sustainable development by improving environmental quality, supporting social well-being, and enabling economic growth in the electricity sector(Farghali et al., 2023). For instance, Omri and Belaid (2021) argue that RE has a significant potential in reconciling the environmental, social and economic goals (Omri & Belaïd, 2021). Indonesia is a country where increasing RE in the energy mix is very critical, as RE (excluding biomass) increased from ~11% to ~23%, while fossil fuel energy remained dominant at ~85% of the energy mix in the country between 2010 and 2020 (Sambodo et al., 2022). Scaling-up RE is important in Indonesia because the country is vulnerable to climate change, and hence improving sustainable energy accessibility and emissions reduction. The theory of sustainable development is therefore provided by the framework of investing in the accessibility of sustainable energy sources, supporting SDG7 (clean energy access), SDG8 (economic activity) and SDG13 (climate action) (Sambodo et al., 2022).

Dutta and Samanta's research suggest that there are indeed policy instruments that can be used to make it easier to finance green energy projects, and that massive frameworks are the right place to look for them, to make financial processes easier to follow with investor needs (Dutta, 2020).

2.1.2 Circular Economy and Ecological Modernization Theory

Circular Economy (CE) theory is an economic system that cannot be considered limited by the need to grow without relying on natural resources such as raw material resources which are limited (Geissdoerfer et al., 2017). The products and materials are re-used, re-cycled or remanufactured during CE, so there is less demand for using the virgin materials. Circular approaches, for example, focus on improving the efficiency of using the resources, extending the useful life of products and recovering the value of waste, thereby reducing GHGs and conserving natural resources (Chen et al., 2025).

A circular economy is also sustainable in terms of resource extraction and waste reduction and can help drive innovation and new business models, such as product-as-service, sharing platforms. Energy will be a crucial resource: instead of fossil fuels, a circular economy would be based on low carbon and renewable energy and effective use of energy carriers. Then, renewables investment would be in line with CE principles by substituting because it would replace fossil (old) energy with sun and wind (new) energy which is cleaner and inexhaustible. The promotion of RE projects is therefore in line with the principles of low emissions and low energy consumption (CE) objectives (Chen et al., 2025). It could be such policy measures as incentives on the use of closed-loop energy systems, combining renewables with recycling industries, and the encouragement of energy-from-waste processes as the part of a circular system.

Ecological Modernization Theory (EMT) suggests that ecological sustainability can be achieved through capitalist modernization, using technological innovation, improved regulations, and institutional reforms (Julkovski et al., 2021). It highlights the importance of rational production and diffusion of clean technologies, which can be a means to both economic development and environmental protection. Advanced societies represent this approach in their solutions to environmental problems, namely those which are resolved by using technology, and by structural changes, such as urbanization, and transition to service economy, which minimize the environmental impact.

In the context of energy, EMT refers to the speeding up of uptake of low carbon technologies such as renewables. Renewable energy innovation policies like subsidies, tax credits and support for R&D drive decarbonisation of power. EMT promotes policies such as feed-in tariffs, renewable portfolio standards, green finance etc. to steer markets towards cleaner technologies. In addition to principles of the Circular Economy (CE) that focus on resource efficiency and waste reduction, the importance of investing in renewable energy and policy support for sustainable economic development is highlighted by EMT (Balsalobre-Lorente et al., 2025).

2.1.3 Financial Intermediation and Green Finance Theory

Financial Intermediation Theory is a theory that discusses how financial intermediaries (such as banks, investors, etc.) can connect money funders and borrowers, particularly for green and climate finance initiatives. Renewable energy projects can involve substantial upfront costs and high risks, such as slow return on investment, construction volatility and technology adoption issues. The risk is reduced by long-term financing, loan structuring and by spreading the risk among banks and financial intermediaries in order to make a project bankable and appealing to investors.

Financing renewable energy is also challenging in developing countries because of the high perceived risk, information asymmetry, and lack of collateral, among other factors, reducing the opportunities for investment in RE (Sambodo et al., 2022). Larger investors or strong sponsors are generally responsible for project finance, providing sufficient resources and risk management, and smaller investors or risk-averse investors are more likely to use corporate finance. This means that financial intermediation capacity is a key driver in mobilizing funds, effectively distributing risks, and fostering the development of renewable energy projects, which is common across the sector (Farjami & Mohamedali 2017 ; Barroco & Herrera, 2019).

Green Finance is about the allocation of funds to environmentally friendly projects. It features tools like green bonds, sustainability linked loans, concessional credit and blended finance, with the goals of supporting low carbon investments. Financiers can support new technologies by setting aside cash for green uses, and by offering concessional conditions and/or guarantees to mitigate the increased costs and risks of such technology. For example, green bonds can lower the cost of capital by drawing in investors with a sustainability interest.

The majority of the analyses of green finance are from the advanced economies, where it is found that green finance funds, whether state-funded or private, can pool projects to lessen the risk for investing in renewables. Some countries in the developing world may be reluctant to fund the green sector, where in such cases, the financing gap can be filled with the specialized green banks (as in Indonesia, IIGF) or public private partnerships. Research shows that restricted availability of green credit and underdeveloped capital markets can hinder the growth of renewable energy, with high collateral requirements and high interest rates. Therefore, the availability of financial intermediation instruments such as national green funds, risk-sharing mechanisms and guarantee schemes is critical to overcome information gaps and control risk premiums for investing in REs (IRENA, 2023).

2.1.4 Sociotechnical Transition Theory

The Multi-Level Perspective (MLP) is a representation of the notion of Sociotechnical Transition Theory (STT), which focuses on the transition of socio-technical systems, including electricity systems (Barroco & Herrera, 2019). Interactions between niche innovations (such as entrepreneurship for solar PV) and the prevailing socio-technical regime (incumbent institutions and technologies such as coal-based electricity networks) and outside conditions (macro trends such as climate awareness and economic growth) are included. The adoption of renewable energy is not only relying on technology price but also on institutional support, regulation, user behaviour and financial flows. Even the lowest cost technologies need a supportive policy and public support to be successful.

The role of financial flows is important and relevant for shaping niche development and the socio-technical regime. One major feature of sociotechnical theory is its focus on co-evolution of technology, policy and society, with the importance of path-dependent processes such as fossil fuel lock-in. The theory also highlights the role of local attitudes and PLN's involvement in both the implementation and inhibition of renewable energy in Indonesia. Overall, the theory sees renewable energy financing as a piece of the larger picture of system change, facilitated by regulatory coordination, market shifts, and cultural change.

2.2 Global Perspectives on Renewable Energy Financing

2.2.1 Global Investment Trends

In the last 20 years, there has been a significant increase in world investment on renewable energy. It has been analyzed that trillions of dollars have been invested in renewables, particularly in wind and solar as the climate policy and reduction in costs have taken place. As an example, Bloomberg NEF and IRENA report that the global investment in RE has been increasing in the last few years to several hundred billion USD per year. Even though the official data (as reported by REN21, IEA) is not a peer-reviewed journal, the academic surveys testify to the trend of quick growth, with the significant role played by China, the EU, and the US, and the increasing proportions in Asia and Latin America. According to the academic literature, today, approximately 40-50 percent of clean energy investment is in the emerging economies, which is determined by the market size and policy impetus(Judijanto et al., 2025). Solar photovoltaics (PV) constitutes a huge and increasing proportion of investment. The report of some bibliometric reviews notes that the use of financial instruments such as green bonds and an energy transition policy landscape have become new areas of interest in the research literature. In short, renewable finance has been a significant area of concern internationally, and there is growing academic interest in the

question of who makes such investments (e.g. institutional vs. public), where (by region) and how policy influences such investments.

2.2.2 Financing Mechanisms

Public Finance: Public finance is any finance that has been given by governments or other public bodies to promote renewable energy. This incorporates direct budgetary allocations, developer or consumer subsidies or tax breaks, research and deployment grants, and concessional loans of public banks or climate funds. Public funding may be in the form of feed-in tariffs or direct subsidies to reduce the project cost, and multilateral development bank (MDB) funding. As an example, multilateral banks such as the World Bank, Asian Development Bank and African Development Bank offer grants, technical support and below-market loans on clean-energy projects in developing countries (Asquith et al., 2013). The government-provided financing has been instrumental in the early market growth e.g., it is worth mentioning that wind and solar power were cheaply popularized in China and India during first stages with the help of subsidies, yet this aid might be dropped due to the growth of fiscal pressures.

- *Advantages:* Public financing has the capability to raise capital flows of large scale, which are shunned by the private market, coordinate investment with the social and climate policy objectives, and subsidize early technologies. It frequently allows the projects, which could not be conducted in the market conditions.
- *Disadvantages:* The reliance of government budgets and political goodwill, subsidies and grants may not be sustainable or even-handed and can distort markets when poorly implemented, which is the reliance of public finance. There is perceived high risk in developing economies and this implies that even the public lenders will insist on strict terms. Indicatively, as Steffen et al. note, the early subsidies in China and India were successful at the beginning but more difficult to maintain as the financial strains intensified (Emezirinwune & Abdulsalam, 2024).

Private Finance: The commercial bank loans along with project finance and corporate or individual equity investment constitute the private finance. Commercial lending is a form of debt financing secured by collateral, or project revenues and a project finance structure is a special-purpose vehicle issuing non-recourse long-term debt against the cash flow of the project. Equity investment - by developers or by the private equity funds - involves creating ownership stakes (usually at a greater expected returns because of the risk) in exchange of funding. Large projects can be financed largely by the private banks and investors, although at times they are hesitant in young markets. As an illustration, commercial bank financing of renewables is widely popular in developed economies, but

does not include much bank financing by many poorer countries due to high risk being very high interest rates (Emezirinwune & Abdulsalam, 2024).

- *Advantages:* The private finance can raise much larger amounts of funds and introduce some commercial discipline. Project evaluation is something that is required by both equity and debt investors and this may enhance efficiency. The debt finance (loans) is usually more tax-beneficial (interest write-offs) and can capitalize on the improvements to the public credit (Rishanty et al., 2023a).
- *Disadvantages:* Business financiers and shareholders need robust revenue opportunities. They require high returns in high-risk environments (Hafner et al., 2018) discovered that in African banks, a significant number of them do not embrace renewables because of technology and market risks. The long-term nature of the RE projects is also mismatched with short loan tenors. This means certain projects in the developing countries will either not get financed or be financed at a very high rate.

Green Bonds: The green bonds are typical debt securities whose proceeds are dedicated to environment-related projects only (mostly renewable energy). Their functionality is like normal bonds (fixed-income instruments) except that the funds have to finance green assets. The government, banks and companies may issue green bonds. They attract investors with the ESG label and can expand the source of capital in renewables (Emezirinwune & Abdulsalam, 2024).

- *Advantages:* They access the huge institutional investors who are concerned with sustainability. Issuers can enjoy reduced costs of borrowing (a greenium) or no penalty of the green label. The green bond has risen into market interest at a high rate all over the world. As an illustration, two-thirds of the money raised by green bonds in Southeast Asia has been invested in renewable-energy or energy-efficiency projects (Azhgaliyeva et al., 2020).
- *Disadvantages:* Green bonds demand strong disclosure and in many cases third party certification to make the funds spent correctly; it is expensive. Greenwashing is also a risk in case the projects fail to provide evident environmental benefits. Also, the market of green bond is not yet developed in most countries, and thus problems may be small and illiquid.

Concessional Loans: Concessional loans are subsidized or otherwise low-interest loans to governments, MDBs or climate funds. They are less harsh (lower interest rates, long maturities or grace period) than commercial debt to make projects viable. In many cases, they are mixed with other sources of funds. As an example, concessional loans that are

combined with technical assistance to help developing countries use renewables are regularly packaged by MDBs and climate funds (Emezirinwune & Abdulsalam, 2024).

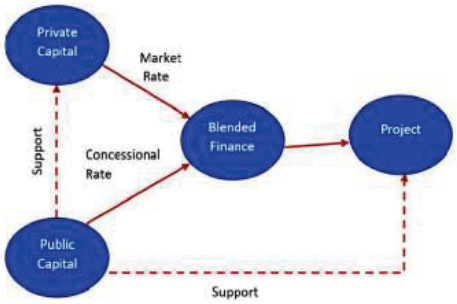
- *Advantages:* Marginal projects may become bankable because of extreme cost reduction of the cost of borrowing by concessional finance. It helps in attracting more private capital by contributing to the financing. There are also capacity building and guarantees (de-risking) that are often contained in these loans.
- *Disadvantages:* These are competitive and scarce funds. Dependence on donors through concessional loans will be created. Critics observe that concessional rates can be excessive and depending on projects on aid priorities can be rigid. Practically, concessional loans are very likely to be granted to those middle-income borrowers, who can bear the debt burden in leaving the poor countries underfunded.

Crowdfunding: Crowdfunding refers to the process of collecting relatively small sums of money contributed by many donors and supporters (usually over the Internet) to fund a certain renewable energy project. They are donation-based (no financial compensation), reward-based, equity crowdfunding (backers get shares or interests) and debt crowdfunding (peer-to-peer loans). Through these platforms, local investors can be linked to community-scale solar, wind or mini-grid projects that are not sufficiently large to draw the interest of big banks (Emezirinwune & Abdulsalam, 2024).

- *Advantages:* Crowdfunding is the democratization of finance and making people more engaged. It can raise funds within a short period of time on local or off grid projects without any established collateral that is required. It also spreads awareness. It is also important to note that one of the Malaysian community solar projects was successful due to equity crowdfunding, which relies on the positive policy and the use of digital platforms to invite people to invest in it (Iea, 2022).
- *Disadvantages:* The amount of money generated at the end of crowdfunding is relatively smaller per project, and, therefore, it should be applied to small or medium-sized installations. The projects can experience failure in meeting funding goals or experience excessive platform charges. It can slow down its expansion in most developing markets due to regulatory uncertainty.

Blended Finance: Blended finance involves a combination of public (or philanthropic) and private capital to use vast investments to fund climate projects. Practically, public or concessional capital is applied strategically (e.g. as first-loss cover, guarantees or subsidy) to make the risk-return series better to the private investors. That is, the development finance providers assume earlier risk to enable significantly larger private funds to pass in (Azhgaliyeva, 2019).

Figure 2.1: Blended finance



Source: *ORF,(2023*)

- Advantages: Blended finance enhances the mobilization of scarce public funds and increases capital mobilization through the utilization of a small amount of public funds to draw in much larger investments by the private sector. It is particularly applicable to new or untested technologies in which commercial financing is hesitant. This is the case with the Scaling Solar program in Zambia which includes World Bank guarantees, IFC loans, and MIGA insurances to minimize investor risk to access grid-scale solar plants deployed through private funds (Emezirinwune & Abdulsalam, 2024).
- Disadvantages: Blended deal design may not be an easy task; it may take a long time, and a number of parties need to be organized. It has disadvantages in high transaction costs and strict monitoring. Otherwise, blended schemes can also lead to a situation where profits are only subsidized, in the absence of proper design (crowding out purely private deals).

Feed-in Tariff (FiT) is a policy measure to promote the use of renewable energy by providing long-term purchase prices for electricity generated from renewable resources, lessening investment risks, and encouraging private investment (Rahmanta et al., 2023). One of the most notable examples is Ontario, Canada, where a FiT program was put in place in 2009 to encourage renewable energy generation and local manufacturing with a requirement for local content. But this policy raised issues with international trade at the World Trade Organization (WTO), as the European Union and Japan claimed the local content requirement was discriminatory against imported renewable energy equipment and

that it violated the General Agreement on Tariffs and Trade (GATT) and the Agreement on Trade Related Investment Measures (TRIMs). Industrial policy and global free trade have clashed in the WTO dispute settlements (DS412 and DS426) in which Canada was found to have violated WTO trade rules with its domestic content requirements for renewable energy projects (Shadikhodjaev, 2013).

Germany and Japan are also countries that offer examples of the effect of FiT implementation. The Renewable Energy Sources Act (EEG) introduced tariffs in Germany for renewable electricity producers, which greatly boosted solar and wind power. The FiT prices were subsequently reduced over time, and replaced by more market-oriented schemes, due to the issue of costs and potential market distortions (Charnovitz & Fischer, 2015).

The FiT scheme has facilitated the rapid growth of solar energy in Japan after the Fukushima nuclear disaster, but has been criticized for increasing electricity costs and growing dependence on imported technology for large-scale deployment as well as environmental issues. The cases show that FiT policies can be effective in stimulating early markets for renewables, but can face long-term economic, regulatory and political risks if solar subsidies are high or if they distort markets (Nakano et al., 2017).

FiT policies have played a significant role in the development of renewable energy around the world by providing certain price guarantees and contracts to investors, as well as lowering the risk involved in investing in renewables. In Europe, FiT schemes proved to have a positive effect on renewable energy participation, but the macroeconomic effects were mixed, with a risk of slowing GDP growth and limited resource allocation effects from these financial incentives. The roll-out of FiT has caused a greater competition regarding financial resources as well as technology, further pushing the necessity of global coordination to avoid inefficiencies and policy conflicts. FiT policies are also being used as structural economic measures, which directly change the global energy market and national development plans (Szendrei et al., 2025).

Internationally, FiT policies are increasingly overlapping with industrial policy and trade law, because governments are incentivizing renewable energy.Internationally, FiT policies are more and more coming in to cross-over with industrial policy and trade law because governments provide renewable energy incentives for domestic industries. It is no longer possible to ignore the importance of green industrial policies, such as FiT schemes and subsidies, in terms of national competitiveness, sometimes mistaking climate policy for protectionism. This generates tensions in multilateral trade systems, where states develop new environmental policies while simultaneously trying to balance environmental and

trade/market access interests. Trade policies also disrupted the global value chains, raised production expenses, and hindered cross-border investments in renewable energy, reducing the efficiency of the FiT policies (Xu & Wang, 2025). On the whole, the interplay between FiT mechanisms and contemporary tariff regimes indicate a paradox: governments promote renewable energy through subsidy and guarantees, but trade barriers can impede the globalisation of the energy transition and impact on the cost-effective, sustainable development (Kim, 2025).

2.2.3 Financing Mechanisms in Indonesia

2.2.3.1 Conventional Bank Loans and Development Finance

Traditional financing through commercial lending institutions, state owned financial institutions and international development institutions is still one of the most popular ways of funding renewable energy and sustainable development. Their main strength is that their repayment pattern is predictable and their interest rates are stable making it less risky to the project developers. Moreover, international development loans are usually associated with government intermediation that makes it easier to conduct business between the project implementers and the lenders. (Alfi Sa'idah et al., 2025).

Nevertheless, there are also considerable drawbacks of loans. The lenders usually place rigid requirements on the borrowers such as technical, environmental and financial requirements that may restrict flexibility as well as raise transaction costs. Further, the high collateral requirements and restricted access to long-term financing also pose a hurdle to the smaller project developers in Indonesia, especially in the renewable energy and energy efficiency ones. In the Indonesian case, bank credits are still very applicable but inadequate to their own. Renewable energy lacks a long track record and the payback period is long, leading financial institutions to be hesitant to lend to it, making the financing of such projects more expensive than usual. Thus, loans are necessary but they should be complemented by other mechanisms that minimize risk and increase loan tenors (OECD, 2021a).

2.2.3.2 Bonds and Green Bonds

Bonds especially green bonds are a financing tool in the market place that is able to raise significant amounts of capital to fund sustainable projects. Bonds usually have lower interest rates and require fewer restrictive covenants than loans and are therefore appealing to issuers who want to have flexibility in financing. Green bonds also allow the governments and corporations to appeal to environmentally aware investors and contribute to climate-related projects (Saa, 2024).

Although these benefits are present, there are also significant limitations when investing in bonds. It is also a financial risk because issuers are required to pay the full principal at the

maturity date and the issuance process is in most cases complex and expensive. In Indonesia, other obstacles are the lack of market awareness, bureaucracy, project pipelines, and the lack of investor appetite, especially in the municipal level (Rfai & Nohong, 2025). However, the green bonds can be widely applicable in Indonesia. The nation has already launched some green financial instruments, which include green bonds and sustainability bonds, whereas their applications are still low because of structural and institutional issues. When regulatory structures and market potential are enhanced, green bonds may make a huge contribution in the provision of a sustainable financing gap in Indonesia (Jumantoro & Novemyanto, 2025).

2.2.3.3. Blended Finance and Public–Private Partnerships

Blended finance is a mix of public, concessional and private capital that aims at minimizing risks and bringing in the private investors to the sustainable projects. It has the chief benefit of risk-sharing mechanisms that enable projects to be financially viable particularly in developing nations whereby, the private investors are not willing to fund high-risk industries. Blended finance also has the ability to bring smaller projects together in commercially viable portfolios thus becoming more scalable. Blended finance, however, has a number of challenges. The lack of the involvement of the private sector, the lack of risks taken by governmental institutions, and the slowness of the market development suppress its efficiency. Also, interest and returns could still be low to attract investors especially in renewable energy infrastructure developments (*IEEFA, 2024*).

In Indonesia, it is believed that blended finance is a promising tool since it could take advantage of the capital of the private sector and neutralize the perception of risks regarding renewable energy initiatives. However, its success will require better policy coordination, institutional capacity and financial innovation which are still underdeveloped in the present system (R. Kurniawan & Kurniawan, 2022).

2.2.3.4 Government Funding and Public Incentives

The government-supported schemes, direct public financing, and subsidies play a significant role in the funding of sustainable projects in their initial stages. Such mechanisms contribute to market failures, minimizing the risks of investments, and encouraging the involvement of the private sector (Phương, 2025). However, government funding is not without constraints, which may include, but are not restricted to, fiscal constraints, bureaucracy-related inefficiencies, and reliance on political agendas. In Indonesia, the fiscal redistribution of crisis, and long-term dependence on the subsidy of fossil fuel have minimized the use of government funds to fund renewable energy. Moreover, the discrepancies between government energy policies and sustainable finance policies have left uncertainty among the financial institutions (OECD, 2021a).

In Indonesia, despite these issues, the public financing is very appropriate, especially to de-risk projects and regions which have low levels of private investment. Nonetheless, a better policy alignment and institutional coordination is necessary to enhance its efficiency.

2.2.3.5 Innovative and Alternative Financing Mechanisms

The new innovative mechanisms have been introduced as a complementary source of funds to sustainable development, which includes crowdfunding, funding through fintech, and foreign direct investment (FDI). Crowdfunding websites, such as, have the potential to mobilize the community-based investments in renewable energy projects, raising the levels of people involvement and social acceptance. The mechanisms are however limited by the technological infrastructure, regulatory uncertainty, and transfer of technologies by the multinational corporations. In the developing countries, their effectiveness is also limited by digital divides and poor institutional capacity (Ma & Jiang, 2025).

Creative financing systems in the case of Indonesia have potential but are not yet used fully. They can only be successful with the digital infrastructure, better regulatory frameworks, and development of human capital.

6. Comparative Assessment of Applicability in Indonesia

In general, according to the available literature, there is no single financing tool that would help sustain Indonesia in the energy transition. This has been a significant source of financing deficit in the country because of coal-dependency, increasing energy consumption, and capital flows that are not aligned. Therefore, there is a need to consider a combined strategy involving loans, bonds, blended finance, and public financing, to raise sufficient funds and decrease the risks of investments.

Furthermore, some structural obstacles, including the perceived riskiness, inadequate long term financing, institutional fragmentation, and inconsistency of regulations, remain to undermine the success of sustainable finance in Indonesia. Hence, financial innovation, policy coherence and institutional capacity need to be reinforced to promote the applicability of various financing mechanisms in the Indonesian environment (OECD, 2021a) .

2.2.3.6 Risk Perception and Mitigation Instruments

Countries with emerging markets have multiple investment risks that increase the cost of renewable energy projects. The risks that fall under the major categories

include: policy risk due to regulatory changes or uncertainty, off-taker risk due to credit risk of the electricity purchasing entity (usually state-owned utilities), currency risk due to the currency depreciation relative to foreign funds, construction risk due to technical risk and broader political/regulatory risk (Halimatussadiah, Kruger, Wagner, Afifi, Lutfi, et al., 2024). A higher perceived risk leads to lower discount rates and may dissuade investors.

These risks are generally reduced through the use of de-risking instruments. If expropriation or inconvertibility is a concern, political risk insurance (PRI) from such institutions as the Multilateral Investment Guarantee Agency (MIGA) could come into play. If the off-taker is concerned, payment security instruments, such as government guarantees of power purchase agreements, may be appropriate. There is also currency exposure that can be hedged. Studies indicate that if this is not done then investors tend to ask for high returns or reject investment in projects (Halimatussadiah, Kruger, Wagner, Afifi, Lutfi, et al., 2024). Partial risk hedges are provided by Power Purchase Agreements (PPAs) and Feed-in Tariffs (FiTs), but not ideally. It has been stressed that guarantees and insurance, along with a reliable policy commitment, are fundamental to make renewable energy projects bankable, otherwise the investors might refrain from investing in the emerging market or set a high risk premium (Barroco & Herrera, 2019).

2.3 Renewable Energy Financing in Developing Economies

2.3.1 Challenges in Accessing Finance

A well-documented challenge to financing renewable energy in developing countries is in existence. The high initial capital expenditure is one of the primary challenges: unless the capital markets are well-established, it will not be affordable to the local businessmen or consumers to adopt even the already developed technologies such as solar PV. Many developing economies have shallow financial markets, and therefore the lenders do not have long term financing. There are also institutional barriers that are imposing. It lists poor policy frameworks, disjointed governance, and poorly developed financial intermediaries as some of the major challenges. Projects might also not be in a position to fulfill the credit requirements of the banks, since they have very little history of projects or collateral. The asymmetry of information is high: lenders might not have much information about the

performance of new RE technologies, particularly at utility scale (Taghizadeh-Hesary & Yoshino, 2019).

Another problem is credit risk: the off takers (such as state utilities) in most developing countries have poor credit, and it is risky to loan the bank money to a generation project. Currency risk is acute in those countries in which there are volatile exchange rates: when the project costs in dollars and the revenues in local currency, the returns can be wiped out by currency depreciation. These risks are in form of high interest rates or denial of finance. One theme that is reiterated in the literature is that project finance, whereby lenders consider solely the cash flow of the project is uncommon and only large, well-connected sponsors are most likely to get it. Even corporate finance (also based on a balance sheet of a company) can be small or community projects. Sub-Saharan African and Asian studies underscore that most projects in the developing countries are unable to be banked without the guarantee of risks as well as concessional capital (Sambodo et al., 2022).

2.3.2 Role of International Climate Finance

Some of these barriers are supposed to be reduced with the help of international climate finance (through such funds as the Green Climate Fund, Climate Investment Funds, bilateral programs, etc.). The scholarly sources are critically assessed. Concessional loans and grants which are offered by climate funds on one hand can reduce the cost of capital, finance technical assistance and aid in the development of new financial instruments. As an example, the GCF and the CIF have funded off-grid solar projects and grid developments in numerous developing nations, allegedly with the intention of co-investing with the private sector. Conversely, research usually concludes that the total amount of multilateral climate funding remains low compared to the requirements, and bureaucracy can postpone payments. It has been analysed that although climate funds are able to mobilise more investment, it is not necessarily the ability to reach the smallest projects or poorest areas without specific channels of delivery (International Energy Agency & International Finance Corporation, 2023).

Furthermore, it has been found that the effectiveness of climate finance varies depending on the design of the program: the combination of government and non-government funds, the association of finance with capacity building, and its national priorities are very important. As an example, IFI-supported guarantees, and partial risk instruments (shared by climate funds) have proven to be effective in certain instances. In conclusion, climate finance is considered a significant facilitator, yet peer-reviewed literature notes that it should be more scaled and coordinated in a way that would help with the actual implementation of RE in the developing economies.

2.3.3 Lessons from Other Countries

Case studies of several countries are used to indicate the discussion of developing-country RE finance. In India, innovative instruments, such as green bonds (both governmental and corporate) and viability gap funding on solar parks, are observed to be used by researchers. Nevertheless, one of the key risks is currency risk: most of the projects are funded in USD and their revenues are in INR, which exposes investors to depreciation (*Climate Policy Initiative, 2016*, n.d.). Furthermore, policy risk (e.g. sudden alteration of solar tariffs) has discouraged investors. Natural research on Indian RE auctions and financing indicates that though the prospects of the Indian small businesses are huge, new risk sharing systems like reserve funds and payment guarantee funds are necessary to lure finance.

Case studies in Vietnam indicate that feed-in tariffs have been applied previously to enhance solar, although the absence of expertise in local financing is a problem. The pattern of domestic banks being cautious was in that many projects in Vietnam were funded through corporates or BOO arrangements by foreign sponsors. Among the lessons, there is the significance of stable contracts and the gradual commercial debt introduction (Nguyen et al., 2018).

In Morocco, a modelling study of 2018 indicates that an estimated US 30 billion investment was required to achieve ambitious renewable goals (42 percent capacity by 2020, 52 percent by 2030). It was not enough to be publicly financed. The paper focuses on mobilizing a private and global financing: the solar and wind plans in Morocco have been mobilized through MDBs and the issues of green bonds. It also observes that investors consider large capital projects to be riskier and in developing situations, which increases the cost of financing. The strategy that Morocco has employed has been to counter this by high levels of sovereign guarantees and international alliances. It is a learning experience that highlights the fact that a comparatively well-planned program requires the inclusion of blended finance to be a viable option (Schinko et al., 2019).

Renewable project finance is examined in the Philippines (Barroco & Herrera, 2019). They discover that feed-in tariffs (FITs) actually triggered the installation of solar and wind systems but because of tough rules on Fitz, the revenues were highly uncertain, which concentrated the proprietorship to large players and restricted application of project finance. It follows that the way policy is designed (e.g. FIT caps and deadlines) may unwillingly increase the risk of investment. The authors suggest the customization of the policies to expand the investor base and stabilize the returns. The case underscores the fact that the patterns of finance (between project and corporate finance application) is determined by the policy details.

All these lessons, together, imply that there is no single model which can be used everywhere. A combination of various devices - auctions, tariffs, green bonds, concessional loans - is used in many countries and has led to trade-offs between costs and investment attraction. The case of the Philippines demonstrates the drawback of FT design without risk buffers; the case of Morocco demonstrates the necessity of utilizing the capital privately and financing the risk; the case of India and Vietnam shows the importance of currency risk and institutional risk. These lessons can inform the knowledge of the Indonesian context by analogy: Indonesia, like these counterparts, needs to reconcile between policy credibility, mitigation of risk, and new financing to speed up RE.

2.4 Renewable Energy Financing in Indonesia

2.4.1 Policy and Regulatory Landscape

The environment for renewable energy in Indonesia is complicated through a policy and regulatory framework. In the past, RUPTL by the state utility PLN had low targets for renewable energy and only planned for its growth until 2030 or 2034 (Halimatussadiah, Kruger, Wagner, Afifi, Lutfi, et al., 2024). The latest RUPTL (2025-2034) shows that while Indonesia has committed to reducing its reliance on fossil fuels, it is still a dominant form of energy in the near term.

There is increased policy support for renewables recently. Based on Presidential Regulation No.112/2022, PLN has the authority to conduct direct bidding for renewable energy without going through a long tendering process, and prioritizes geothermal and hydro technologies. But despite its academic novelty, PR112/2022 may help to dampen volatility in the marketplace, provided that there are investor protections in place. With its involvement in the Just Energy Transition Partnership in 2022, Indonesia will receive international support from the G7 countries, depending on Indonesia's policy commitments. Financing environment is further affected by other policies promoting rooftop solar and mini-grid (Rahmanitya & Ardiansyah, 2023).

Scholars highlight the importance of sound regulatory frameworks, including well-defined tariff regimes, interconnection standards and local content regulations. Local content policies, such as turbine production, come with a compromise between supporting local industry and maintaining project cost low (Sitompul et al., 2022). In general, although policy development has improved, there is still regulatory uncertainty and a high frequency of change that is a concern of investors.

2.4.2 Current Financing Mechanisms

Renewable energy financing in Indonesia comes from the public and private sectors. Small hydro and solar schemes, feasibility studies and pilot projects are supported by the state

budget and development banks. Rooftop PV projects have also been encouraged by the government and low interest loans provided by the banks. For larger projects, loans and guarantees come from multi-lateral agencies like the ADB, World Bank and IFC. IFC, for instance, has facilitated the financing of geothermal plants in Indonesia through syndicated loans, and ADB provided credit facilities to local banks based on a conditionality that they provide financing for green projects (Hendriwardani et al., 2022).

The private sector financing has grown and for power projects, self financing or financing through independent power producers (IPPs) has become common. Ownership of utility-scale solar and wind plants comes in the form of corporate green bonds, and some plants are funded by foreign equity or joint ventures, which are subject to foreign ownership regulations. Microfinance and cooperatives are looking at financing off-grid rural solar, with donor-concessional funds sometimes used. Scholarly observations point out that public investment is utilized to draw in private investment, but it's inadequate. The mobilisation of a massive amount of private investment, with tens of billions of USD, is needed to reach Indonesia's renewable energy targets, as observed in Morocco where massive co-investment by private and multi-lateral development banks (MLDBs) was required to achieve large-scale renewables (Schinko et al., 2019).

In the context of financing, there are emerging financing tools such as green sukuk (Islamic green bonds), a new instrument for climate projects, but the academic evaluations of the green sukuk mechanism are still limited (Hendriwardani et al., 2022).

2.4.3 RE Achievement and RE Targets

The gap between national renewable energy (RE) targets and performance from 2023 to 2025 is presented in Table 2.1, which also contains projections for the future. It demonstrates the percentage deficit and specifies the primary factors that are resulting in underperformance – technical, financial, policy related or others. This overview emphasizes the persistent challenges to reach the goals of Indonesia's RE policy.

Table 2.1: Gap Analysis Between RE Targets and Achievements

Year / Target Period	National RE Target (%)	Actual RE Achievement(%)	Gap (%)	Key Reasons for the Gap
2023	17.87%	13.09%	−4.78%	Rising fossil fuel subsidies, technical barriers in RE projects, and financing constraints.

2024	~19.5%	13.93%	−5.57%	Slow infrastructure development, insufficient investment, and delays in RE project commissioning.
2025 (KEN target)	23%	15.75%	−7.25%	Limited capacity additions, weak project implementation, and reliance on coal-based power generation.
2025 (revised policy discussion)	17–19%	15.75%	−1.25% to −3.25%	Policy revisions reflecting difficulty in meeting original targets and persistent fossil fuel dependence.
Long-term projection	23% postponed to 2030	14.68% (recent estimate)	−8.32%	Structural barriers, regulatory uncertainty, and slow investment flows in renewable energy.

Sources: ESDM, OJK, ISER and RPP KEN, (2023 ;2025)

- **Financial and Investment Constraints:** Lack of investments in renewable energy infrastructure is one of the key factors that have contributed to the gap. It needs huge capital inflows to reach national targets but funding commitments and implementation are minimal. Furthermore, it is expected that renewable energy projects would be perceived to have longer and higher risks.
- **Technical and Infrastructure Challenges:** Technical barriers, such as delays in power plant construction and limited grid integration capacity, significantly hinder renewable energy deployment. Additionally, Indonesia's geographical complexity and uneven distribution of renewable resources complicate infrastructure development and increase project costs.
- **Policy and Regulatory Issues:** The fact that policy commitment is doubtful is indicated by frequent revisions of renewable energy targets. In illustration, the government weighed the idea of reducing the 2025 target of 23 % to 17-19 %

meaning that it was challenging to make high targets. These changes in policy minimise investor confidence and the growth of renewable energy.

- **Continued Dependence on Fossil Fuels:** Indonesian energy is significantly reliant on coal and oil that are heavily subsidized and industry requirements. This dependency takes away investments in renewable sources of energy and discredits clean energy transition.
- **Institutional and Implementation Gaps:** In most cases, planning is far ahead of implementation even with the policies in place. National electricity plans of energy projects involving renewable energy and others have not been achieved as anticipated, which adds to the consistent gap between targets and achievements.

2.4.4 Supply-Side and Demand-Side Perspective

2.4.4.1 Conceptual Link Between Supply-Side and Demand-Side Perspectives

The nature of the interaction between the supply-side and the demand-side forces determines the development of renewable energies. The supply side means the presence of energy resources, production capacity, technological infrastructure and funding mechanisms whereas the demand side includes consumption patterns, market absorption capacity, consumer behavior, and institutional demand of energy (*Iea, 2023*).

The traditional policy discourse in most developing countries such as Indonesia has been more of focusing on supply-side growth such as augmenting installed renewable energy capacity and investment attraction. Nevertheless, the fact that the gap between the targets of renewable energy and the reality has remained constant implies that a shift towards supply-side interventions is not enough. To gain a full understanding of the development of renewable energy, such an analytical framework is thus needed, which simultaneously addresses both supply-side limitations and demand-side restrictions (Connolly, 2025).

The structural issue in the energy transition in the context of the Indonesian case is evidenced by the fact that the supply of fossil fuel is too high and the demand on renewable energy is too low. In this part, the interaction between resource accessibility, the cost of production, market uptake, institutionalization of fossil fuels, and the organization of financing is examined to determine the renewable energy trends in Indonesia (Apramadha & Prasetyo, 2025).

2.4.4.2 Supply-Side Analysis: Resource Availability, Costs, and Institutional Structures

2.4.4.2.1 Availability and Distribution of Renewable Energy Resources

Indonesia has high potential of renewable energy contained within a wide range of natural energy sources that include solar radiation, hydro-power, geothermal, wind energy, and biomass. The technical potential estimates show that the renewable energy sources in

Indonesia are much more than the existing electricity need. However, the percentage of this potential that has been exploited is minimal (Sisdwinugraha et al., 2025).

The lack of resources is not a critical problem but the space distribution. Several of the high potential renewable energy areas are remote or poorly developed, e.g. the eastern part of Indonesia, where there is a lack of grid infrastructure and population density is sparse. This geographical incompatibility between the supply and demand of resources focal point greatly amplifies development expenses and declines the viability of a project (*IEEFA, 2024*).

Additionally, renewable sources of energy are naturally fluctuating and intermittent. Solar and wind power is not only subject to the weather but hydropower and biomass is also affected by the season and the climate. These features pose technical difficulties in the stability of grids and worsen the operational planning of PLN (Sisdwinugraha et al., 2025).

2.4.4.2.2 Cost of Production and the Economics of Renewable Energy

In the light of supply side this makes renewable energy seem expensive because it requires high initial capital outlay. Renewable energy projects are high cost in terms of equipment, acquisition of land, grid connection and risk containment efforts. Renewable energy projects have much longer payback durations and are perceived to be more risky compared to fossil fuel-burning power plants (*IEEFA, 2024*).

Nevertheless, this feeling covers the economic benefits of renewable energy in the long term. The renewable energy systems are relatively cheap in terms of operation and maintenance once in place as well as the marginal costs are low since they do not necessitate fuel supplies. During the life cycle of a project, renewable energy may be as cost-effective as it can be competitive or even less expensive as fossil fuel-based electricity. Macroeconomic and institutional factors such as currency fluctuations, regulatory uncertainty and poor access to long-term funding also affect the cost of renewable energy in Indonesia. The cost of capital is too high due to the high interest rates and risk premiums, which can make renewable energy projects less appealing to the investors. Therefore, renewable energy does not seem to be cheap due to the technological aspects only but also because of the structural financial considerations (Sisdwinugraha et al., 2025).

2.4.4.2.3 Abundance of Fossil Fuel Supply and PLN's Structural Dependence

One of the peculiarities of the energy system in Indonesia is the fact that there is a great amount of fossil fuel, and coal in particular. Indonesia is a major coal producer and exporter of coal in the world and coal-fired power plants constitute most of the national electricity mix. This structural reliance on coal is represented in the generation portfolio of PLN, and

it has a number of operational benefits: stability, scalability, or predictable cost (Rishanty et al., 2023b).

Renewable energy has the negative effect of having a competitive disadvantage because of the abundance of fossil fuel. The electricity produced using coal is relatively cheap because it is available locally, it is a proven infrastructure and the government subsidizes it. Consequently, renewable energy has to compete not only on a technological and environmental level, but also on an economic and institutional one (Kabel & Bassim, 2020). In the case of PLN, the choice of using fossil fuels is not a policy choice but a logical reaction to the operation needs. The requirement of PLN is to secure energy and make it cheap and reliable. The intermittency of renewable energy and high initial cost are threat to these goals, which is in part the reason why PLN is being wary of integrating renewable energy on a large scale. Such structural hegemony of fossil fuels therefore becomes one of the greatest supply-side obstacles to the growth of renewable energy (Rudolph et al., 2025).

2.4.4.3 Demand-Side Analysis: Market Absorption, Consumer Behavior, and Institutional Demand

2.4.4.3.1 Market Absorption Capacity

The issue of market absorption is the capability of the electricity system and consumers to use renewable energy supply effectively. It is based on multiple variables, among them the growth of electricity demand, tariff frameworks, and grid capacity, and the readiness of the institutions to incorporate renewable energy into the grid (Respitawulan & Rahayu, 2020). In Indonesia, the demand of electricity has been increasing steadily owing to economic development, urbanization, and industrialization. Nevertheless, the expanded demand has not resulted in the demand of renewable energy. Rather, the generation has been largely satisfied through the fossil fuel-generated power (Prihantoro et al., 2025).

This trend indicates the lack of powerful demand side incentives towards renewable energy. The cost of electricity is comparatively low and in many cases, it is subsidized reducing the sensitivity of consumers towards environmental concerns. Market absorption will not be very high without price signals or regulations that would give preference to renewable energy (Rahmanta et al., 2023).

2.4.4.3.2 Consumer and Industrial Behavior

Consumer behavior on the demand side is an important factor in determining the adoption of renewable energy. Cost, reliability, and convenience are the factors that households and industries attach priority over considering the environment. Consumers in Indonesia are not encouraged to purchase renewable energy at a higher cost as the cost of energy is a political issue (Torro et al., 2024).

The needs of industry consumers in specific disruptive situations are to have steady and uninterrupted electricity. The intermittency and the lack of reliability of renewable energy makes industries not want to rely on this type of energy. Therefore, the industrial demand supports the reliance of PLN on generation using fossil fuels (Prihantoro et al., 2025).

Moreover, the lack of knowledge of people on the benefits of renewable energy and the spread of information obstructs the behavioral change. The lack of specific awareness initiatives and reward systems will slow down the demand-side change (Torro et al., 2024).

2.4.4.4 Interaction Between Supply and Demand: Structural Imbalances

The supply-demand side interaction reflects an imbalance in the Indonesian energy system structure. Renewable energy on the supply side is expensive, technical and institutional. Between the demand and supply, the low cost of electricity, low tariffs, and consumer behavior restrict the adoption of renewable energy (Setyawan, 2015).

This is a vicious cycle, as investors are deterred to invest in renewable energy because of low demand, and the lack of supply strengthens the need of fossil fuels. As a result, the renewable energy development is marginal though the resources and a policy commitment are substantial (Torro et al., 2024).

2.4.4.5 Large-Scale vs. Small-Scale Financing: Comparative Implications

2.4.4.5.1 Large-Scale Financing

The utility-scale solar farms, hydropower plants, and geothermal facilities, which are large-scale renewable energy projects, are mainly financed by institutions, including banks, government owned corporations, and overseas investors. These projects also enjoy the economies of scale and are capable of greatly boosting renewable energy capacity (Ahlborg et al., 2019).

Nonetheless, the mega projects are characterised by complicated regulations, time consuming approvals and also enormous financing risks. The success of them is also very dependent on the willingness of PLN to buy electricity in the form of power purchase agreements (PPAs). Therefore, institutional priorities of PLN are directly related to the large-scale development of renewable energy (Respitawulan & Rahayu, 2020).

Demand-side The high-scale projects require absorption at a system level as opposed to the demand at the consumer level. In case PLN focuses on fossil fuel generation, the large-scale renewable energy projects can be curtailed or postponed (Burke & Kurniawati, 2018).

2.4.4.5.2 Small-Scale Financing

Smaller-scale renewable energy projects, including rooftop solar systems and community-size micro grids are more consistent with demand side dynamics. They are based on

decentralized financing schemes, such as household investment, crowdfunding, and local government support (Arifin et al., 2022).

Micro-scale projects help in terms of energy access, social inclusion and local economies. But their contribution to the national energy goals is also not a lot based on their comparatively small capacity. Additionally, legal, fewer financial incentive policies hinder their growth (Setyowati, 2020). The simultaneous presence of major and minor models of financing emphasizes the necessity of diversified financing strategy that will tackle the issue of both supply-side and demand-side (*Iea, 2023*).

2.4.4.6 Counterarguments in Favor of PLN: A Balanced Perspective

Although many complain that PLN is a system that depends on fossil fuels and is slow to use renewable energy sources, there are a number of rebuttals that should be taken into account:

First, PLN is subject to complicated institutional imperatives that focus on energy security, affordability, and reliability. In this regard, this is because fossil fuel-based generation can deliver stability and predictability, which renewable energy cannot fully achieve at the moment (Burke & Kurniawati, 2018; Setyawan, 2015).

Second, incorporation of renewable energy presents technical issues such as grid stability, intermittency and limitation of infrastructure. PLN needs to put the goals in harmony with operational considerations, and this is why the integration of renewable energy should be gradual (Aditya et al., 2025).

Third, PLN has started other sustainability-oriented initiatives, such as renewable energy initiatives, digitalization initiatives, electric vehicle infrastructure, and energy efficiency initiatives. Such endeavors point to the fact that PLN can not oppose renewable energy but is limited by specific systemic and institutional forces (Kurniawan et al., 2025; *UNDP, 2025*).

Fourth, a fast pace of renewable energy production when the grid is not sufficiently prepared may raise the system expenses and may result in a compromised energy security. Thus, the conservative attitude of PLN may be viewed as a risk management technique instead of an institutional inertia (Aditya et al., 2025; *IEEFA, 2024*).

2.4.4.7 Critical Synthesis: Toward a Structural Explanation of Indonesia's Renewable Energy Gap

Combining the supply and demand sides, it becomes clear that the renewable energy gap in Indonesia is not a technological or financial issue but a structural one, based on the relationship of resource availability, cost structures, instability of the fossil fuel as an institutional asset, poor market incentives and fragmented financing (Overland, 2019). The

richness of the fossil fuel source and especially in the generation mix of PLN establishes a systemic prejudice against renewable energy. Meanwhile, the cost of financing and lack of demand-side incentives discourage the use and adoption of renewable energy (*OJK , 2025*, n.d.).

Thus, to attain Indonesian renewable energy goals, there is a need to have a comprehensive redesign that will not only solve the supply-side bottlenecks, demand-side incentives, but also institutional reforms. The lack of such combined reforms means that the development of renewable energy will still lag behind national ambitions despite the decent availability of resources and policy pledges (Overland, 2019).

2.4.5 Barriers to Renewable Energy Investment

The challenges to renewable energy in Indonesia are well known. Fossil fuel lock-in and vested interests are still major barriers at the national level. Uncertainty with respect to policy and regulation causes investors to lose faith in the market, such as with the sudden shift in tariffs and the permitting process. In a qualitative study, stakeholder interviews were used to uncover central challenges, including misaligned planning (RUPTL) and procurement, limited pricing policies, such as low feed-in tariff caps, and opaque tendering processes (Halimatussadiah, Kruger, Wagner, Afifi, Lutfi, et al., 2024)

The problems at the project level are the speculative nature of the land acquisition process, the lack of clarity in the licensing process, and the unequal distribution of risk in contracts, with projects being given too much risk and off-takers being given insufficient risk. There are also financial issues, since project finance is usually only available to big companies and loan applications are more difficult for smaller companies (Sambodo et al., 2022). Barriers can be classified as socio-cultural (e.g., “Not In My Backyard” attitudes), technological (absence of grid infrastructure and skills), economic (high capital costs, limited financing instruments) and governance (bureaucratic delays, conflicting regulations) (Sambodo et al., 2022).

The importance of the role of governance is highlighted with the need for coherence of central and local policies noted. The financial and institutional obstacles such as high capital costs, access to capital for small scale projects, policy risk, low institutional capacity, etc. further complicate the issue of deployment of renewable energy. Moreover, PLN is a single buyer, which increases the off-taker risk, reduces market competition, and reduces effectiveness of renewable energy financing policies (Rudolph et al., 2025).

2.4.6 Oversupply and Fossil Fuel Lock-in as Structural Barriers to Renewable Energy Development

A vast amount of literature has considered electricity oversupply as a major structural obstacle to development of renewable energy. Oversupply happens when supply of electricity outweighs the actual demand of electric power, which is usually caused by vast investments in fossil fuel-powered generation stations and long-term energy planning, which place emphasis on the traditional generation production. This situation essentially takes down the capacity of the system to absorb new capacity of clean energy renewal, the probability of curtailment and the incentive of clean energy investment. Additionally, this oversupply may affect the dynamics of the electricity market because it may decrease the wholesale price and decrease the economic feasibility of renewable energy projects, which will be perceived as a higher risk to investors. Research on energy transition suggests that the presence of excess capacity in fossil fuels is likely to preempt the growth of renewable energy sources and decarbonization, especially in the emerging economies where the energy system is expanding rapidly (Halužan et al., 2023).

The lock-in of fossil fuels also supports the structure-related obstacles to oversupply and hinders the shift to the renewable energy systems. The concept of lock-in suggests that there are infrastructures, institutional arrangements and policies that promote the use of carbon-inducing fuels i.e. fossil fuels instead of renewable fuels to generate energy. The presence of the path dependency of investment in coal and gas power facilities makes the transition to low-carbon energy technologies not so simple as the pressure on the environment and economy grows. The literature believes that fossil lock-in does not just impede technological innovation but also determines the financial flows and policy decisions and therefore places the additional obstacles on funding renewable energy. Empirical studies emphasize that the interactions between fossil fuel and renewable energy form a complex that can influence the course of infrastructure development and market implications and consequently inhibits the spread of renewable energy and undermines sustainable finance efforts (Harlan & Baka, 2024).

In the Indonesian case, the issue of oversupply and fossil fuel lock-in have become major challenges in the electricity industry. The Indonesian power system is still largely reliant on coal, and, as a result, the power plant capacity with coal as the fuel is constantly increased according to the national electricity development plans. A study indicates the fact that electricity over supply has been witnessed in some parts of Indonesia especially in the Java-Bali system where the installed capacity has surpassed the demand growth. This excess supply has inhibited the introduction of renewable energy as it has limited grid

capacity and chances of renewable projects to get long-term power purchase contracts. Additionally, the pre-eminence of coal generation and long-term contractual dealings has strengthened fossil fuel lock-in, and thus, it has become hard to align energy planning with national renewable energy goals and national climate commitments. Research indicates that such structural conditions make the investors less certain, enhance financing risks, and undermine the efficiency of sustainable finance to support the development of renewable energy in Indonesia, hence decelerate the energy transition in Indonesia (Burke & Kurniawati, 2018).

2.4.7 Emerging Opportunities

Despite these obstacles, several new sources of financing are emerging in Indonesia. There has been an increasing interest in green sukuk or Islamic bonds, with Indonesia making the first step towards issuing green sukuk for financing climate change projects such as renewables. While very little research has been conducted, it has been recommended by practitioners that green sukuk could take advantage of the large investor base in Indonesia and meet the principles of Islamic finance, provided that project selection and reporting is done carefully. Microfinance strategies, pay-as-you-go schemes and community-level energy financing projects and cooperatives are some of the mechanisms that can support decentralized energy finance, such as off-grid solar, micro-hydro and biomass, often partially funded by NGOs or CSR funds (*Republic of Indonesia Presentation Book - March 2023 (Green*).

Other sources are carbon pricing and trading; Indonesia's carbon tax is still new, but the carbon revenue in the future may be used to subsidize renewables. However, the country's rich renewable resources enable cross-border investments and financing arrangements to be made as well, including ASEAN power grid connections. In addition, linking Projects to International Climate Commitments such as REDD+ or the Paris Agreement Climate Finance may draw additional financial resources. These sources are identified as potential sources that need to be supported and developed in the market to make them effective (Hardini & Rosdiana, 2025).

2.5 Linkages between Renewable Energy Financing and Sustainable Development

2.5.1 Economic Impacts

The cost of financing renewable energy can significantly impact the economy. Literature indicates that renewable energy investment stimulates GDP growth through infrastructure construction and manufacturing capacity development. Projects create employment in construction and manufacturing (e.g., producing wind turbines or solar panels) as well as

operational roles in maintenance and facility management. In Indonesia, such projects can promote regional development and strengthen local supply chains.

Research suggests renewable energy projects generate more employment per unit of capacity compared to conventional power, particularly during installation and maintenance. Increased energy availability from renewables can boost productivity, support new business formation, and reduce long-term energy costs, fostering economic growth. However, economic gains depend on whether equipment is imported or locally manufactured and the cost of project financing. While high financing costs may offset some gains, concessional finance can enhance net economic returns. Empirical studies generally find a positive relationship between renewable energy financing and national economic indicators when investments are efficient and sustainable.

2.5.2 Social Impacts

Financing renewable energy can improve social outcomes by enhancing access to electricity and public health. In many developing countries, rural communities lack grid electricity, and funding off-grid solar or micro-hydro projects provides electricity for lighting, cooking, and communication. Access to energy has been shown to improve education (longer study hours), income through small businesses, and gender equity by reducing time spent on fuel collection and providing livelihoods for women. Health benefits also arise from reducing reliance on diesel generators or kerosene lamps, lowering indoor and ambient air pollution, and decreasing respiratory and cardiovascular risks.

Community empowerment and local development are additional benefits, as communities gain capacity to manage renewable projects and improve governance. For example, Indonesian villages with solar microgrids report higher satisfaction with living standards. Funding initiatives that involve co-investment or revenue-sharing by local communities tend to increase buy-in and distribute benefits more equitably. However, literature cautions that social impacts are not automatic; equitable and inclusive financing mechanisms such as microloans or grants are essential, along with active community involvement to ensure benefits are shared. Thus, equity and local engagement are critical when linking finance to social development outcomes.

2.5.3 Environmental Impacts

Renewable energy finance directly contributes to environmental benefits, primarily by reducing greenhouse gas emissions. Funding renewables today locks in a cleaner generation mix, helping mitigate climate change (SDG13). Empirical models indicate that each additional MW of solar or wind can prevent hundreds of tons of CO2 annually. Given the dominance of coal plants in Indonesia, replacing even part of this capacity with

renewables can significantly reduce national emissions. Renewables also consume fewer natural resources, such as water in solar plants compared to thermal plants, and benefit the local environment by decreasing deforestation for fuelwood (Suliman et al., 2024).

Financing mechanisms like green bonds often include environmental performance requirements to ensure positive outcomes. Academic literature consistently finds that the expansion of RE finance is crucial for achieving Net Zero targets. For instance, to meet Paris Agreement objectives, Indonesia requires ambitious RE financing scenarios (Schneider et al., 2022). Overall, studies demonstrate a clear causal relationship: increased financing leads to more clean generation, lower emissions, and a reduced ecological footprint (Asquith et al., 2013).

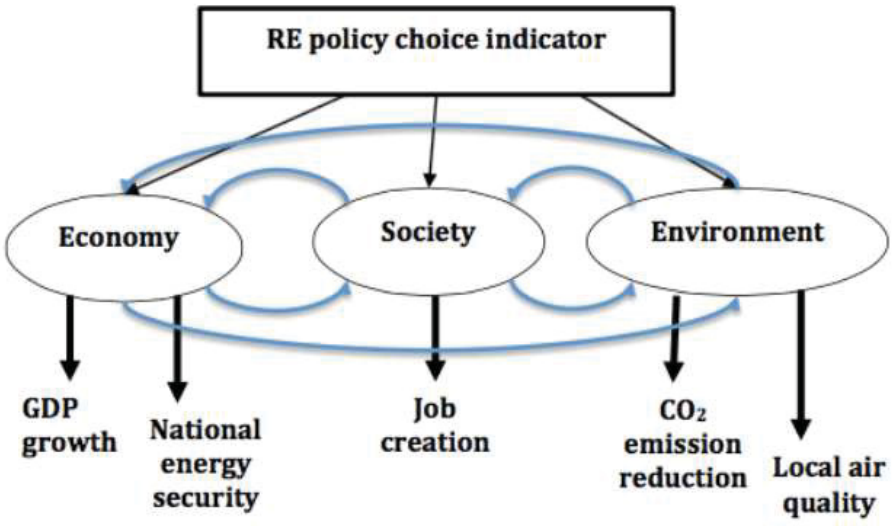


Figure 2.2: Conceptual linkage between social finance instruments, renewable energy deployment, and sustainable development outcomes.

Source: Al-Sarihi et al., (2015)

2.6 Previous Relevant Studies

Previous studies provide an important foundation for understanding the relationship between sustainable finance, renewable energy development, and sustainable development outcomes. Existing literature shows that renewable energy supports environmental quality, economic development, and social welfare, but its implementation often depends on financial instruments, regulatory stability, institutional capacity, and market readiness. Therefore, this study uses previous research to identify the main theoretical, financial, and structural issues that shape renewable energy development in Indonesia.

The studies summarized in Table 2.2 cover several key themes, including sustainable development theory, renewable energy finance, energy transition barriers, multilateral

finance, fossil fuel subsidies, and institutional constraints in Indonesia's electricity sector. These studies are relevant because they explain why sustainable finance has not fully accelerated renewable energy growth, especially in countries with strong fossil fuel dependence and complex policy structures. The table also helps position this study within the existing academic debate by showing the research gaps that still need further analysis in the Indonesian context.

Table 2.2: Previous Relevant Studies

Author(s) & Year	**Context**	**Focus**	**Key Findings and Relevance to This Study**
Purvis et al., (2019)	Global	Sustainable development theory	The research clarifies that sustainable development incorporates the aspects of environmental, economic, and social aspects and should be handled in totality. This applies to this research since it offers a theoretical basis on the analysis of the impact of sustainable finance and renewable energy in creating sustainable development results.
Omri and Belaïd (2021)	Global	Renewable energy & sustainability	The researchers conclude that the use of renewable energy enhances the quality of the environment and economic development. It applies to this study since it justifies the significance of renewable energy as an important factor to sustainable development and justifies looking into sustainable finance to speed up the use of renewable energy.

Sambodo et al., (2022)	Indonesia	Energy transition barriers	This paper indicates that fossil dependence, competency, and regulatory unpredictability are some of the factors which limit the energy transition in Indonesia. This applies since it brings out structural and financial impediments that sustainable finance has to solve in the Indonesian renewable energy industry.
Dutta, (2020)	Global	Renewable energy finance	The paper states that new financial instruments like green bonds and blended finance are needed to raise money to invest in renewable energy projects. This is applicable since it offers conceptual understanding on which sustainable finance frameworks are to be analyzed when developing renewable energy.
IRENA, (2023)	Global	Financial barriers	The report cites the high capital cost, uncertainty about investment, and uncertainty regarding the policy as some of the major impediments to the financing of renewable energy. This applies since it aids in the explanation as to why sustainable finance has not completely turned around renewable energy markets even in Indonesia.
Barroco & Herrera, (2019)	Global	Sociotechnical transition	The research paper highlights that technological, institutional and social factors have an impact on

			energy transitions. This applies since it helps in supporting the claim that sustainable finance should be coupled with institutional and governance reforms to facilitate the development of renewable energy.
Judijanto et al., (2025)	Global	Investment trends	The paper demonstrates that the investment on renewable energy in the world is on the rise but not uniform all over. This is applicable since it would be able to compare the global trends and the performance of Indonesia and identify gaps in the implementation of sustainable finance.
Asquith et al., (2013)	Developing countries	Multilateral finance	The researchers conclude that multilateral development banks lower the risk of investment and access the capital of the private on renewable energy. This is applicable since it brings out the role of international finance that will help in the development of sustainable energy in Indonesia.
G20 (2022)	Global	Sustainable finance policy	The report has highlighted the role of international coordination and standards of regulation in enhancing sustainable finance structures. This becomes applicable since it justifies the necessity of ensuring that sustainable finance policies in

			Indonesia are aligned with the international standard.
OECD, (2021)	Global	Fossil fuel subsidies	The research demonstrates that the fossil fuel subsidy distorts the energy markets and makes renewable energy less competitive. This applies to the fact that it clarifies the limitation of renewable energy development in Indonesia in spite of sustainable finance programs.
World Bank (2020)	Global	Financial systems	The analysis concludes that robust financial institutions are critical towards mobilization of climate finance and sustainable development. This applies since it offers a guideline on the approach of examining the financial structure of Indonesia in promoting renewable energy.
Sambodo et al., (2022)	Indonesia	Energy sector structure	The article brings forward the fact that the reliance on coal and excess supply of electricity inhibit the growth of the renewable energy in Indonesia. It is applicable as it offers fossil fuel dominance and oversupply specific evidence to Indonesia that undermine sustainable finance.
Khan (2023)	Global	Carbon lock-in theory	According to the study, fossil fuel infrastructure instills institutional and technological dependency on carbon-intensive energy after a long period. This is pertinent since it gives a theoretical justification of

			why Indonesia continues to consume fossil fuels even with the sustainable finance initiatives.
Sambodo et al., (2022)	Indonesia	Energy market competition	The research concludes that electricity generated using fossil fuels is still economically viable because of the presence of infrastructure and subsidies. This is applicable since it is in the way that it describes the impact of market conditions on the investment in renewable energy and the effectiveness of sustainable finance..
Sitompul et al., (2022)	Indonesia	Electricity oversupply	In the research, surplus capacity in fossil fuels diminishes the chances of investing in renewable source of energy. This is applicable since it proves the point that the situation of excess supply is counterproductive to development of renewable energy in Indonesia.
Halimatussadiah et al., (2024)	Indonesia (PLN)	Role of PLN	The researchers conclude that the centralized planning and long-term contracts of fossil fuels by PLN limit the integration of renewable energy. It applies to this paper since it shows how institutional arrangements in PLN can affect the development of renewable energy and the efficacy of sustainable finance in Indonesia.
Handayani et al. (2020)	Indonesia (PLN)	RUPTL planning	The research indicates that the RUPTL of PLN still gives priority to coal even with the national

			renewable energy targets, which generate policy and planning inconsistencies. This is applicable since it shows how institutional incompatibility in PLN fosters the sustainability of finance and restricts the development of renewable energy in Indonesia.

Source: Researcher's findings (2026)

Unlike previous research that primarily documents the barriers, policy frameworks, or economic impacts of renewable energy in Indonesia, this study explicitly examines the direct link between renewable energy financing and measurable sustainable development outcomes. While earlier studies focus on descriptive analyses of investment flows or case-specific project assessments, this thesis integrates financial, economic, social, and environmental dimensions to evaluate how financing instruments (public, private, and innovative mechanisms like green sukuk) translate into development indicators such as GDP growth, employment, energy access, and emission reductions.

Additionally, this research applies to a multi-theoretical framework—including Circular Economy, Ecological Modernization, Financial Intermediation, and Sociotechnical Transition theories—providing a more comprehensive lens than prior studies, which often rely on a single perspective. By combining empirical evidence with policy analysis, this thesis not only identifies the gaps in financing mechanisms but also quantifies their impact on national SDG targets and climate commitments, offering actionable insights for policymakers and investors in Indonesia.

2.7 Research Gap

Existing studies on renewable energy finance in Indonesia mainly focus on policy barriers, investment constraints, regulatory uncertainty, renewable energy targets, and technical challenges. These studies are useful because they explain why renewable energy development in Indonesia remains slow despite the country's large renewable energy potential. However, many of them treat financing as a general investment problem. They do not fully explain how financing conditions affect sustainable development outcomes in the Indonesian electricity sector. The gap addressed in this study is therefore not about whether renewable energy is important for sustainable development. That relationship is already discussed in previous literature. The specific gap is how renewable energy financing barriers and support mechanisms shape the economic, social, and environmental

outcomes of renewable energy development in Indonesia. In other words, limited research explains how issues such as high capital costs, limited access to long-term finance, policy uncertainty, weak risk-sharing mechanisms, and institutional coordination problems affect the ability of renewable energy projects to support sustainable development.

This thesis fills this gap by analyzing renewable energy financing in Indonesia through qualitative evidence from interviews and document analysis. The study identifies the main financial, regulatory, institutional, and technical factors that influence renewable energy financing. It then links these factors to sustainable development outcomes in the electricity sector. The analysis focuses on economic outcomes such as investment growth, job creation, infrastructure development, and energy security. It also examines social outcomes such as electricity access, welfare improvement, and support for underserved areas. In addition, it discusses environmental outcomes such as emission reduction, lower fossil fuel dependence, and support for Indonesia's climate commitments.

2.8 Conceptual Framework

Based on the considered theories and results, we develop a conceptual model, which connects renewable energy finance with sustainable development outcomes, and technology mediators, with the policy context. The outputs of this model are that, in this model, RE financing (inputs) which includes the investments in the area (public and private) in different types of instruments has a direct influence on RE deployment (MW of solar, wind, hydro installed). Deployment, in its turn, has an impact on SD results: economic (GDP growth, employment), social (energy access, health) and environmental (emissions, resource use). Importantly, policy/institutional context is a moderating factor to the effectiveness of finance: clear regulations, consistent procurement policies (such as FITs or auctions) and the capacity to govern can both enhance or decrease the project-translation of finance. A green bond is an example that will be more effective when applied in a transparent and well-managed program. Likewise, the relationship is mediated by the technology and infrastructure factors: grid capacity, level of technology maturity, and innovation influence the flow of finance to electricity and results. As an example, the investing in nascent technologies (e.g. ocean energy) can have lagging effects to the old solar PV. Another feedback loop is formed by the behavior of the population and its willingness to accept renewables, as social acceptance of renewables can reduce risk premiums (to enable cheaper financing) and can have a better impact on the region.

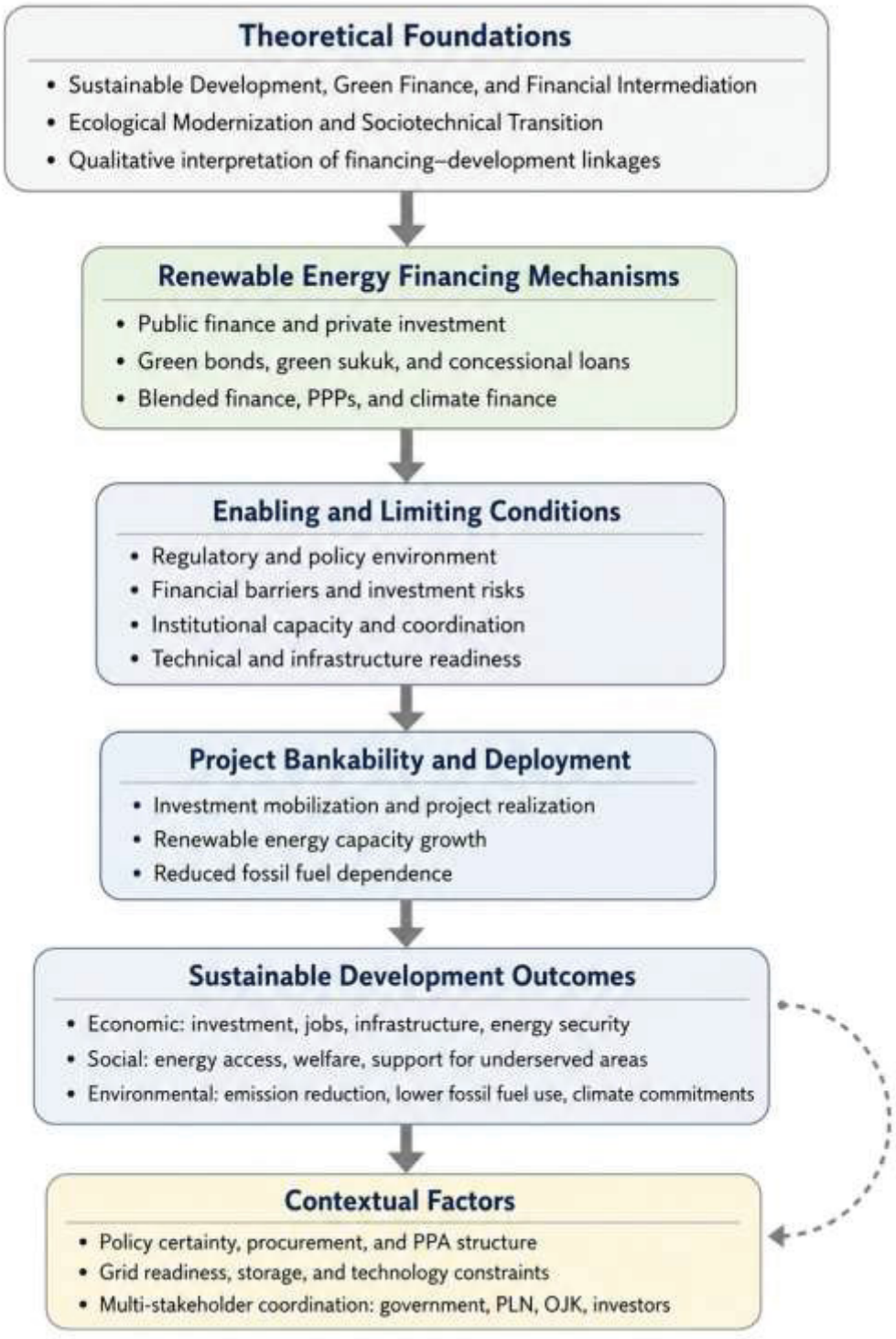


Figure 2.3: conceptual framework

Source: Developed by the Researcher (2026)

This conceptual framework qualitatively explores the processes through which financial inputs such as green financial instruments, public-private financing arrangements, and policy-supported investments enable the deployment of renewable and clean energy

technologies within the energy sector. It emphasizes how financial resources are translated into technological implementation, including renewable generation capacity, energy efficiency improvements, and supporting infrastructure. The framework further illustrates how these technological developments contribute to sustainable energy outcomes, encompassing environmental improvement, economic development, and social benefits such as energy access and affordability. Importantly, these relationships are understood as being embedded within and shaped by broader policy, institutional, and technological contexts, which influence how financial and technological dynamics unfold across different settings. Rather than testing causal effects, the framework serves as an analytical guide for interpreting interactions, mechanisms, and contextual differences in a qualitative empirical investigation.

CHAPTER 3
DATA AND METHODOLOGY

This chapter explains the method for investigating the role of financing renewable energy in sustainable development in the electricity sector in Indonesia. Describes the research design, sources of data, research participants, sampling strategy, instrument design, instrument validation, data analysis techniques, and ethical issues. This study deploys a pure qualitative research design aligned with the research objectives to explore the in-depth views of the stakeholders, institutional practices, financing problems and policy conditions. This approach is appropriate since the study is about experiences, meanings, and decision making processes, not about statistical relationships. The research focuses on qualitative inquiry to obtain detailed data on the impact of financing renewable energy on sustainable development in the electricity sector in Indonesia.

3.1 Research Design

This study is conducted using the approach of Method for Analysis of Empirical Evidence in Management (MAEEM) which is used in analysing qualitative data obtained from interviews and documentary sources from renewable energy financing and sustainable development in Indonesia. The MAEEM method is adopted for systematic analysis of the identified keywords, codes, themes and core concepts and then synthesis of them to a conceptual model to explain the relationship between financing mechanisms for renewables and sustainable development outcomes (Naeem et al., 2023).

The research design used is qualitative, analytical and comparative. It is qualitative since the primary data are collected from stakeholders, policy documents and institutional reports. It is analytical as the study does not just describe the financing of renewable energy but also gives reasons and processes behind the financing barriers and sustainable development outcomes. It is comparative because the study is based on China, Vietnam, and Bangladesh as case studies to gain insights into alternative financing routes and lessons to be learned from these countries for Indonesia.

Indonesia is chosen as the primary country due to its large renewable energy potential, ambitious energy transition target and numerous financial challenges in the electricity sector. The choice of China as a reference case is since it is a state-led coordinated finance model, with long-term policy planning and a large public financial institution. Vietnam is chosen because it is a market incentives-led model with feed-in tariffs and private investment to promote rapid growth of renewable energy. Bangladesh is chosen as its very decentralised and inclusive financing model including in rural electrification and off-grid solar development.

This comparison is not intended to suggest that Indonesia should blindly follow the example of a particular country. The purpose is, however, to pinpoint the financing mechanisms, institutional arrangements and policy measures that could be relevant to Indonesia. This comparative design further supports the discussion, as it enables the study not only to explain the dynamics that occurs in Indonesia, but also why Indonesia's financing performance is different from the selected peer countries.

The study uses a combination of sources of evidence to help in a thorough and substantiated analysis. The primary data is gathered by performing a semi-structured interview with the key informants such as a senior official of the Ministry of Energy and Mineral Resources (MEMR), an expert in energy finance from Asian Development Bank (ADB) and PLN expert. This analysis is also done in a contextual and empirical way by analysing the documentary sources from the report and policy documents of the MEMR, PLN, OJK, BRI, BCA, International Energy Agency (IEA) and other official institutions. The data gained from the supplementary interviews by OJK further enriches the data and reinforces the institutional view in the study.

The MAEEM approach in triangulation of data and increases the credibility and validity of the research results due to the combination of the findings of interviews and documentary evidence. The method will enable the study to generate comprehensive evidence based thematic analysis regarding energy financing obstacles to renewable energy and contribution of financing renewable energy to sustainable development in Indonesia, based on the institutional, regulatory and financial elements. (Naeem et al., 2023).

3.2 Data Sources

Secondary data: create an original panel (or time-series) dataset in Indonesia between 2015-2025. The main sources are the official Indonesian agencies and foreign databases. Economic and energy data will be attracted with the help of the Ministry of Energy and Mineral Resources (MEMR), the state utility PLN (Perusahaan Listrik Negara) and the Financial Services Authority (OJK) annually. MEMR releases the energy production and capacity statistics, whereas annual reports of PLN contain the description of the electricity mix and significant investments. The reports on sustainable finance of OJK monitor the investments in renewable activities. These are complemented by the international organizations: the World Bank provides macro indicators (GDP per capita, electrification levels), and IEA/IRENA give information on energy production, the proportion of renewable sources, and CO_2 emissions. As an illustration, IEA statistics indicate that since 2000, rural electrification in Indonesia (funded by PLN and consumers, predominantly the poor as well as individuals and businesses) has taken an exponential jump in access. Such

will be considered the source of all the quantitative variables (2015-2025). Transparency and replicability of the analysis are guaranteed by using public datasets (e.g. World Bank WDI).

Primary data: A semi-structured interview with a purposive sample of ≈10 experts. The most important stakeholder groups are MEMR officials, PLN senior managers, financial regulators (OJK), multilateral development bank representatives (e.g. ADB) and renewable energy developers. The interview protocol includes the issues of investment channels, incentives of the policy, issues of financing barriers, and views on the sustainability outcomes. Interviews will be audio-taped (with permission) and transcribed to be analyzed. The sample used to interview will be individuals with first-hand experience in policy and finance in Indonesia to minimize the possibility of gathering information that lacks pertinence. Everything (recruitment, scheduling) will be carried out according to the institutional ethics.

The timeframe of 2015-2025 can be explained by the fact that recent policy commitments (SDG adoption and the Paris Agreement in 2015) fit within this timeframe and reflect current tendencies in the development of renewables. This time frame enables the incorporation of the latest data (e.g. electrification rates, CO2 emissions, investment volumes) and sufficient time to conduct econometric analysis, at the same time being able to concentrate on the current policy environment. (Note: To provide natural reference points on this study, the Indonesia target of 2025 of renewable energy and the 2015 SDGs offer natural benchmarks of this study).

3.3 Variables and Measurement

Since the quantitative analysis is descriptive, the study is centered on a small number of significant variables, which present the results of financing and development of renewable energy between 2015 – 2025.

The main variables include:

1. **Renewable Energy Investment Volume**

   This variable is defined as the amount of money that is spent in yearly projects of renewable energy in the electricity industry. It is calculated using a monetary value (Indonesian Rupiah or USD) using reported investor and lending data of banks, PLN, and official government sources.

2. **Installed Renewable Energy Capacity**

   Installed capacity is the sum of the operating capacity of renewable energy plants of power, in megawatts (MW). This encompasses the solar energy, hydro power, wind power as well as geothermal power.

3. **Electrification Rate**

   Electrification rate is expressed in percentage of the households that have access to electricity. This indicator is a social aspect of sustainable development and based on the MEMR and PLN statistics.

4. **Renewable Energy Share**

   This variable demonstrates the percentage of the renewable energy in the national mix of electricity generation, as a percentage of the installed capacity or total production of electricity.

5. **Emissions Reduction**

   In the case of available data, the reduction of emissions is characterized qualitatively and descriptively, relying on the renewable energy output provided by the company and its official emissions factors.

Measurement of all variables is done after every year and the results are presented in tables and figures. The paper is not a hypothesis test or causal estimation study; the variables are employed to show trends and time patterns.

3.4 Analytical Methods

Qualitative Analysis: Thematic Analysis

This study employs thematic analysis as the primary qualitative analytical method to examine interview data and documentary sources related to renewable energy financing in Indonesia. Thematic analysis is chosen because it allows for the systematic identification, organization, and interpretation of recurring patterns and meanings across qualitative data, making it well suited to policy- and finance-oriented research (Braun & Clarke, 2006).

The analysis follows the six-phase framework proposed by Braun & Clarke (2006)):

1. **Familiarization with the data**

   The researcher has gone through the transcripts of interviews and policy documents severally just to be able to understand the content and context of these policies in a broad way. Opening notes were made based on the financing system, legal framework, institutional functions, risk, and anticipated sustainable development.

2. **Generating initial codes**

   A preliminary open coding step aimed at identifying meaningful passages of text was done. Codes included policy uncertainty, perception of risks, limitation in financing, institutional coordination and social and environmental advantages of renewable energy projects.

3. **Searching for themes**

The corresponding codes were put together during the axial coding into larger themes and constituted preliminary themes, expressing patterned responses to the whole data.

4. **Reviewing themes**

   Themes were critically examined and developed to guarantee internal coherence and consistency with the coded information and as well with the entire data set. Repeated themes and themes that were less prominent were integrated or removed.

5. **Defining and naming themes**

   Final themes were explicitly stated and given a name, to show what they are about, and to link them to the research questions.

6. **Interpretation and reporting**

   The final themes were re-interpreted in the context of the conceptual approach and theory of the study, such as the theory of sustainable development, green finance and sociotechnical transition theory.

The thematic analysis is done in a hybrid manner, inductive–deductive. Inductively the analysis is rooted in the themes that arise from the stakeholder interviews and policy texts and deductively by the theoretical framework and research question. This is a way of having theoretical synchrony, and empirical openness.

3.5 Population and Sampling

Data Collection and Preparation

The sampling of data collection was done on purposive sampling which selected the stakeholders who are directly involved in RE financing and policy implementation. Sources include:

1. **Interviews**
   - Senior MEMR Official: Provided knowledge on regulatory frameworks, institutional capacity, financing gaps and barriers.
   - Academic/ADB Energy Expert: Common understanding on international good practice, blended finance models and risk mitigation strategies.
   - PLN Expert: Discuss challenges and gaps regarding regulatory frameworks, institutional capacity, funding and barriers.
   - **OJK Officials**: Provided clarification on Sustainable Finance Regulations, Sustainable Finance Taxonomies, Risk Management Instruments.
2. **Documentary Analysis**
   - National Energy Policy (GR 79/2014), Presidential Regulation No. 22/2017, and RUPTL 2025–2034.

- Banking reports: BRI and BCA sustainable lending portfolios, green financing strategies, and project-level financial data.
- International references: IEA, OECD, IRENA, World Bank, and JETP policy documents.

3. **Supplementary Interviews and Confirmations**
   - MEMR and PLN confirmation of financing mechanisms, RE project implementation, and policy gaps.
   - Triangulation ensures credibility, with multiple sources validating findings.

All qualitative data were **transcribed, organized, and stored in a structured database**, facilitating keyword extraction and coding.

Table 3.1 Interview Respondent Coding

Respondent Code	**Institution / Stakeholder Category**	Interview Date	**Main Information Provided**
Respondent A	MEMR / Policymaker and Regulator	April 2026	Provided information on renewable energy policy, regulatory barriers, financing mechanisms, and government strategies to support renewable energy investment.
Respondent B	Academic / ADB Energy Finance Expert	May 2026	Provided expert insight on renewable energy financing, blended finance, investment risks, and sustainable development impacts.
Respondent C	Financial / Regulatory Institution	May 2026	Provided clarification on sustainable finance regulations, green taxonomy, risk management instruments, and financial sector readiness
Respondent D	PLN / State-Owned Utility	April 2026	Provided information on PLN's role as off-taker and system planner, including procurement, PPA issues, grid constraints, and

			renewable energy project implementation.

Source: Developed by the Researcher (2026)

The respondents to the interview were coded as Respondent A, Respondent B, Respondent C and Respondent D to maintain confidentiality. The codes are those of individual participants and do not necessarily reflect the official position of the institutions. The respondents in this study are comprised of a PLN respondent, a senior official of MEMR, an academic/ADB expert, and an OJK official, based on the analysis of Chapter IV.

3.6 Thematic Saturation

In this study, thematic saturation as the determination of the qualitative sample size was informed by the idea that it is when the data is collected that no other new themes or analytic fruit will be generated. The measure of saturation was performed due to the process of iterative coding and thematic analysis, as consecutive interviews provided similar data and validated the previously developed themes concerning the mechanisms of renewable energy financing, the policy and regulatory environment and context, the institutional barriers and effects of sustainable development. When the level of saturation was attained, no addition was made to the interviews. The method is in line with the known qualitative research practices and helps to substantiate the sufficiency and the rigor of the qualitative sample.

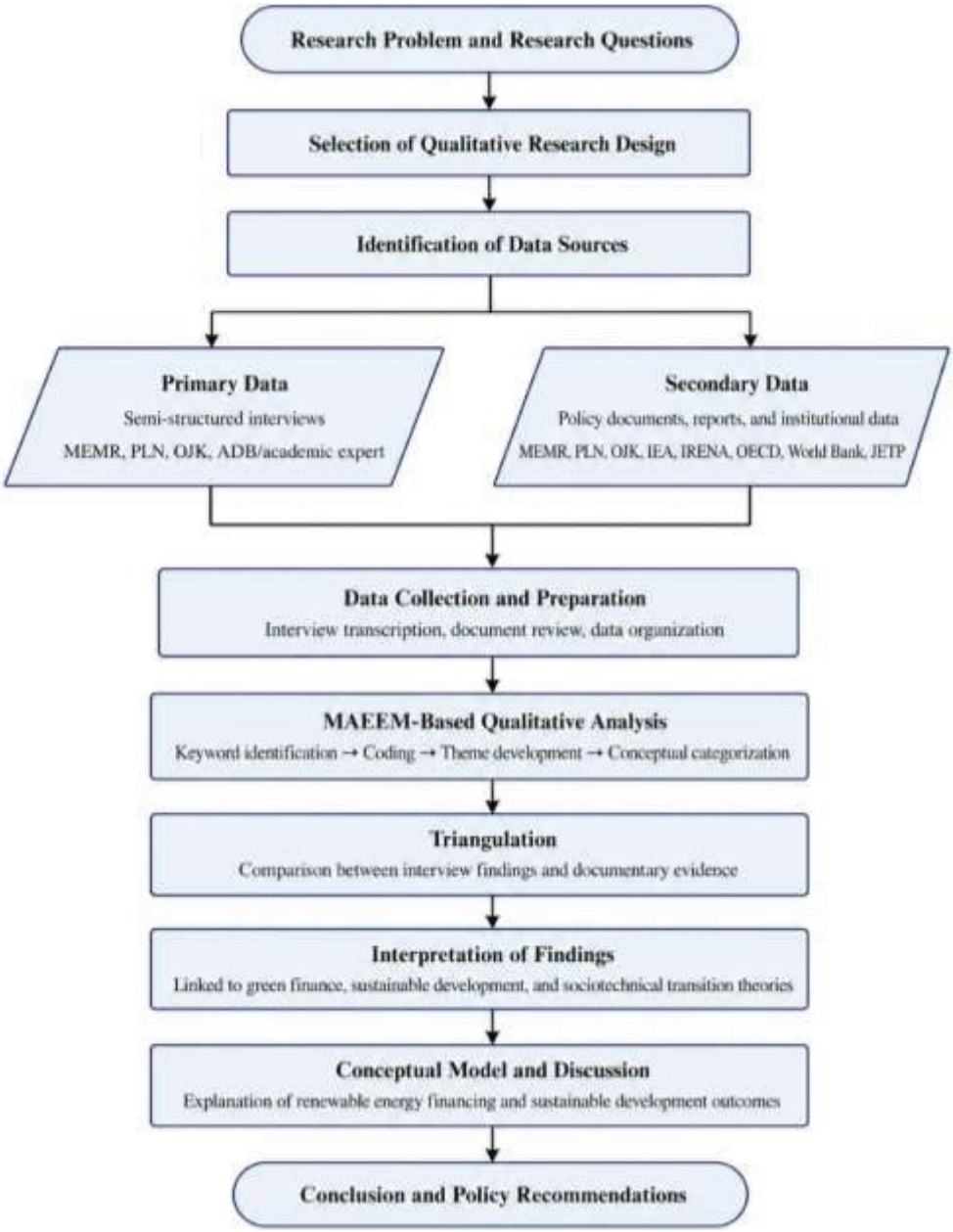


Figure 3.1 Research Methodology Flowchart

Source: Developed by the Researcher(2026)

3.7 Instrument Design and Validation

Interview Guidelines: The semi-structured interviews will be used to gain knowledge on the expert information on the financing of renewable energy and how this relates to sustainable development in Indonesia. The interviews will be in a flexible format instead of strict set of questions so that the participants can proceed at length on the issues they feel are most pertinent although the interviews will maintain uniformity. The guidelines are also informed by the theoretical underpinning that has been developed in Chapter 2,

namely, the theory of sustainable development, the green finance theory and the sociotechnical transition theory, and is adopted in line with the thematic analysis approach used in Chapter 3.

3.8 Research Instrument: Interview Guide

This research uses semi structured interviews as a data collection technique to discuss on renewable energy financing in the context of sustainable development in Indonesia. The questions for the interviews were aimed at gaining insights from key informants such as policy makers, financial institutions, renewable energy developers and academic experts.

3.9 Condensed Interview Points by Stakeholder Group

1. Policymakers and Regulators (MEMR, OJK, Ministry of Finance)

- Existing policies and instruments of renewable energy finance.
- Major entry obstacles in investment.
- Government involvement in mobilization of private finance.
- Renewable energy financing and its relatedness to sustainable development.

2. State-Owned Utility (PLN)

- The position of PLN as off-taker and system planner.
- Funding issues on PPAs and procurement procedures.
- Effects of grid and operating limitation on renewable deployment.
- Renewable project contribution to their access to energy and their reliability to a system.

3. Financial Institutions (Banks, development finance institutions, green finance units)

- Funding vehicles employed in renewable energy projects.
- Primary risk factors affecting the lending and investment decisions.
- Access to long term and cheap funding.
- Intense risk reduction and blended finance efficacy.

4. Industry Experts and Academics

- General analysis of the renewable energy financing in Indonesia.
- Significant institutional blocks to increasing the renewable energy investment.
- Liaisons between financing and sustainable development consequences.
- Financing reforms/ priority policy.

Expert review: To determine the overall coverage and impartiality of the questions, piloting will be reviewed by one or two external experts (e.g. a faculty member or practitioner in the Indonesian energy sector). This professional audit translates into construct validity by making sure that the interview does represent ideas of renewable energy financing.

Reliability measures: To increase the reliability of the qualitative coding we shall have more than one coder as indicated. A sample of transcripts coded will be subjected to an inter-coder reliability check (e.g. percentage agreement or Cohens kappa). Any differences will be addressed with the help of discussion, and coding categories will be narrowed down as necessary. This assists in making sure that the interpretation of the data is not specific to a researcher.

Documentation: The documentation will include all the versions of the interview guide, recruitment scripts, and coding manuals. This openness helps in duplication and dependability of the qualitative analysis.

3.10 Ethical Considerations

The focus of this study is on ethical considerations. The appropriate university ethics committee approves the procedure of data collection beforehand. Every participant is well informed on the purpose, procedures, and their rights of the study.

The major ethical principles are:

- Informed consent: The participants on the study are allowed to take part willingly and have the option of dropping out any time they choose.
- Confidentiality and anonymity: The personal identifiers will be eliminated in transcripts and reports.
- Data security: The recording and transcripts of the interviews are kept in a secure location and are not allowed to be accessed by anyone except the researcher.

The research guarantees that the process of participation is not harmful to the respondents and the results are responsibly and transparently published.

CHAPTER 4
RESULT AND DISCUSSION

Indonesia needs to speed up the country's energy transition and achieve sustainable development goals as an urgent need. Renewable energy (RE) is a solution to decrease the greenhouse gas emissions, to improve the energy security, and to achieve economic and social development. Although there is plenty of renewable energy resources, the investment in RE is still limited due to regulatory, financial, technical and institutional barriers. To reach the national targets and the Sustainable Development Goals (SDGs) in the electricity sector, it is important to understand how RE is financed, its impacts and the policy mechanisms that can foster investment

Indonesia's renewable energy transition also shows a measurable implementation gap. In 2025, Indonesia's new and renewable energy mix reached 15.75%, still below the national target of 23%. The installed capacity of renewable energy-based power plants reached 15,630 MW in the same year. This shows that Indonesia has made progress, but the pace remains insufficient to meet the national energy mix target. The gap supports the qualitative finding that financing, regulatory certainty, and institutional coordination remain central barriers to renewable energy development (*IESR, 2026*).

4.1 Keyword Identification

The key words in this study were taken from the literature review, the conceptual framework, and the transcript of the interview. They weren't chosen at random. Through the literature review, the key theoretical aspects related to renewable energy financing were identified, including renewable energy financing, green finance, policy challenges, institutional enablers, technical limitations, and sustainable development outcomes. These concepts were then mapped in the conceptual framework, which structures them according to the connection between financing mechanisms, development of renewable energy and economic, social and environmental impacts. These keywords were then expanded and further analysed in Chapter IV using MAEEM and the interview transcripts in conjunction with supporting documents. Thus, the keywords are the theoretical basis of the study and the patterns that are found in the electricity sector in Indonesia empirically.

Keywords were identified from all interviews and documents. They are common ideas, challenges, facilitators and results with regard to RE financing:

- **Regulatory and Policy Keywords**: regulatory uncertainty, overlapping laws, PPA delays, tariff enforcement, NRE Law, licensing bottlenecks.
- **Financial Keywords**: high capital expenditure (CAPEX), low IRR, financing gaps, risk aversion, blended finance, green bonds, concessional loans.

- **Institutional Keywords**: coordination, capacity building, workforce training, domestic industry readiness.
- **Technical Keywords**: grid constraints, intermittency, technology-specific challenges, storage solutions, hybrid systems.
- **Outcome Keywords**: economic growth, job creation, energy access, emissions reduction, SDG7, SDG8, SDG13.

These keywords formed the foundation for **coding**, ensuring that all relevant qualitative information was captured.

4.2 Coding

The keywords were converted into codes that are a summary of key concepts and can be used to systematically cluster data. Examples include:

Table 4.1: Coding

Theme	Codes	Source/Illustrative Quote
Regulatory Environment	Policy uncertainty, overlapping regulations, weak enforcement	Respondent A: "Investors hesitate because regulations can change unexpectedly."
Financial Barriers	High CAPEX, low IRR, risk perception, financing gaps	Respondent A: "IPP projects struggle to meet bank risk thresholds without guarantees."
Institutional Capacity	Domestic industry readiness, workforce gaps, coordination challenges	Respondent D: "Coordination among directorates is fragmented, delaying approvals."
Technical Infrastructure	Grid capacity, intermittency, technology-specific issues	Respondent A: "Solar requires storage, geothermal requires exploration risk coverage."
Opportunities	Green bonds, blended finance, concessional loans, international programs	Respondent B: "Blended finance mitigates risk and attracts private capital."
Outcomes	Economic growth, job creation, emissions reduction, electricity access	Respondent A: "Financing projects improves energy access and reduces fossil fuel dependence."

Source: Developed by the Researcher(2026)

4.3 Theme Development

Codes were grouped into six major themes reflecting structural factors, barriers, and enablers affecting RE financing in Indonesia:

4.3.1 Regulatory and Policy Environment

Regulatory and policy framework has also an important role to determine investments in renewable energy in Indonesia. The regulatory and policy framework for this study is defined as the rules, institutional requirements, planning documents, licensing process, tariff structures and laws that affect the planning, development and financing of renewable energy projects. These evidence-based sub-themes that are interwoven with one another include fragmentation and overlapping authority, weak enforcement of key mechanisms, and delays in implementing major legislation, as seen in Interviews A, B, C, and D, as well as in official documents like RUPTL 2025–2034, the OJK Sustainable Finance Taxonomy, the National Energy Policy, GR 79/2014, and Presidential Regulation No. 22/2017 (*OJK , 2025*).

The interview data supported by quantitative evidence pertain to regulatory and policy constraints. In the observation period, the contribution of renewable energy in the energy mix in Indonesia grew steadily but stayed below the national target. The share of renewable in the national energy mix was 13.09% in 2023. It increased slightly to 13.93% in 2024 and reached 15.75% in 2025. This was still less than the national target of 23% by 2025. The gap in both 2024 and 2025 was larger than in 2023, increasing to 5.57 percentage points and 7.25 percentage points respectively. The trend is that policy targets are not matched by the levels of project execution. It also backs the interview results, which include that instruments for policy implementation need to be more robust, procurement regulations should be more clear, regulatory consistency more robust and investment conditions more predictable (*IESR, 2026*).

4.3.1.1 Fragmentation and Overlapping Authority

Multi-agency fragmentation is a phenomenon of overlapping and fragmentation of several institutions in the renewable energy development sector, including MEMR, PLN, OJK, Bappenas, local governments, and other permitting institutions. It does not mean in this study that renewable energy projects are managed by a single, transparent and coordinated institutional channel. Instead, developers and investors frequently face various agencies with varying rules, priorities, permits and procedures. This causes delays, uncertainties and extra transaction costs, thus leading to loss in investor confidence and project bankability. For instance, respondent D stated that, “So if there is any potential renewable energy in this place, PLN must have the permit…others can bid in the same place” (Interview B, 2026). It is clear from this quote that there can be uncertainty when two agencies have overlapping

jurisdiction regarding who will approve a project and who will be able to develop or bid for a renewable energy site. A respondent A also explained, “We have different directorates here and different regulations, just like power,” meaning the more fragmented the roles of the institutions, the harder it is to coordinate. Thus, multi-agency fragmentation becomes an institutional hurdle as financing for renewable energy is not only a question of funding availability, but also of good governance, regulation and coordination.

Interview A (April 2026) said, “We must change,... in case you want to go to one place and purchase land and construct a power plant, the different institutions give you different permissions,... the certainty of doing business is really sensitive to regulation changes” (Interview A, April 2026 As Respondent B pointed out, “There’s no policy, there’s no direction, there’s no guidelines… That’s the problem with government” (Interview B, April 2026), indicating that the absence of one overarching guidance hinders the private sector's involvement.

This is confirmed by official documents. An overlapping of mandates between MEMR, PLN, local government and forestry authorities are identified in the RUPTL 2025–2034 as barriers to timely deployment of renewables projects. The regulatory fragmentation is also mentioned as one of the main constraints to fulfil Indonesia's renewable energy targets, as suggested by CREA (2026) and IEA reports. Overall, Respondent D and other interviewees described fragmentation as being more than just a bureaucratic problem—it is also a reality that raises the risk of investing and slows down financing processes, thus further reinforcing the need for more harmonized and transparent policy space (Interview A; Interview B; Interview C; and Interview D, 2026).

4.3.1.2 Weak Enforcement of Tariffs, Licensing, and PPAs

Regulatory enforcement is defined as the level of compliance with existing regulations, permits, tariff requirements and procurement processes from institutional to project levels. Unconsistent enforcement creates uncertainty in the renewable energy financing, as investors and developers are unable to easily foresee how license, bidding or tariff criteria will be applied. This was present in the interview information. This issue appeared in the interview data. Respondent D stated, “PLN has technology, and others have technology… so others can bid in the same place” (Interview D, May 2026), demonstrating operational ambiguity in permits and the impact on competitive bidding. Respondent A added, “Certainty… is sensitive to regulatory changes” (Interview A, April 2026), referring to the importance of stable licensing and tariff enforcement.

Enforcement gaps also include inadequate enforcement of the market access or financial protection rules. This is a risk in renewable energy financing, as banks like long-term

certainty regarding the regulations before giving long-term loans. Respondent B highlighted that this uncertainty directly affects financing decisions, stating, “No bank will talk about 20 years if OJK says this sector is risky, OJK will not give protection” (Interview B, April 2026). Respondent B also emphasized PLN’s monopoly as a structural limitation, stating, “The target is okay… but the policy is not there. That means PLN has to open up the monopoly” (Interview B, April 2026). This means that investment in renewables is less likely to happen due to the lack of market access and protection measures.

These challenges are also seen in official and policy documents. The OJK TKBI offers a classification framework that helps banks and investors identify sustainable finance and classify it as such for low carbon activities. But with a high risk at the project level, taxonomy guidance may not be enough to secure financing for renewable energy. Banks still have to have clear tariff rules, bankable PPAs and reliable licensing processes to enable them to approve long-term renewable energy loans. This indicates that the sustainable finance regulation system should be harmonized with energy-sector regulation(*OJK , 2025*).

This is confirmed by Evidence from RUPTL. While RUPTL 2025–2034 shows the necessity for large renewable energy additions, it also reveals that project realization requires readiness of the grid, transmission development, planning of procurement, and the ability of PLN to integrate new renewable generation. Outside Java these problems are more serious, due to less flexible transmission infrastructure and less flexibility in systems. This means that renewable energy projects can be delayed even with funding (*PLN, 2025*).

The above is reflected, among others, in the report from IEEFA, which identifies several regulatory hurdles that hinder investors in Indonesia's renewable energy sector. These include high and unattractive ceiling tariffs, lengthy procurement processes, local content requirements, mandatory partner arrangements and sub-optimal contractual structures. IEEFA also estimates that Indonesia received USD 1.5 billion in renewable energy investment in 2023, and requires approximately USD 146 billion in near-term investment in renewable energy to achieve its 2030 climate objectives. This is reaffirmation that private investment is not unlimited in the absence of tariff, licensing, procurement and PPA frameworks, which offer greater certainty (*ESDM,2025* ; *IEEFA, 2024*).

Thus, the research findings are supported by the interview findings. Capital availability is not the only constraint for the financing of renewable energy in Indonesia; the implementation rules are also of poor quality. The risk is high and private investment is lacking because of unclear tariffs, slow licensing, lack of transparency in procurement, weak grid planning and lack of bankable PPAs.

4.3.1.3 Delays in NRE Law and Presidential Regulations

New and Renewable Energy (NRE) realization shows a measurable implementation gap. NRE refers to energy derived from new energy sources and renewable energy sources. Under Law No. 30 of 2007, renewable energy includes sustainable energy resources such as geothermal, wind, bioenergy, solar, hydropower, and ocean energy. In this thesis, NRE focuses on renewable energy sources used in Indonesia's electricity sector, including solar, geothermal, hydropower, wind, and biomass (Pambudi et al., 2023). The Legislative delay is the time it takes to complete the legal and regulatory process in establishing renewable energy targets, eligibility criteria for projects, rules for tariffs and institutional responsibilities. These timelines are a source of uncertainty in renewable energy financing, as investors and lenders need certainty of targets and legal definitions before investing long term capital. Respondent A noted, "So, it means that we did not fail for the target. We only changed the target. We have to chase the target until 2034, no matter the change on it. The target is quite high" (Interview A, April 2026). This indicates that in the future, the targets for renewable energy may need to be continually adjusted due to pending or changing regulations. Respondent B added, "You have to define… what is renewable" (Interview B, April 2026), stressing the need for clear project definitions for financing, monitoring, and compliance purposes.

Respondent D reinforced the practical consequences of regulatory uncertainty, stating, "Change of regulations should not be overlapping each other… certainty of doing business is really sensitive to the change of the regulations" (Interview D, May 2026). This shows that the delays or ambiguities in the NRE Law and Presidential Regulations are directly related to the feasibility of projects, the financing of projects, and investor confidence.

The above observations are supported by official sources. The RUPTL 2025–2034 reflects, among others, the revised renewable energy goals, which are sensitive to the decisions of the regulatory process, and the fact that policy delays impede private investment and slow down the uptake of renewables, as highlighted by the IEA and the World Bank.

All of the stakeholders interviewed reiterated that the lack of a coherent set of power authorities and the overlapping and/or conflicted nature of the permits that renewable projects must obtain place renewable energy in a significant practical and financial risk. Confusion and delays due to lack of clear responsibilities and coordination which can also lead to additional compliance costs and deter investors and slow project development. Lack of clarity on revenue streams and regulation from the private developer, coupled with low enforcement of tariffs, power purchase agreement (PPA) and licensing requirements, is also reducing the financial viability of projects. Apart from that, slow implementation of the

New Renewable Energy (NRE) Law and related Presidential Regulations only exacerbate the problems and render the legal and policy framework uncertainty for planning and financing renewable energy projects.

All this combined, and with the results of official reports, indicates that regulatory clarity, timely legislation and enforcement are critical prerequisites to draw and deploy private investments. Clearly defining, standardizing and sanctioning regulations would decrease the risk perception of investors, increase project bankability and facilitate greater investor interest in participating in the projects. Finally, the need to overcome these regulatory and enforcement hurdles is essential to drive faster the deployment of renewable energy technologies, achieve the ambitious renewable energy targets and contribute to the Indonesian energy transition to a more sustainable and resilient energy system.

4.3.1.3.1 Comparative Analysis: China, Vietnam, and Bangladesh

The evidence presented is comparative and indicates that the regulatory stability is one of the important factors in shaping the direction of renewable energy financing. Development of renewable energy in China is closely related to the long-term planning and policy coordination. The International Energy Agency reports that China installed as much solar PV as the rest of the global market for the year 2022, and installed wind capacity by 66% more than in 2021. By 2028, it is estimated that nearly 60% of the new renewable capacity added worldwide will be in China (IEA, 2024). This suggests that policy continuity and synergy between the state can minimise uncertainty and bring about faster investment realization.

Vietnam offers an alternative. It has been well driven by policy incentives, particularly feed-in tariff mechanisms, for its expansion in renewable energy. The IEA also reports that Vietnam raised its target for non-hydro renewable power to 21% of total installed power capacity in its power development plan, down from 9.4%, and the proportion of coal-based power is slashed from 52% to 43% (IEA, 2024). This demonstrates how tariff and planning reforms can lead to changes in investment expectations, toward renewables. In Vietnam, however, the essential problems of grid readiness and tariff continuity have to be well managed so as not to create investment volatility due to incentive-based policy.

Bangladesh is an example of a policy model that is more access oriented. Bangladesh has not emphasized primarily renewable energy power plants but rather renewable energy for electrification and decentralization of access to electricity in the rural community. According to IEA, the electricity access rate is 85% in recent years in Bangladesh, which was 20% in 2000, and the share of wind, hydropower and solar PV in the energy system has been rising (IEA 2024). This suggests that by providing policy flexibility and

development, the social outcomes can be reinforced, despite limited renewable energy capacity.

Indonesia's regulatory issue differs from these countries, as there is no policy but also the disparity between policy objectives, procurement procedures, tariff policies and the implementation power. The merits of long-term policy coordination are evident in China, the strength and potential danger of tariff incentives are seen in Vietnam, and regulatory flexibility is crucial for decentralised access is demonstrated in Bangladesh. Hence, Indonesia should have a stability in regulation which is supported by investors and also flexibility in supporting various renewable energy business models.

4.3.2 Financial Barriers

One of the most significant challenges for the development of renewable energy in Indonesia is still financial barriers. For this study, the financial barriers are the funding related conditions that inhibit renewable energy projects from being able to reach financial close, access long-term capital investments and attract private investment. The four interrelated sub-themes indicated by the evidence collected from Interviews A, B, C and D as well as official documents, including on the RUPTL 2025-2034, OJK Sustainable Finance Taxonomy, and World Bank/IEA reports, are: high capital expenditure, perceived risk arising from technology and regulation, limited bank awareness of renewable energy technologies, and potential solutions through blended finance and government guarantees.

4.3.2.1 High CAPEX and Low IRR

High upfront cost and low projected return is the financial challenge associated with renewable energy projects having high initial cost, but low returns relative to the investor's cost of capital. The absence of this condition makes the participation of the private sector less attractive unless additional support is provided. Respondent A responded, “For the IPP, [renewables] are not attractive because if they have the IRR targeting the WACC… it will reduce the IRR of the project” (Interview A, April 2026). This suggests that traditional economic calculations such as the internal rate of return and the weighted average cost of capital, can make renewables look less attractive economically without appropriate policies, tariff certainty, or risk-sharing arrangements.

The financing barrier identified by respondents is consistent with recent investment evidence. Indonesia attracted only around USD 1.5 billion in renewable energy investment in 2023, which added only 574 MW of renewable energy capacity. This investment level remains low compared with the scale of financing needed for the national energy transition. IEEFA estimates that Indonesia needs around USD 285 billion to meet its 2030 climate commitment, with an estimated USD 146 billion private investment gap. These figures

support the interview finding that public finance alone is insufficient and that blended finance, concessional loans, guarantees, and private sector participation are needed (*IEEFA, 2024*; *IESR, 2026*).

This was also mentioned by Respondent D from an operational point of view, by saying, "Even if we don't need the energy, we still have to pay 60%" (Interview D, May 2026). This includes take-or-pay clauses in power purchase agreements where PLN might still have the obligation to pay even if the contracted power supply is not fully used. These arrangements result in a misalignment of the money invested in projects and the expected returns, and can influence the type of procurement methods used, project viability, and the overall financing framework of renewable energy projects.

Respondent B continued, "because the energy sector is perceived as high risk, so investors are expecting the government to provide initial support for investments without conducting risk reduction. If it does not carry out risk reduction, then investors will be reluctant to invest." (Interview B, April 2026). This underlines the fact that, without risk mitigation up front, investors may see renewable energy projects as nonfinancially viable. These are also officially reported observations. The RUPTL 2025-2034 and IEA studies indicate that renewable energy projects in Indonesia need much more capital investment, whereas OECD analyses reveal that investment for renewable energy is still far less than investment for fossil fuels. Combined, they suggest that both high CapEx and low IRR are fundamental impediments to financing renewable energy. Hence, novel financial tools, public subsidies and risk-sharing schemes are needed to enhance the viability of projects.

4.3.2.2 Perceived Risk from Technology and Regulatory Uncertainties

The interviewees pointed to a range of factors as determinants of the perceived risk of renewable energy projects, not just financial cost. In this context, perceived risk is the uncertainty of the investor, lender, and project developer about the performance of the technology, project implementation, regulation, and returns. Respondent A explained, "Renewable energy is one of the most difficult [generation types]… every type has a different challenge" (Interview A, April 2026). This indicates the technological uncertainties of various renewable energy sources: drilling risks at geothermal sites, intermittency of solar energy, integration of renewable energy in the grid, and hybrid system complexity.

Respondent D also noted, "We have technology, and our competitors also have technology, so they can compete in the same market" (Interview D, May 2026). This points to market uncertainty caused by overlapping authority and unclear licensing procedures. Respondent B added, "No bank will discuss a long-term plan if the sector is considered risky by OJK,

because without the umbrella of OJK, there is no protection" (Interview B, April 2026). This suggests a possible negative impact of regulatory uncertainty on financial risk perceptions, particularly if there is not adequate policy protection for long-term financing of renewables.

The perceived risk from technological and regulatory uncertainties is a major financial barrier for renewable energy projects in Indonesia. It has been officially reported and recorded that this is true. Technical risk is driven, for instance, by variability in solar and wind generation, and operational uncertainty is driven by constraints in the grid and limited storage capacity, according to the International Energy Agency (Iea, 2025). The regulatory risks involve frequent changes in tariff rules, PPA delays and complex licensing process. The impact of these risks is reflected in the investment figures: in 2023, Indonesia only received investment of USD 1.5 billion for renewable energy (574 MW) compared to the desired target. Of these, 145 MW was from one large solar project (Cirata Floating Solar), indicating that financing is focused on a few low-risk projects (*IEEFA, 2024*). It is estimated that USD 97 billion must be invested to achieve the 2030 transition targets, while the private financing gap is USD 146 billion. The quantitative findings corroborate the interview results that perceived risk is complex and can be attributed to technical factors, regulatory issues, and economic considerations (*JETP, 2025*).

4.3.2.3 Limited Bank Familiarity with RE Technologies

One of the key challenges cited in all interviews is the lack of understanding within domestic banks of renewable energy technologies. Bank familiarity is the capacity for financial institutions to identify and understand the risks of renewable energy projects, understand cash flows, understand technology performance and offer appropriate long-term financing. Respondent B stated, "Local bank? No. Zero" (Interview B, April 2026). This is suggestive of either a de-risking mechanism or the lack of it, or governmental support or guarantee in the form of long-term financing to renewable energy projects by domestic commercial banks.

Interview C also noted that in the banking sector, renewable energy projects continue to be assessed primarily based on the traditional financial criteria like Return on Assets, Return on Equity and Internal Rate of Return. Many banks, however, have not had a lot of experience in modelling renewable energy risk, which includes risks associated with technology performance, resource variability, regulatory uncertainty and long payback periods. The need for enhanced financing mechanisms, better regulations and comprehensive risk-sharing mechanisms was echoed by Respondent A, who said, "The acceleration of renewable energy investment requires stronger financing schemes,

improved regulatory support, and comprehensive risk-sharing mechanisms" (Interview A, April 2026). This indicates that to increase financing for renewable energy in Indonesia, capacity of banks must be enhanced and appropriate instruments for risk mitigation must be developed.

This is confirmed by official reports. In the RUPTL 2025–2034 Action Plan, OJK TKBI highlight the need for financial institutions to build capacity, provide technical direction and establish a clear regulatory framework to boost confidence in financing renewable energy. Even if technical readiness is achieved, problems of credit support and government risk-sharing mechanisms remain as a constraint on financing, especially for independent power producers (IPPs) (Interview D, May 2026). It demonstrates the viability of blended finance, guarantees, and reinforced institutional guidance as both policy options and instruments to enhance the bankability of projects and draw private investment.

4.3.2.4 Blended Finance and Guarantees as Solutions

A blended finance option and guarantees were mentioned repeatedly by interviewees as potential approaches to address perceived investment risks. Within this context, blended finance is a coming together of public, concessional, and private sources to enhance project bankability, and guarantees are risk-sharing instruments that mitigate specific financial, regulatory and payment risks Respondent B noted that "Because of the high upfront risks, investors often require public first-loss protection or government guarantees before committing their funds." (Interview B, April 2026). Respondent A also emphasized "loans, grants, risk-sharing" (Interview A, April 2026) as essential tools to make renewable energy projects more bankable. Respondent D added, "We bundle projects until one gigawatt in spread location… more attractive for investors" (Interview D, May 2026). This illustrates that the project aggregation can not only lower the risk of investment, but also improve the scale and make the renewable energy project more attractive for private investors.

These recommendations are confirmed by official reports. Based on analyses by the World Bank and IEA, blended finance, with concessional loans, guarantees, and private equity, can mitigate high capital expenditure risks and unlock private investment in Indonesia's renewable energy industry. Green bond, sustainable linked sukuk and other sustainable finance instruments such as green bonds can also help mitigate the risk of investments in renewable energy projects, which are supported by OJK regulations including POJK 18/2023. Therefore, the results of the interviews are also in line with the official policy documents which highlight the need for de-risking measures, improved financial sector capacity, and improved regulatory frameworks for increasing financing for RE in Indonesia.

One thing is constant: High CAPEX and low IRR directly limit the involvement of the private sector in renewable energy projects, interviewees repeatedly say. In addition to technological and regulatory uncertainty, a lack of perceived risk and domestic banks' lack of expertise in renewable energy further prevents investment. Blended finance solutions and guarantee mechanisms have been mentioned repeatedly as vital to addressing these challenges and mobilizing private investment.

If combined with official reports, these observations suggest that financial barriers are not just about economic barriers, but also about other systemic regulatory, technical, and institutional barriers that exist in Indonesia. Any effort to mobilize investment to meet the national targets for renewable energy in the country can only be tackled by addressing these challenges by using risk-mitigation tools, capacity building initiatives for financial institutions and development of innovative financing instruments.

4.3.2.5 Comparative Analysis: China, Vietnam, and Bangladesh

Comparative evidence shows that renewable energy financing depends strongly on the way investment risk is allocated between the state, private sector, and financial institutions. China reduces financial barriers through a state-led financing structure. The scale of China's renewable expansion reflects the role of state-backed planning, long-term contracts, and coordinated investment in grid and generation infrastructure. The IEA reports that global renewable capacity additions increased by almost 50% to nearly 510 GW in 2023, with China as the main driver of this acceleration (IEA, 2024). This demonstrates that the financial risk can be lowered if part of the risk is taken by the public institution and can provide long-term certainty in investments.

In Vietnam, the financing approach is a market-oriented one. Feed in tariffs (FiTs) enabled the private sector to invest as they offered developers certainty of revenue. This model is, however, sensitive to change in regulation. Tariff incentives are also subject to change or grid connection may be uncertain, causing investors to postpone projects due to the uncertainty of expected cash flows. In this regard, Vietnam is a good example, proving that financial barriers can only be addressed by attracting private capital. They can be resolved if the policy of tariffs, grid access and procurement are credible throughout the project life cycle.

In Bangladesh, they have a different financing mechanism of renewable energy financing linked with microfinance financing, development finance and decentralized energy delivery. It is more inclusive due to its model, where financing is about smaller systems and the affordability of rural households. This contrasts with China and Vietnam where the emphasis is more towards utility-scale expansion. The Bangladesh experience indicates

that ticket sizes can be scaled down, development finance support provided, and local channels of implementation established to overcome financing hurdles. But the decentralized systems and this are not sufficient for national power sector decarbonization, as there is a need to replace large fossil fuel based generation.

The comparison shows that the issue of finance is not only about money; it is also related to risk allocation in Indonesia. The power sector transition pathway (JETP Secretariat, 2023) estimates the investment need in Indonesia to be at least US$97.1 billion for 2023–2030 and US$580.3 billion for 2023–2050. This is not something that the taxpayer can pay for. So, Indonesia requires a mixture of the approach of de-risking by the Vietnamese government and private investment incentives, and the decentralised financing model used in Bangladesh for remote areas, which is a form of state support.

4.3.3 Institutional Capacity and Coordination

Capacity and coordination of institutions are the most influential in successful deployment of renewable energy in Indonesia. For this study, institutional capacity refers to the capacity of public agencies, financial institutions and energy-sector actors to effectively design, implement, finance, monitor and coordinate renewable energy projects effectively. The results of Interviews A, B, C, and D, as well as official documents like the RUPTL 2025-2034, OJK TKBI, and the reports from the World Bank/IEA analysis, have led to the identification of three interrelated sub-themes: fragmented roles between agencies, limited technical and financial skills, and the need for training and harmonized.

4.3.3.1 Fragmented Roles and Overlapping Mandates

One of the problems stated in all of the interviews is the lack of coordination between the responsibilities of MEMR, PLN, OJK, and Bappenas. In this context, fragmentation refers to the division of authority across multiple institutions without sufficient coordination, which can create overlapping permits, inconsistent policy interpretation, and conflicting implementation priorities. Respondent A highlighted this challenge by stating, “We have different departments and different rules here” (Interview A, April 2026). This is indicative of the challenges in operating the projects together, particularly when project approval, financing regulation, energy planning and implementation are managed by different institutions.

Respondent D added, “So if there is any potential renewable energy in this place, PLN must have the permit… others can bid in the same place” (Interview D, May 2026). This emphasizes how fragmented institutional roles can create practical bottlenecks in project execution, particularly in licensing, project allocation, and competitive bidding. Respondent B reinforced this concern by stating, “There is no clear pipeline… coordination

between ministries and local authorities is lacking" (Interview B, April 2026). This underscores the need for more centralized project planning and stronger inter-agency coordination to reduce uncertainty for investors.

Official documents also confirm the problem of fragmented roles and overlapping mandates. The RUPTL 2025–2034 plans around 69.5 GW of additional power capacity, including 42.6 GW from renewable energy and around 10.3 GW from storage. It also requires major transmission expansion, including about 48,000 circuit-km of transmission lines (*PLN, 2025*). These figures show that renewable energy development is not only PLN's responsibility. It requires coordination between PLN, MEMR, OJK, the Ministry of Environment and Forestry, the Ministry of Finance, regional governments, land authorities, and financial institutions. Project approval becomes more complex when renewable energy projects require land permits, environmental approval, forest-area clearance, grid connection approval, PPA negotiation, and financing approval from different institutions.

The OJK Sustainable Finance Taxonomy, or Taksonomi untuk Keuangan Berkelanjutan Indonesia (TKBI), also reflects this coordination challenge. TKBI was prepared with input from at least 13 ministries and government agencies, including MEMR, the Ministry of Environment and Forestry, the Ministry of Finance, Bappenas, Bank Indonesia, and the National Energy Council. It also involved 13 other stakeholder groups, including energy associations, financial-sector associations, investors, NGOs, the JETP Secretariat, and the Sustainable Finance Task Force (*OJK , 2025*). This shows that renewable energy financing depends on multi-agency coordination, not only financial regulation. Therefore, the evidence supports the interview findings that fragmented mandates can slow project approval, weaken implementation, and reduce investor confidence.

4.3.3.2 Lack of Technical and Financial Expertise

In all of the interviews, it was consistently pointed out that technical and financial knowledge is lacking at home, which hinders the implementation of renewables. Technical and financial expertise, in this context, means the capacity of the local institutions, engineers, developers, project managers and financial actors to design, evaluate, finance and successfully implement large-scale renewable energy projects. Respondent A noted, "Domestic industry readiness is also a challenge" (Interview A, April 2026). This is the lack of competent staff and institutional competence to operate renewable technologies, project risk assessment and to facilitate the implementation of renewable energy on a large scale.

Respondent B added that "much renewable energy financing in Indonesia still depends heavily on international institutions and foreign investors rather than domestic commercial

banks" (Interview B, April 2026). This means that the local financial institutions are not yet very familiar with the subjects of renewable energy risk assessment, cash-flow modelling of projects and financing structures with long terms and long-term. "Domestic industry readiness is also an issue" (Interview D, May 2026). This shows that institutional capacity barriers are not only financial, but also technical and operational

This is confirmed by official reports. According to CREA (2026) and IEA studies, workforce preparedness and institutional competence are crucial factors in determining the success of projects, as they lack trained personnel and technical expertise are likely to become delayed, cost overrun and/or underperforming.

4.3.3.3 Training Programs and Harmonized Sustainable Finance Reporting

Interviewees proposed practical solutions to address these capacity gaps. Respondent A suggested stronger training and capacity-building programs, stating, "Further training and coordination, such as sustainable finance roadmap training by OJK and collaboration between MEMR and OJK, are required" (Interview A, April 2026). This implies that standardized reporting, project aggregation, and clearer financial documentation can make renewable energy projects more bankable and easier for investors to evaluate.

Respondent B also stressed the importance of transparency and harmonization, noting that "investors want to see which project they need to invest in" (Interview B, April 2026). This means investors need to see transparent, comparable and reliable financial statements before investing in renewable energy projects. OJK documents also highlight the importance of harmonized reporting frameworks, including TKBI-supported sustainability reports, to facilitate banks and investors in making consistent assessments of the risk, eligibility, and compliance of projects.

Coordinated institutional capacity, training programs and standardized reporting are the main focuses that need attention to enhance the investment environment in renewable energy in Indonesia, as per official reports. The RUPTL 2025–2034 explicitly highlights the importance of these actions – otherwise, high-level policy goals are not likely to get followed by projects on the ground.

The interviewees collectively highlight that there are many delays and uncertainties in the development of renewable energy projects due to fragmented roles in MEMR, PLN, OJK, and Bappenas. There is often a lack of technical and financial know-how in the domestic institutions, leading to reliance on foreign investors and slower pace of projects' implementation. There is a need for targeted training programmes and for improving the harmonisation of sustainable finance reporting, to increase the bankability of projects,

lower the perceived risks and improve the coordination between agencies, stakeholders point out.

Taken together with official reports, these findings highlight the importance of institutional capacity and inter-agency coordination as well as financing mechanisms and regulatory clarity. In addition to qualified human resources, effective planning, execution and mobilisation of investment will require streamlined processes within the government institutions to meet the objectives of renewable energy in Indonesia.

4.3.3.4 Role of Financial Institutions in Supporting Renewable Energy Financing: Evidence from BRI and BCA

Financial institutions play a significant role in the transition to renewable energy in Indonesia, both as financial intermediaries that provide access to capital and as institutions capable of assessing investment risks and directing investment capital to sustainable economic activities. Financial intermediation theory suggests that banks can eliminate information asymmetry between the investor and the project developer by evaluating the credit and by tracking the project and by designing financing mechanism. This role becomes significant for renewable energy as it often involves a high initial investment, long-term payback periods, and uncertainties related to technological and market factors. The ability of banking institutions to offer sustainable financing is, therefore, important to the success of renewable energy development. (Taghizadeh-Hesary & Yoshino, 2019)

The role of banks in sustainable finance has been growing and has been strengthened since the issuance of the regulations on sustainable finance by Financial Services Authority (OJK), including OJK Regulation No. 51/POJK.03/2017 which mandates the implementation of sustainable finance strategies and preparation of sustainable finance reports by financial institutions in Indonesia. Financing specifically for renewables, however, continues to be relatively small compared to general ESG/green financing portfolios although practices have improved. The experience of Bank rakyat Indonesia (BRI) and Bank central asia (BCA) shows that sustainable finance has been done in various ways in Indonesia's banking institutions and can assist in the energy transition. (OJK 2017, BRI Sustainability Report 2023, BCA Sustainability Report 2023)

BRI is a state-owned enterprise, and it is a policy-oriented sustainable finance model. BRI is strategically located in the Indonesian financial system, thus has a great influence on supporting national development goals, such as environmental sustainability and financial inclusion. The bank's sustainable financing portfolio is growing to IDR 777.3 trillion by end 2023 and will reach IDR 793.6 trillion by end 2024. Only a part of this portfolio, though, was renewable energy financing, which was estimated to be around IDR 6–6.5

trillion. It means that while state-owned banks have the capacity to mobilize sustainable capital, they are still facing hurdles in bringing general sustainable finance to the specific renewable energy investment. The BRI Sustainability Report 2023, BRI Sustainability Report 2024

BRI has also created financial instruments for sustainable development such as bonds that contain sustainable finance elements and adjusted its lending policies to the OJK sustainable finance guidelines. State-owned banks have the benefit of being better equipped to serve government sustainability agenda through increased institutional linkages and policy alignment. One challenge in increasing renewable energy lending is that projects are perceived as higher-risk projects because their revenue streams are uncertain, investment horizons are longer, and there is a lack of project history. Thus, government assistance and risk-sharing arrangements are relevant to encourage financial institutions' engagement in renewable energy financing. (OJK, 2017; BRI Sustainability Report, 2023; Barroco & Herrera, 2019)

BCA is, on the other hand, a "private-sector and market-oriented" approach to sustainable finance. The bank has adopted a Sustainable Finance Action Plan and a sustainable financing framework to promote green economic activities such as renewable energy and green infrastructure projects. In 2023, BCA reported that the volume of sustainable financing amounted to IDR 203 trillion, up to IDR 229 trillion in 2024, and renewable energy financing was estimated at around IDR 3 trillion. Unlike state-owned banks, the strategy of BCA is more demand-driven, customer-involved, and business sustainability focused than it is directly government policy driven. Sustainability Report BCA (2023), Sustainability Report BCA (2024)

The analysis of BRI and BCA reveals the difference in the ownership structure of the company and how it affects the implementation of sustainable finance strategies. The example of BRI shows the ability of the state-owned financial institutions in serving national sustainability agenda, and BCA shows how private banks can do their part by integrating ESG and innovating around the markets. However, both institutions are experiencing similar challenges, such as short pipelines for renewable energy projects, the limited return from renewable projects, limited risk mitigating tools, and continued use of traditional collateral-based financing. While the ambition of banks to finance sustainable investment grows, the obstacles limit their appetite for sustainable investments in the renewable energy sector. This can be found in the BRI Sustainability Report 2023, BCA Sustainability Report 2023 and Sambodo et al., 2022.

In the light of the theory of green finance, BRI and BCA cases shows that boosting green finance commitments are not enough to incentivise renewable energy deployment. To diminish investment risks, financial institutions need to be better coordinated with government entities, development institutions, and renewable energy developers. Project bankability can be enhanced and private sector participation can be driven by instruments like guarantees, blended finance, concessional financing, and public–private partnerships. (Barroco & Herrera, 2019; Sambodo et al., 2022)

Thus, in addition to being a source of capital, Indonesian banks can also be considered as an institutional actor which affects the direction and speed of the energy transition. BRI and BCA have demonstrated that Indonesia has established key building blocks for sustainable banking, but more needs to be done to build regulatory clarity, arrangements for risk sharing, and financial innovations to move sustainable finance pledges into increased renewable energy investments. (OJK 2017, BRI Sustainability Report 2023, BCA Sustainability Report 2023)

4.3.3.5 Comparative Analysis: China, Vietnam, and Bangladesh

Another important aspect, which helps understand variations in the outcomes of renewable energy financing across countries, is institutional coordination. The institutional coordination is higher in China since the planning of renewable energy is more closely tied to that of grid extension, state finance and industrial policy. This enables project targeting to be done more quickly from policy targets. But China also demonstrates the importance of having the institutional capacity to accommodate changes in the grid. According to the IEA, China's coal demand and production capacity are still high and that one ton of coal is consumed for every four to produce power in the country. That is, the fossil fuel lock-in can occur even in the case of robust institutions when there is structural dependence on coal in the power system.

Vietnam has an institutional model with a blend of strengths and weaknesses. The state provides incentives on national planning and tariff, while the private developers play an important role in project implementation. This arrangement allowed for quicker investments to be made, but had drawbacks of coordination issues between renewable generation growth and the transmission infrastructure. Low grid investment is one of the key global challenges for accelerated growth of renewables alongside policy uncertainty, permitting delays and financing challenges in emerging economies (IEA, 2024). Based on the experience of Vietnam, the three departments need to be coordinated, namely investment approval, grid expansion, and project commissioning.

The institutional structure in Bangladesh is more decentralised. Local implementation partners, including public agencies, development finance institutions, NGOs, have contributed to increase in electricity access. It is a structure that works well in off-grid and rural energy programs to lessen reliance on one central energy provider. But the constraint is that decentralised institutional capacity works better when it comes to access programs than a large-scale power sector transformation. Still, the development of larger-scale renewable projects needs to be improved with regards to grid planning and the capacity to acquire land, as well as national coordination of financing.

The institutional coordination is one of the weaknesses that needs to be improved in Indonesia as the investment logic of PLN, MEMR, OJK, the Ministry of Finance, project developers, and financial institutions is not always the same. The OECD also points out that PPA bankability, uncertainty about procurement, local content requirements and limited capacity of project developers and financial institutions are some of the challenges facing clean energy investments in Indonesia (OECD, 2021). Thus, in addition to developing more policies, the institutional reform should also maintain the harmonization of energy planning, financial instruments, procurement system, and grid development in Indonesia.

4.3.4 Technical and Infrastructure Constraints

However, technical and infrastructure problems are a major obstacle to the deployment of renewable energy in Indonesia. Technical and infrastructure issues are the physical, technical and infrastructure related constraints that impact the development of renewable energy projects such as grid capacity, intermittency, readiness of the transmission network, technology specific risk and system integration. The evidence from interviews A, B, C and D and official reports (RUPTL 2025–2034, OJK TKBI and IEA/World Bank reports) indicate three sub-themes, which are interrelated: grid limitations and intermittency; high capital geothermal projects; and the need for hybrid systems, storage, and grid upgrades.

4.3.4.1 Grid Limitations and Intermittency

A recurring theme in the interviews was the difficulty of integrating intermittent renewable energy sources, particularly solar and wind, into Indonesia's electricity system. In this context, intermittency refers to the variable and weather-dependent nature of renewable electricity generation, which can affect grid stability when supply does not match demand. Respondent A stated, "NRE is among the most complex energy sectors…. because every technology faces different challenges." (Interview A, April 2026). This emphasizes that variations in solar irradiance and wind speed create operational challenges for system planning, grid reliability, and electricity dispatch.

PLN highlighted practical transmission issues: “Renewable is spread in our nation…we must also make transmission for the transfer of energy”, reflecting the geographic Another related issue is the geographic dispersion of renewable energy resources and the need for extensive transmission networks. Respondent B added, “Without a clear grid and proper planning, investors cannot see how their electricity will reach the market reliably” (Interview B, April 2026). This underscores how grid limitations can translate into perceived financial risk for private investors, because weak transmission planning creates uncertainty about whether generated electricity can be delivered, purchased, and monetized effectively.

The concerns are confirmed by official documents. However, the RUPTL 2025–2034 highlights the need for substantial transmission investments, especially off Java, to meet the 42,569 MW of new renewable capacity that will be added to the grid by 2034, and the IEA has warned that intermittent generation can pose reliability problems without the support of storage facilities and transmission upgrades.

Interviewees and reports confirm that, together, grid limitations and intermittency represent much more than operational risks, but are also financial and planning risks, impacting project feasibility and bankability.

4.3.4.2 High-Capital Geothermal Projects and Exploration Risk

Geothermal projects present unique technical and financial challenges due to high upfront costs and exploration risk. In this context, exploration risk refers to the uncertainty of discovering commercially viable geothermal resources after costly drilling activities. Respondent A emphasized, “Geothermal drilling is expensive and risky; initial investment is a major hurdle” (Interview A, April 2026). Respondent D added, “For each site, the technology and costs differ… investors hesitate because they cannot predict the outcome” (Interview D, May 2026). This highlights that uncertainty in subsurface conditions increases perceived investment risk and can discourage private financing for geothermal projects.

Respondent B also emphasized the need for risk mitigation mechanisms, stating, “Energy is high risk… they need government to put the money first… I will not go there unless you cut the risk” (Interview B, April 2026). This indicates that government guarantees, concessional finance, or blended finance are crucial to attract investors to high-risk geothermal projects. Official reports confirm this finding, as IEA and World Bank analyses note that geothermal development requires capital-intensive exploration and that early-stage drilling is often financially prohibitive without risk-sharing instruments.

This shows that geothermal cannot be dependent on market financing only, but additional financial interventions are required, taking a structured approach to make projects bankable, due to the technical complexity and exploration risk.

4.3.4.3 Hybrid Systems, Storage, and Grid Upgrades

Interviewees consistently emphasized the importance of hybrid systems, energy storage, and grid modernization for project feasibility. In this context, hybrid systems refer to the combination of two or more energy sources or technologies, such as solar, wind, geothermal, hydropower, and battery storage, to improve reliability and reduce intermittency risk. Respondent A suggested that "optimizing the technology mix, including hybrid systems and battery storage, is essential to make intermittent resources viable" (Interview A, April 2026). Respondent D highlighted the practical infrastructure need by stating, "We need to make transmission for the transfer of energy, especially from remote renewable sites" (Interview D, May 2026). This shows that renewable energy financing depends not only on generation assets, but also on supporting infrastructure such as storage systems, transmission networks, and grid upgrades.

Respondent B reinforced that investors require confidence in technical integration, stating, "Without proper grid upgrades and storage, solar and wind projects cannot meet their performance or revenue expectations" (Interview B, April 2026). Official documents support this point. The RUPTL 2025–2034 identifies hybrid solar-wind systems, storage solutions, and transmission upgrades as necessary to meet Indonesia's 34.3% renewable energy target by 2034. IEA technical studies also emphasize that storage and smart grid management are essential to maintain system reliability as variable renewable energy increases.

These answers point to the fact that technical solutions are part and parcel of financial viability: integration lowers the risk of performance, stabilizes income flows and boosts investor confidence.

The operational and financial problems of project planning and risk management regarding grid constraints and renewable energy sources variability are mentioned by the stakeholders in all interviews. Especially in the case of geothermal projects, initial investment costs are high, and there are risks associated with exploration, meaning that government support, or blended finance solutions are required to attract investment. The interviewees also describe how hybrid energy systems, energy storage systems, and upgrading the energy grid are essential to ensure the output is stable, reliable and to allow the project to be economically viable overall.

The technical and infrastructure aspects are very closely linked to the financial and regulatory aspects, as can be seen in the knowledge acquired in this study, and the information which can be extracted from the official documents. A coordinated planning process, along with investments in grid modernization and support financing mechanisms, which are crucial in mobilizing private capital and are necessary for meeting Indonesia's renewable energy targets, will be needed for this.

4.3.4.4 Comparative Analysis: China, Vietnam, and Bangladesh

The technical and infrastructure dimension shows that renewable energy financing can only produce deployment outcomes when grid infrastructure is prepared to absorb renewable capacity. China has invested heavily in renewable energy capacity and is expected to contribute almost half of its electricity generation from renewable sources by the end of the IEA forecast period (IEA, 2024). But China also provides an example of the other side of the coin – fast capacity growth brings new challenges. The more wind and solar power enters the grid, the more important it becomes to make the grid flexible, install transmission infrastructure and reform dispatch.

Vietnam is indeed a good example of how infrastructure burden can be caused by the quick growth of renewable resources. The country upped its non-hydro renewable target to 21% of total installed capacity by 2030, although the target's effectiveness will rely on the readiness of the transmission grid and the ability to integrate with renewable energy systems into the grid (IEA, 2024). This indicates that policy incentives can be more appealing than the ability of the grid to take up the investment. Untimely upgrades to the grid may result in lowered project returns due to curtailment risk, delayed connection, and reduced dispatch certainty.

The technical challenge which Bangladesh is facing is different. The renewable energy model has been better for decentralised electricity access as off-grid and small-scale systems lessen reliance on national transmission facilities. This model has been found to be applicable in remote areas where expanding the grid is expensive. But the decentralized system has its own drawbacks, as it will not be able to deliver enough power for an industrial expansion or decarbonize a country. Thus, Bangladesh's experience reveals that decentralized renewable systems are technically constrained for large scale power transition, but are socially beneficial.

In Indonesia, there are some common characteristics with all three cases. Indonesia is experiencing geographical mismatch between the sources and load points for renewable energy, as in China. Indonesia is at risk of policies being more progressive than grids, as Vietnam was. However, even in the remote/highly archipelagic areas like in Bangladesh,

decentralized renewable electricity generation can be more appropriate than centralized generation in Indonesia. Thus, infrastructure development in Indonesia should be integrated by expanding the grid, storage, inter-island transmission planning, and decentralized in remote areas.

4.3.5 Opportunities and Support Mechanisms

Although challenges in the regulations, financing and technical capacity were mentioned by interviewees, the opportunities facing the development of renewable energy in Indonesia were consistently highlighted by the interviewees, especially in the form of support mechanisms and international programs that have emerged. Three sub-themes of the analysis of the interviews and the official documents are innovative financial instruments, international concessional finance and technical assistance, and domestic policy reforms to attract private investment.

4.3.5.1 Innovative Financial Instruments: Green Bonds, Sukuk, and Blended Finance

Respondent A and Respondent D talked about the new financial instruments that could help minimize renewable energy investment risks. Here, green finance is the term used for financial instruments and mechanisms that can help develop or fund environmentally sustainable projects, including green bonds, sustainability-linked loans, concessional finance, guarantees and blended finance. Respondent A explained, “Strengthening regulations and improving the banking environment… this will accelerate investment” (Interview A, April 2026). This is indicative of green finance being used to mitigate the perceived risk and to boost investor confidence. Respondent D pointed out that, “We bundle projects across different locations until they reach a total capacity of one gigawatt, making them more attractive to investors” (Interview D, May 2026). This is an example of the added value of project aggregation and structured finance to bankability, as it brings more scale, geography risk diversification and renewable energy portfolios to investors.

Respondent B stressed the importance of government-backed mechanisms, stating, “Investors require public ‘first-loss’ or guarantees due to high upfront risk” (Interview B, April 2026). This means that blended finance, using concessional loans, grants and guarantees, can help to de-risk investment and to catalyse private investment. This is also seen in the OJK regulation, namely POJK 18/2023 related to Sustainability-based Debt Securities and Sukuk as a regulation that regulates the issuance of green bonds, social bonds, sustainability bonds, and sustainability-based-linked sukuk, which are used to channel capital to environmentally sustainable businesses.

These opportunities are confirmed by the official reports. The continued growth of sovereign green sukuk and ESG bonds issuance in Indonesia, which will mobilize private

sector participation in renewable energy development, are mentioned in RUPTL 2025–2034 and World Bank assessment. The IEA analysed that structured financial instruments represent a key requirement to address the high CAPEX and long-term risk profiles of RE projects.

4.3.5.2 International Programs and Technical Support

Interviewees also highlighted the importance of international development institutions to deliver concessional financing and technical assistance. Respondent B noted, "The biggest [financier] is ADB… local banks? No. Zero" (Interview B, April 2026). This shows that domestic banks do not often finance renewable energy projects for the longer term without de-risking instruments, and that multilateral development institutions continue to play an important role in de-risking renewable energy projects by means of concessional loans, guarantees, project preparation support and technical assistance.

Respondent A noted that such support from international programs, including funding support and risk protection, contributes to closing financing gaps and offers technical support through "We can say like funding support, and risk protection" (Interview A, April 2026). Respondent D added that international collaboration helps transfer technical know-how and operational standards, stating that "energy projects benefit from structured partnerships and international support to reduce investment risk" (Interview D, May 2026). This indicates that there is a support for renewable energy financing through international development institutions, which goes beyond capital provision and involves strengthening of project preparation, risk mitigation and institutional capacity.

These views are confirmed by official reports. Concessional finance, technical assistance, and project preparation support are essential to de-risk renewable energy investment and speed up renewable energy deployment in emerging markets such as Indonesia, as mentioned in the documents of World Bank, IEA and JETP.

The scale of the required transition finance also supports the need for blended finance and risk-sharing instruments. The JETP Comprehensive Investment and Policy Plan estimates that Indonesia requires around USD 97.1 billion for the power sector transition pathway by 2030. Around USD 66.9 billion is linked to more than 400 priority projects, while the initial JETP package provides USD 20 billion. This financing gap shows that support mechanisms such as guarantees, concessional loans, project aggregation, and blended finance are necessary to improve bankability and attract private capital (*JETP, 2025*).

4.3.5.3 Domestic Policy Reforms to Unlock Private Sector Participation

Lastly, interviewees stressed the need for domestic policy changes for a maximum utilization of financial and external assistance. Respondent B remarked, "Bank prefer

conventional energy projects with more stable revenue streams and lower uncertainty" (Interview B, April 2026). This means that international finance will not be enough without clear domestic laws, convincing guarantees and a better banking system for renewable energy investments.

Respondent B highlighted practical bottlenecks by stating, "This needs central government involvement" (Interview B, April 2026). This shows that policy and social support is necessary to enable private participation and prevent local resistances – particularly in areas where the local economies rely on the current power plants. There are similar points in the official reports. Stable regulations, standardized contracts, and transparent permitting are prerequisites for effective mobilization of private capital as mentioned in the RUPTL 2025-2034 and OJK Sustainable Finance Roadmap.

Interviewees believe that de-risking renewable energy investments to draw in private capital comes at the heart of these innovative financial instruments such as green bonds, sustainability-linked sukuk and blended finance. The institution of international concessional finance and technical assistance, including from ADB, JETP and the World Bank are a key to finance gaps and domestic technical capacity. Coherent regulations and transparent permitting processes, along with alignment with social priorities, are also key domestic policy reforms to unlock sustained private sector participation, stakeholders note. These inputs, along with the official reports, indicate that there are real possibilities in financial instruments and international programs, but that these may be limited by the lack of adequate domestic policy, regulation, and institutional capacity to put them into practice and mobilize investments. To assess the extent of achieving target goals and sustainable development outcomes.To evaluate target achievement and sustainable development outcomes.

4.3.6 Target Achievement and Sustainable Development Outcomes

RE capacity achievement is closely associated to the Government of Indonesia's other sustainable development goals, including SDG7 (Access to clean energy), SDG8 (Economic growth and employment) and SDG13 (Climate action). The three key themes from the interviews with PLN, MEMR, OJK and the academic/ADB expert, as well as from official documents such as RUPTL 2025-2034, NDC reports, and World Bank/IEA studies are changes to RE targets, economic and social benefits of financing flows, and policy clarity and risk mitigation.

This is because the level of renewable energy results falls short of the targets set, demonstrating the need for greater financing implementation to deliver sustainable development outcomes. In 2025, the realization of Indonesia's renewable energy was

15.75%, whereas it was supposed to be 23%. This shortfall limits the speed at which renewable energy can contribute to SDG 7, SDG 8, and SDG 13 through clean electricity access, employment creation, investment growth, and emission reduction (Iea, 2025).

4.3.6.1 Revisions to RE Capacity Targets

Target adjustments were identified as a problem in interviews, where renewable energy targets are frequently changed due to regulatory, technical and financial limitations. In this case, the term ‘target adjustment' means changes to renewable energy timelines or percentages to account for implementation challenges, funding constraints, grid capacity and policy changes. Respondent A clarified that, “So, it does not mean that we failed to achieve the target. Instead, the target has been revised. Create a new Target from 2025 and 30 2034., and the target remains very ambitious.” (Interview A, April 2026). This is an example of how revisions of the targets may not be interpreted as a failure of policy, but rather as necessary adaptations for implementation.

Respondent D confirmed the operational challenge by stating, “Changes in regulations should not overlap with one another, because business certainty is highly sensitive to regulatory changes” (Interview D, May 2026). This underscores the need for regulatory delays and over-lapping rules to be recalculated of renewable energy capacity targets. Respondent B also emphasized the financial dimension, stating, “Investors require public ‘first-loss’ or guarantees due to high upfront risk” (Interview B, April 2026). This shows that the level of readiness of private investment is directly related to the speed of renewable energy target achievement.

These assertions are backed up by official reports. RUPTL 2025–2034 originally established a 2030 RE goal with capacity of 20.9 GW but reduced it to 18.6 GW due to financing and grid constraints, as an example of the connection between policy, investment, and actual capacity. Likewise, the IEA and the World Bank emphasise that financial flows, grid preparedness and regulatory certainty should go hand in hand in order to achieve national RE targets.

4.3.6.2 Economic, Social, and Environmental Benefits

There was a unanimous view amongst the interviewees that funding of renewable energy projects can have positive implications for both the economic and social. Economic and social outcomes here are defined as the generation of employment, local income generation, energy access and other community development outcomes. Respondent A noted, “Green jobs around 760k” (Interview A, April 2026), reflecting the potential for renewable energy projects to create employment opportunities. Respondent D also highlighted local development implications by stating, “Local governments say, ‘If you stop that power

plant, what about us?'… This needs central government involvement" (Interview D, May 2026). This indicates that energy projects are closely linked to local income, regional development, and community-level economic stability.

Respondent B stressed broader benefits, stating that "renewable projects may create new employment opportunities, improve technological development, and strengthen long-term energy security" (Interview B, April 2026). This indicates that financing of renewable energy projects is not only relevant for the development of the projects themselves, it is also relevant for other sustainable development objectives. These include economic growth, environmental benefits (including CO_2 reduction) and electricity access in remote areas in line with the SDG 7, SDG 8 and SDG 13 commitments of the Republic of Indonesia.

Official reports corroborate these observations. RUPTL 2025–2034 and World Bank studies note that investments in RE not only expand installed capacity but also generate local employment, reduce reliance on fossil fuels, and improve energy security. CREA reports also highlight that RE deployment provides measurable environmental benefits, supporting national climate targets.

4.3.6.3 Clear Policies and Risk Mitigation Mechanisms

Policy clarity and risk mitigation were identified as key factors to achieve renewable energy targets and sustainable development outcomes by all interviewees. Respondent A highlighted, "Strengthening financing schemes and risk mitigation are necessary to accelerate investment" (Interview A, April 2026). Respondent B also said, "Without guarantees, policy certainty, or supportive regulations, banks prefer conventional energy projects with more stable revenue streams and lower uncertainty" (Interview B, April 2026). This evidence indicates that, in addition to the availability of capital, financing renewable energy depends on regulations, credible guarantees and risk sharing mechanisms that would bring private capital.

The interviewees all clearly state that renewable energy (RE) targets often undergo changes due to regulatory, technical and financial constraints, but this does not mean it is a failure. Inflows and outflows of financing in the sector help economic growth, create jobs in local areas, increase electricity access and provide environmental benefits such as reduced CO_2 emissions. Stakeholders emphasize the need for effective risk mitigation mechanisms and clear and enforceable policies to increase the chances of meeting national RE targets and sustainable development goals.

This, in addition to what was obtained from the official documents, shows that sustainable development results go beyond investment, requiring coordination of policies, strong

institutional capacity and a comprehensive risk management. A holistic approach that creates a framework of renewable energy deployment in Indonesia as a whole by combining aspects of finance, technology and regulation with long-term national goals.

4.3.6.4 Comparative Analysis: China, Vietnam, and Bangladesh

Sustainable development outcomes of financing renewable energy is varying between the three countries.The sustainable development outcomes of renewable energy financing are varying between the three countries. China has the best economic and industrial result. Its commitment to renewable energy has enabled it to expand manufacturing, promote the development of technology, create jobs and enhance competitiveness in exports. By 2028, China's share of new renewable energy capacity put online will be nearly 60% of the world's total, and China is projected to meet its country goal for wind and solar PV six years early (IEA, 2024). This demonstrates that financing for renewable energy can be part of an overall economic transformation if combined with industrial policy.

Vietnam demonstrates an outcome for transition. It has helped to move power planning away from coal through the development of renewable capacity targets for non-hydro renewables and the phase-out of planned coal capacity. But the long-term outcome of sustainable development is not guaranteed as Vietnam still needs to work more on the investment grid, tariff design, and long-term procurement procedures. Hence, Vietnam demonstrates the capability to rapidly ramp up capacity through financing renewable energy, but the long-term economic and environmental impacts will rely on whether this type of system can sustain financing after the incentive period.

The outcome of social development is more visible in Bangladesh. Electricity access and rural welfare are the key aspects of the major contribution of renewable energy financing in the country of Bangladesh. The IEA (2024) states that electricity access reached 85% in recent years up from 20% in 2000. That suggests that financing renewable energy can help enhance social inclusion when it is decentralized and affordable. But the positive side of the story is that access improvement does not equate deep decarbonization in Bangladesh, where the power system is still very reliant on gas and other conventional sources.

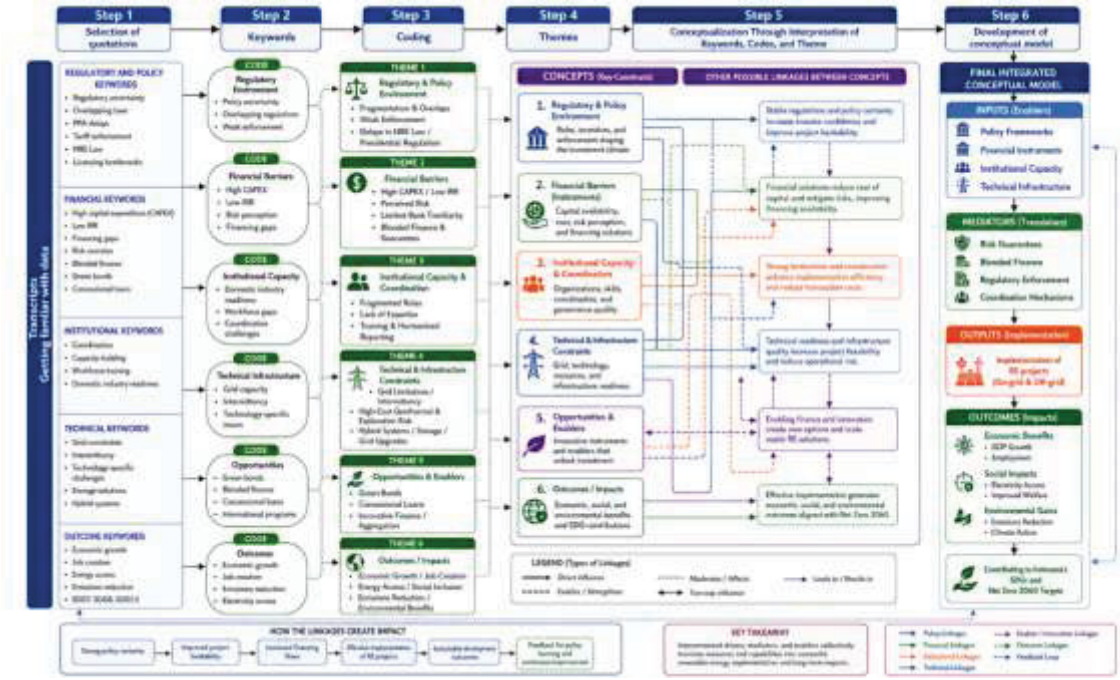
These three outcomes offer varying policy messages for Indonesia. China demonstrates how financing for renewable energy can help spur industrial development if Indonesia builds domestic supply chains and long-term financing. Vietnam has demonstrated that investments can drive up capacity expansion, provided the procurement and grid systems stay constant. If decentralized energy is channeled to rural areas, Bangladesh demonstrates how renewable finance can have a positive impact on social inclusion. Thus, Indonesia should not use installed capacity or emission reduction as a measure of sustainable

development outcomes. It should also look at employment, energy access, energy regional equity and energy security as mutually connected but distinct outcomes.

4.4 Conceptual Model

Figure 4.1 presents the conceptual model developed from the thematic analysis. The model shows how renewable energy financing is linked to sustainable development outcomes in Indonesia's electricity sector. It connects data from interviews, official documents, and statistical evidence with key themes such as regulation, financing instruments, institutional capacity, technical infrastructure, risks, and development outcomes.

Figure 4.1 Conceptual Model



Source: Developed by the Researcher(2026)

The conceptual model in this study depicts conceptualized pathways of Renewable Energy (RE) financing and its contribution to sustainable development (SD) in the country. It is based on thematic analysis of various data sources such as interviews with PLN, MEMR, OJK and an academic/ADB expert, official documents and statistical evidence. The model exhibits a strong connection between raw data, new insights and policy and investment action.

The model begins with the raw data from documents, reports, interviews and statistics which are analyzed to form initial codes at the foundation. The codes are focused on a number of factors, including policies and regulations, funding mechanisms, institutional barriers, and what has been observed. These codes are organized into higher order categories, based on theme development: regulatory environment, financing instruments

and sources, barriers and risks, institutional capacity, technical infrastructure, and outcomes.

These themes are then brought together into ideas which explain the mechanisms of RE financing. Key concepts which are mentioned are the availability and accessibility of finance, risk allocation and mitigation, institutional effectiveness and sustainable contribution to development. These concepts are then interpreted using the thematic analysis process to elicit the assertions or key findings on the influence of the policy framework, financial instruments and institutional arrangements of Indonesia on project bankability and sustainable outcome.

The final integrated model visually and conceptually links these elements. It helps to understand the conditions or inputs that are required to make RE projects successful, such as policy, financial, institutional and technical infrastructure. Risk guarantees, blended finance, regulatory enforcement, and coordination are some of the mediators that bridge these inputs and bring effective project execution. This results in outputs which are implementation of RE projects on-grid and off-grid. Finally, these outputs produce outcomes, such as economic outcomes (GDP growth, employment), social outcomes (electricity access, improved welfare), and environmental outcomes (emissions reduction, climate action), which all help to deliver results towards the SDGs for and the Net Zero 2060 for Indonesia.

Causality is also emphasized in the model, as stable regulations and risk mitigated financing make prjects bankable, institutional capacity and technical readiness facilitate effective implementation, and investment flows result in tangible and measurable contribution to SDG. The model offers an analytical clarity and actionable guidance for the policy makers, investors and development institutions who want to scale up renewable energy in Indonesia by connecting the elements of raw data with codes and themes, concepts and assertions to an actionable framework.

Overall, the conceptual model is supported by both qualitative and quantitative evidence. The interview findings show that renewable energy financing is shaped by policy uncertainty, investment risk, institutional capacity, technical constraints, and project bankability. The quantitative evidence strengthens this interpretation: Indonesia's renewable energy mix reached only 15.75% in 2025, realized renewable energy investment reached around USD 1.5 billion in 2023, and the JETP power sector transition pathway requires around USD 97.1 billion by 2030. These figures confirm that financing remains a core condition for translating renewable energy policy into sustainable development outcomes (*ESDM,2025* ; *IEEFA, 2024* ; *JETP, 2025*).

4.5 Cross-Country Analytical Synthesis

Comparing the financing models of China, Vietnam and Bangladesh, reveals that there is no one- to-one renewable energy financing model that can be directly replicated in Indonesia. Construction of a Chinese model is solid with regard to scale, as the state is actively involved in investment, planning, and coordination of industry. But continued reliance on coal indicates that the expansion of renewables is no magic bullet that eliminates fossil fuel lock-in. The model works well in Vietnam to mobilise private capital by incentivising it, but is susceptible to policy change and grid constraints. The Bangladesh model is good for social inclusion and for providing access in the rural areas but not well suited for decarbonization of the electricity sector on a large scale.

The principal take-away message for Indonesia is to make renewable energy financing a package. Capital will be cheaper if state-backed de-risking takes place. It is necessary to attract additional funds from private investors by private investment incentives. A decentralized financing approach is needed to reach remote and underserved areas. There needs to be an investment in the grid in order to ensure that financed projects are able to supply electricity. The problem of funding is not just a funding gap, but also a coordination gap, among policy, financing, institution and infrastructure in Indonesia.

Thus, a combination of both is the most suitable solution for Indonesia. Indonesia can learn from China on how to implement a consistent policy at the state level and long-term planning. Indonesia can learn from Vietnam the value of transparency in providing tariff and procurement measures for private investors. Bangladesh can draw lessons from Indonesia on the significance of inclusive financing for the rural and remote areas. These lessons, however, need to be shaped according to the institutional context in Indonesia, particularly the central role of PLN, the archipelagic context, and the need for balancing utility-scale renewable energy and decentralised energy.

4.6 Discussion

This section presents the results of the study based on the three research questions of the study. The discussion is arranged to clarify and make the answers to each research question systematic. The first discussion is about the existing financing mechanisms of renewable energy in Indonesia. The second discussion, which is related to sustainable development outcomes, explains how renewable energy financing is related. The third discussion provides an explanation of policy frameworks and measures that need to be adopted to reinforce financing for renewable energy in Indonesia.

It is important to note that this study does not employ the econometric or statistical causal definition of impact. In this study, which adopts qualitative analytical approach with

secondary quantitative data, outcome is considered as the relationship that has been observed and interpreted between renewable energy financing, deployment of renewable energy and indicators of sustainable development. Therefore, quantitative data are employed to support the discussion and to provide empirical evidence, but not to measure cause and effect.

4.6.1 Renewable Energy Financing in Indonesia

The first research question is about the current financing mechanisms for renewable energy in Indonesia. The results indicate that public finance, concessional loans, international development finance, blended financing and private investment via independent power producer schemes continue to play a major role in financing renewable energy in Indonesia. Domestic commercial banks have come out of their shell to invest in renewable energy projects, but the involvement of these institutions is still restricted as renewable energy projects are still considered risky. High initial capital cost, long payback periods, uncertainty in power purchase agreements, regulatory changes and limited project preparation capacity are responsible for this risk.

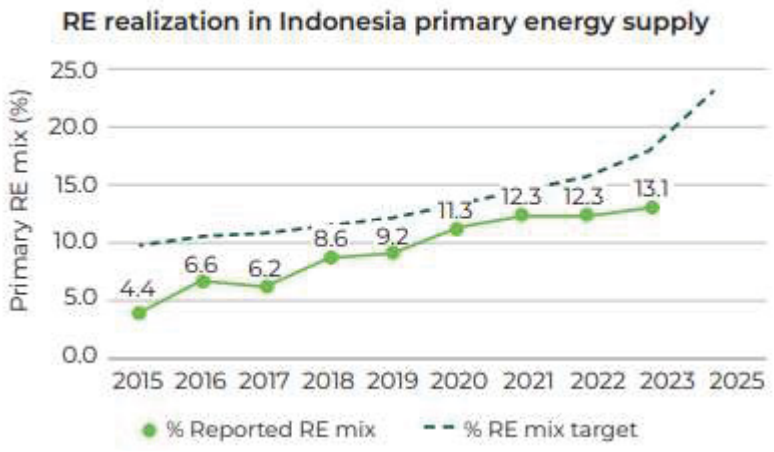
Financial requirements are very high in relation to the realization of investments. According to the Just Energy Transition Partnership (JETP Secretariat and Working Groups 2023), Indonesia requires at least US$97.1 billion to deliver the pathway to the power sector transition between 2023 and 2030; and at least US$580.3 billion between 2023 and 2050. This shows that the initial US$20 billion JETP commitment is important, but it is still not sufficient to meet the whole financing requirement. Thus, the financing of renewable energy in Indonesia is no longer just based on public funding or international commitments in financing but must be accompanied by increased funding from private funds and greater domestic financial participation.

Local project evidence also shows that renewable energy financing in Indonesia is developing but still depends on project bankability. The Cirata 145 MWac floating solar project is one important example because it shows how renewable energy projects can attract private investment when the power purchase agreement and risk allocation become clearer. The JETP CIPP mentions Cirata floating solar as an example of PLN's progress in improving PPA bankability to attract private finance (JETP Secretariat and Working Groups, 2023). The expansion plan of Cirata floating solar up to 500 MW between PLN Nusantara Power and Masdar also shows that floating solar has potential to become one of the important financing opportunities in Indonesia.

Other solar projects also explain the development of renewable energy financing. The Bali 2x25 MWp solar project signed in March 2022 showed that solar PV PPA prices decreased

by 78% between 2015 and 2022, from 0.25 US$/kWh to 0.056 US$/kWh. The Hijaunesia I auction, the Bangka 10 MWp solar project, the Bali 2x25 MWp project, and the Cirata floating solar project are part of a pipeline of eight solar projects with a total capacity of 585 MWp (JETP Secretariat and Working Groups, 2023). This indicates that financing conditions can improve when procurement is clearer, project pipelines are available, and tariff structures become more predictable.

Fiuger 4.2 Renewable Energy growth in Indonesia



Source: IESR et al., (2023)

But, the financial challenge remains evident in geothermal projects. Indonesia has geothermal resources and reserves of approximately 23 GW, however, geothermal projects are challenging to finance due to its high exploration risk, long development times and high initial costs. The development and construction of geothermal and large hydro projects can be 6-10 years; investment cost for geothermal can range to US$4 million to US$5 million per MW (JETP Secretariat and Working Groups, 2023). This is the reason geothermal financing needs more robust risk mitigation mechanisms like government drilling support, concessional financing, guarantees and transparent PPA arrangements.

As such, the response to Q1 is that various financing instruments such as public finance, private investment, concessional loans, blended finance, development finance, and emerging green finance instruments are used to finance renewable energy in Indonesia. However, the financing system is still not robust enough as many projects remain non-bankable and the risk associated with regulation, procurement, grid connection and project implementation remains high for investors.

4.6.2 Renewable Energy Financing and Sustainable Development Outcomes

The second research question is what is the contribution of the financing of renewable energy to sustainable development outcomes? The results indicate that the financing of renewable energy has a relationship with outcomes of sustainable development in three

main dimensions: economic outcomes, social outcomes and environmental outcomes. The results are interpreted as evidence-based contributions, however, and not as statistically measured impacts.

On the economic front, de-risking of renewable energy is achieved by enabling investment activity, infrastructure development, employment and energy security. With financing, renewable energy projects can make a transition from planning to building and using energy. With the development of renewable energy projects, economic activities will be in construction, engineering, project services, equipment supply, operation and maintenance. In addition to energy transition, Indonesia's energy transition can also minimize exposure to fossil fuel imports and benefit the country's economic development long-term, according to the IEA. The prospect of Indonesia's net zero roadmap is that its oil import bills could decrease by 33% in 2030 from the business-as-usual scenario (IEA, 2022). This demonstrates the linkages between financing renewable energy and energy security and macro-economic resilience.

This economic argument is backed up by the local project evidence. The Cirata floating solar project demonstrates that the project structure can be bankable and thus private investment can be mobilized. Competitive procurement can lead to lower tariffs on solar energy, as demonstrated by the Bali 2x25 MWp project. The Tanah Laut wind project also demonstrates how prices for wind power have fallen; the PPA price is $0.055/kWh, however, according to the JETP CIPP very low bids can raise questions about commercial bankability if the project economics are not realistic (JETP Secretariat and Working Groups, 2023). So, financial solutions for renewable energy can impact economics, but they need to be backed by realistic costs, appropriate risk management, and project readiness.

Renewable energy financing is linked from the social perspective to energy access, welfare improvement and regional equity. Despite the significant progress in electrification, there are still disparities between urban and remote/archipelagic areas in terms of access and reliability. Renewable energy financing can benefit social development by not only being allocated to large grid-connected renewable energy projects, but also by being directed to decentralized renewable energy technologies, including solar, mini hydro, biomass and hybrid systems. These systems are vital in remote locations where it is hard to extend the grid and diesel generation is costly.

In addition, the JETP CIPP also identifies solar de-dieselization projects in several areas, including Maluku, Papua, Nusa Tenggara, Sulawesi, Sumatra, Kalimantan, and Java-Madura-Bali (JETP Secretariat and Working Groups, 2023). The importance of these

projects lies in the fact that they can help lessen reliance on diesel power plants in remote systems and contribute to cleaner access to electricity. It is not only a matter of how much financing is provided, but where and what projects are financed, that determines the social nature of the financing for renewable energy.

Environmentally, renewable energy financing helps increase the generation of low carbon electricity and decreases reliance on the use of coal, diesel, and gas power in the future. The electricity sector in Indonesia is still dominated by fossil fuels and financing for renewable energy is important for climate mitigation. According to the JETP CIPP, the need for additional capacity for dispatchable renewable energy until 2030 is estimated at 16.1 GW, at a cost of up to US$49.2 billion. To achieve variable renewable energy acceleration, an additional 40.4 GW of capacity is needed by 2030, at up to US$25.7 billion of investment costs (JETP Secretariat and Working Groups, 2023). The numbers illustrate that environmental results are contingent upon the capacity to secure the mobilisation of finance on a large enough scale.

The project evidence also shows that environmental outcomes are not only about installed capacity, but also about project design. The Cirata floating solar project supports low-carbon electricity generation without requiring large land areas. Geothermal projects such as Rajabasa 220 MW show the importance of dispatchable renewable energy because geothermal can support baseload electricity. Hydropower projects such as Batang Toru 510 MW show renewable potential, but also indicate that environmental and social safeguards remain important because renewable projects may also create ecological and local impacts if not properly managed (JETP Secretariat and Working Groups, 2023).

Hence, the answer to the second research question is that financing for renewable energy has various economic, social and environmental impacts which can be used to achieve sustainable development goals. Economically it facilitates investments, tariff reductions, energy security and project development. Socially, it enables access to electricity, equity in the region, and minimizes use of diesel in remote locations. It facilitates the potential for fossil fuel replacement and emission reduction from an environmental perspective. But these impacts are still small, due to a lack of scale in financing, inadequate project preparation, and insufficient grid infrastructure as well as fragmented institutional coordination.

4.6.3 Policy Frameworks and Measures to Strengthen Renewable Energy Financing

The third research question is what policy frameworks and measures should be adopted to foster the financing of renewable energy in Indonesia. The results reveal that funding alone does not provide a way to strengthen renewable energy financing. It is also necessary to

have regulatory certainty, improved allocation of risks, financial instruments, institutional coordination and infrastructure readiness.

The first is to increase the bankability of PPA and the transparency of the procurement process. It was concluded that investors are looking for stable incomes and a well-defined contract. For the PLN, although there has been some improvement in the bankability of PPA such as in the Cirata floating solar IPP, there is still potential for further improvement to reduce financing costs and boost investor confidence (JETP Secretariat and Working Groups, 2023). As a result, the risk allocation, payment security, curtailment and termination clauses and procurement procedures should be improved in PLN.

The second measure is the scale up of blended finance and concessional finance. Unattractive upfront costs and long payback periods can be associated with renewable energy projects, like geothermal, hydropower, transmission and early-stage solar projects. Public or concessional funding of infrastructure projects should thus be utilized to share the risk of private investors that cannot be borne alone. These may comprise of exploration guarantees, political risk insurance, viability gap financing, credit enhancing and concessional loans.

The third measure is to move towards a more robust domestic green financing. Commercial banks, OJK & institutional investors require the capacity to enhance the risk assessment of renewables and to create long term financing products. If domestic finance is not strengthened, then Indonesia will continue to be dependent on international finance development. Clearly defined project pipelines and credible reporting frameworks are needed to support green, green 'sukuk', and sustainability-linked instruments to mobilize domestic funds.

The fourth measure is to make more investments in grid and transmission. Renewable energy financing shouldn't just be for power generation projects; generation can't be absorbed without readiness of the grid. Electricity network investment in Indonesia is estimated to be between 3–4 times that amount annually by 2030, growing to a total capital expenditure of 50–80 times that amount by 2040, with over 80% of the investment going into transmission (JETP Secretariat and Working Groups, 2023). This clearly demonstrates that the grid infrastructure is a key enabler for renewable energy finance to successfully translate into deployment.

The fifth is putting in place measures to ensure that financing of renewable energy has a positive impact on the just transition outcomes. However, the IEA makes it clear that while much can be gained from the clean energy transition in Indonesia, policy reform and people-centred transition options are required, particularly for coal transition impacted

areas and workers (IEA, 2022). Hence, there is a need to link financing of renewable energy with transition of jobs, reskilling, development of local industries and diversification of regional economies.

Hence, the answer to the third research question is that what is needed in Indonesia is an integrated policy framework that makes renewable energy projects bankable, lowers investment risks, optimizes PLN procurement and grid planning, mobilizes domestic and international financing, and links financing to just transition goals. The policy direction should shift from the target to the operational instrument in which the role of government, PLN, financial institutions, developers and international partners are clearly specified.

4.6.4 Integrated Discussion: Root Cause and Causal Mechanism

The mismatch between the renewable energy targets, financing structures, institutional capacities and infrastructure readiness are the root cause of the financing problem for renewable energy in the Indonesian market. Despite the huge potential and targets of renewable energy, Indonesia's electricity system remains very much reliant on coal-based generation, centralized procurement process, and financing by project. This puts the appearance of riskiness on renewable energy projects despite the continued drop in the technology cost of renewable energy.

There are several stages in the causal mechanism. First, there is regulatory uncertainty, and the procurement rules are not well understood, which adds to the perceived risk for investors. Second, the higher the perceived risk, the higher the required return will be and the cost of debt. Third, higher cost of capital decreases the bankability of projects. Fourth, lack of bankability means delayed financial close and project implementation. Fifth, renewable capacity addition is constrained by slow implementation of projects. Lastly, there is insufficient renewable capacity to offer broader economic, social and environmental benefits.

The evidence of the project in Indonesia confirms this mechanism. The floating solar Cirata demonstrates that improved PPA bankability can draw private funding. The lower solar tariff as seen in Bali 2x25 MWp reflects the clearer procurement. Geothermal projects demonstrate that more de-risking tools are needed in terms of the high upfront cost/s and the exploration risk. The transmission projects demonstrate that grid investment must go hand in hand with financing renewable generation. Renewable energy financing can only therefore be a driver for sustainable development goals when it is backed up by policy credibility, institutional coordination and infrastructure readiness.

In terms of percentage representation this study does not use percentages as statistical representation of respondents as the research design is qualitative. If percentages or

numerical data are used, they are used as descriptive secondary indicators or simple support for the themes, not as inferential evidence. Therefore, the emphasis is on the meaning of the themes, the consistency of stakeholder perspectives, and the support from secondary data rather than statistical generalization.

4.6.5 Financial Barriers and Investment Risks

The results show that high capital expenditure (CAPEX), low internal rate of return (IRR) and perceived technological risk remain as the deterrents for private funding of renewable energy projects. For power technology, CAPEX varies among the technologies in the Indonesian power sector. According to the Indonesian Technology Catalogue 2024, the investment cost of utility scale ground-mounted solar PV is estimated at USD 0.96 million/MW in 2023, onshore wind is estimated at USD 1.65 million/MW in 2023, and biomass is estimated at USD 2.07 million/MW in 2023 (*ESDM, 2025*). Further, capital costs of supercritical coal power estimated at approx. USD 1.55 million/MW are lower or competitive when compared with recent gas combined-cycle projects. Asian Development Bank, (2020), for example, found that Jawa 2 CCGT project cost approximately USD 0.54 million/MW, and Jawa 1 CCGT project cost approximately USD 1.02 million/MW. As can be seen in this comparison, renewable energy does not necessarily cost more per MW than coal (particularly solar PV). But the financing risk of renewable energy projects is also perceived to be higher, as the revenue is dependent on resource availability, grid connection and the PPA terms, and investor confidence in long-term regulation (*PLN, 2025*).

Bankability is also impacted by the worry over IRR. According to IESR's financial modelling for 2025, renewable energy projects are feasible if their project IRR is greater than WACC. It adopts as a benchmark a WACC of 6.96% and observes that acceptable IRR benchmarks for renewable energy are in the range of 6 to 10% for low-risk projects and can be greater than 15% for higher-risk projects. This could result in projects that are technically possible but have uncertain revenues and/or weak guarantees and high development risks going unattractive to private investors. In Indonesia, solar PV projects that can achieve an EIRR of more than 10% are found in specific regions while the projects that result in an EIRR between 6.96% and 10% are found in moderate regions. This aligns with an empirical observation, that investors and banks are still very picky, and are interested in projects with higher cash-flow security (IESR et al., 2023).

In this context, technological risk is a type of risk which is specific to the project and includes several risks. Investors in solar PV could be concerned about the variability of resources, grid curtailment, degradation of panels, land limitations, the cost of local content requirements, anchoring of floating solar and the cost of floating solar. The key

uncertainties for wind energy are insufficient local experience of installation, wind resource assessment, turbine performance in local conditions, grid stability and the need for reliable wind power forecasting (Egli, 2020). Indonesia has few experiences in wind deployment and consequently, data on costs and performance are lacking, as mentioned in the Indonesian Technology Catalogue. Technological risk is tied to an exploration risk for geothermal projects as substantial investments can be made before a commercially viable steam resource is verified. With biomass there are risks related to the availability of feedstock, quality of feedstock, logistics, and price volatility. They can impact the generation output, operating costs, debt-service capacity and long-term project returns, making these risks more a concern for lenders (Halimatussadiah, Kruger, Wagner, Afifi, Lufti, et al., 2024b).

So, the traditional financial parameters, including the collateral value, DSR, repayment certainty, strength of the sponsors, and proven cash flows, are still the top concerns of domestic banks. According to the financial model of IESR, the project appraisal of renewable energy is dependent on capital, revenue, operating cost, size of the loan, financing cost, DSCR, WACC, EIRR, PIRR, NPV, payback period and profitability index. That is why banks might want to stick with traditional fossil fuel or existing infrastructure projects, with technology performance, fuel supply contracts and revenue structures more familiar. The empirical results thus show that in addition to lowering CAPEX, the quality of risk-sharing instruments, the guarantee, the PPA structure, and the quality of technical data to reduce lender and investor uncertainty are also important factors in improving renewable energy financing in Indonesia (Polzin, 2017).

Not to mention that renewable energy comes with a high upfront investment, it is also a barrier. The problem is that banks are making comparisons between CAPEX and a less sure revenue, the performance of the technology, and less robust guarantees. This renders some renewable energy projects unappealing in comparison to the conventional energy investments, even if long-term generation costs are competitive.

This discovery is in favor of Green Finance Theory as Green Finance is supposed to fill the risk-return deficit that deters private investors and invest in green projects. Renewable energy projects in Indonesia tend to have high upfront costs, long pay-back periods, regulatory uncertainty and technological risks. All these factors have put private investors and commercial banks on their guard. Hence, the need for green finance instruments, which enhance the bankability of the project by reducing financial risk, building the investors' confidence and making renewable energy projects more appealing than traditional energy investments.

The empirical findings show this relationship clearly. Respondent B commented that the reason for providing public “first-loss” support or guarantees for renewable energy projects is that there is a high risk for investors at the beginning of the project. This implies that private investors are more inclined to get involved if some portion of the loss risk falls on public institutions, development banks, or concessional finance providers, as both OECD (2021) and Iea (2025) reports indicate. Respondent D also described how project aggregation can make a project bankable, that is, increase the size of the project to an investment level that the banks are more comfortable with. This decreases the risk in the location and improves the investment portfolio for institutional investors (World Bank et al., 2024).

This is because blended finance is a key element in the relationship, which includes public, concessional, and private funding. Using public or concessional funds to take higher risk positions, such as first-loss capital, guarantees or below-market loans. This limits the risks for the private investors and promotes them to invest commercial capital (OECD, 2025). This aligns with the IEA's call for greater investment in clean energy in emerging and developing economies, and the necessity of "concessional finance, guarantees and risk-sharing tools to mobilize private capital at scale" (Iea, 2025).

Government guarantees also lower the risks of investment, increase confidence in project revenues and repayment. Investors may be concerned of off-taker risk, delay in payment, uncertainty of tariff rate, and changes in policy in a renewable energy project. Lenders or investors can be insured to some degree against these risks with a guarantee. This can lead to banks being more credit-worthy and the cost of capital (World Bank et al., 2024). The OECD (2021) further highlights the need for India to increase its policy interventions and investment structures to scale up clean energy finance and mobilize private investments.

Concessional loans can help reduce the costs of borrowing and the length of time to pay back loans and facilitate funding for renewable energy. It's crucial because renewable energy projects must have a significant amount of capital cost up front and then receive a trickle of revenue over the life of the project. With lower cost loans, the project has a better internal rate of return, and better debt-service capacity (Gandhi, 2020). The thesis results also reveal that, without de-risking support, renewable energy investments are hardly financed by domestic banks; multilateral banks like the Asian Development Bank and the World Bank are very significant sources of financing, as well as for the provision of guarantees, technical assistance and project preparation support (*ADB, 2025*).

Green bonds and sustainability linked sukuk do not operate the same way. They support mobilisation of capital market investors by effectively connecting debt towards the

activities that are environmentally sustainable. POJK 18/2023 is the regulation in Indonesia that gives the framework to green bonds, green sukuk, social bonds, sustainability bonds and sustainability-linked bonds. The framework enables any issuer to raise capital for sustainability-related projects - such as renewables (*OJK , 2025*).

Hence, the link becomes apparent: Green Finance Theory is the one that provides the understanding of the necessity of financial innovation; the empirical results, on the other hand, demonstrate how these instruments can alleviate the risk in practice. Blended finance is risk sharing of the early-stage risk. Government guarantees decrease the off-taker and repayment risk. Concessional loans lower the cost of capital. Green bonds and sukuk help to diversify funding sources for sustainability. These instruments can be used in combination to transform renewable energy projects into bankable projects (OECD, 2025). In line with the studies conducted by the World Bank and Asian Development Bank (ADB), the results indicate that financing obstacles for renewable energy in Indonesia are closely related to financial obstacles but are not only financial but also related to regulation, technical constraints and institutional weaknesses (*ADB, 2025* ; World Bank et al., 2024).

CHAPTER 5
CONCLUSION, RECOMMENDATIONS, AND LIMITATIONS

5.1 Conclusion

This study aimed to explore the contribution of renewable energy (RE) financing towards sustainable development in the Indonesia Electricity Sector. The research was conducted using qualitative analysis method based on the MAEEM approach, which involved analyzing real data from interviews with the various stakeholders involved such as MEMR, PLN, OJK, and an academic/ADB expert, as well as official policy and financial documents. The results reveal that financing for renewables is not just a matter of finances, but also of regulation, institutions and technologies, making it a critical issue that affects Indonesia's capacity to achieve sustainable development goals and the national energy transition targets.

Research Question 1: How is renewable energy currently financed in Indonesia?

The results indicate that financing renewable energy in Indonesia is done by using a mix of public finance, private finance, financing through concession, financing through blending, financing through green bonds, financing through green sukuk, and international climate financing. Government institutions also have significant influence on financing structures through energy planning, the regulatory framework and sustainable finance policy, namely forms of energy planning and energy regulation by MEMR, PLN, and energy financing policy by OJK. International institutions like ADB, the World Bank and JETP also participate and provide funding support and technical assistance.

But even with the provision of several financing mechanisms, the investment is still modest in terms of the country's needs. In 2023, investment in renewable energy was estimated in the range of USD 1.5 billion, and this is much lower than the investment estimated to be needed in 2030 which is USD 285 billion to reach Indonesia's energy transition target. This reflects significant financing shortfall and limited involvement of domestic financial institutions due to perceived high risk, regulatory uncertainty and poor project bankability.

Research Question 2: How does renewable energy financing contribute to sustainable development outcomes?

The findings of this study demonstrate that the financing of renewables can be a driver towards sustainable development from three perspectives: economic, social and environmental.

Economically, financing for renewable energy delivers energy security, job creation, development of renewable energy infrastructure and growth of investment. Socially, renewable energy financing enhances access to electricity, especially in remote and less

accessible places, and helps to increase welfare. In addition, renewable energy financing is also environmentally friendly, as it helps lower greenhouse gas emissions and dependence on fossil fuels to support Indonesia's climate change commitments under SDG 13.

The study also reveals that these contributions are hampered by the still relatively small size of investments, a slow pace of project realization, and structural constraints in the electricity sector. This illustrates that funding is not enough, in absence of robust institutional and regulatory support.

Research Question 3: What policy frameworks and measures can strengthen renewable energy financing in Indonesia?

The research finds that improving financing for renewable energy in Indonesia needs to be done in a comprehensive manner, both in the regulatory, financial, institutional, and technical aspects.

From a regulatory standpoint, policies must become more stable and clearer, and tariff structures must become more simplified, as well as power purchase agreements (PPAs) being put into place and legally binding. Certainty of regulation is key to decreasing investor risk and making projects bankable.

Financially, there is a need to mobilise private capital and minimise investment risks through the expansion of blended finance mechanisms, government guarantees, concessional loans, and green financial instruments like green bonds and Sukuk.

Institutional framework, the coordination between the institutions related to energy marketing and security, such as MEMR, PLN, OJK, etc., is needed to minimize the fragmentation and increase implementation of energy marketing policy. There is also a need for capacity building of financial institutions and technical actors to enhance their understanding on renewable energy investment risks and project evaluation.

From a technical perspective, infrastructure improvements such as grid modernization, energy storage systems, and hybrid renewable energy systems are required to support large-scale renewable energy integration.

5.2 Recommendations

This study suggests making the recommendations more operational, it should be explained the role of each actor in strengthening renewable energy financing in Indonesia in the form of an action matrix. The matrix is significant because no single institution can enhance the financing of renewables. This needs to be coordinated among government, PLN, financial regulators, commercial banks, project developers, international development partners and academic institutions.

Table 5.1 Recommendations

Actor	**Main action**	**Expected outcome**	**Indicator**	**Indicator**
Ministry of Energy and Mineral Resources (MEMR)	Strengthen regulatory certainty and policy consistency	Finalize and harmonize renewable energy regulations, tariff rules, licensing procedures, and procurement guidelines	Lower policy uncertainty and higher investor confidence	Stable renewable energy regulation, clearer tariff mechanism, and reduced licensing delay
PLN	Improve PPA bankability and grid connection process	Standardize PPA clauses, clarify risk allocation, improve procurement transparency, and accelerate grid connection approval	Renewable energy projects become more bankable and easier to finance	Shorter procurement period, more renewable projects reaching financial close, and clearer PPA terms
Ministry of Finance	Expand fiscal support and risk mitigation instruments	Provide guarantees, viability gap funding, concessional support, and risk-sharing facilities for high-risk renewable projects	Lower investment risk and lower cost of capital	Number of renewable projects supported by guarantees or fiscal facilities
PT SMI and Indonesia	Develop blended	Combine concessional finance,	More private capital is mobilized into	Amount of private finance mobilized

Infrastructure Finance (IIF)	finance facilities	development finance, and private capital for solar, geothermal, hydro, and transmission projects	renewable energy projects	through blended finance
OJK	Strengthen sustainable finance regulation and green financial instruments	Improve green bond, green sukuk, and sustainability-linked financing frameworks, including reporting and verification standards	More domestic capital market participation in renewable energy financing	Increase in green bond/sukuk issuance for renewable energy projects
Commercial banks	Increase renewable energy project finance capacity	Develop long-term loan products, improve technical risk assessment, and train credit officers on renewable energy project evaluation	Higher domestic bank participation in renewable energy financing	Growth of renewable energy loan portfolio and longer loan tenor
Project developers and IPPs	Improve project preparation and bankability	Prepare feasibility studies, environmental and social safeguards, land	Projects become more attractive to lenders and investors	More projects reaching financial close and lower project

		documentation, grid studies, and financial models		cancellation rate
Property and industrial developers	Expand rooftop solar and corporate renewable energy use	Develop rooftop solar projects in commercial buildings, industrial estates, and factories through leasing or power purchase schemes	More distributed renewable energy deployment and lower electricity costs for business users	Installed rooftop solar capacity in commercial and industrial sectors
International development partners	Provide concessional finance and technical assistance	Support guarantees, project preparation facilities, grid planning, and institutional capacity building	Lower early-stage project risk and stronger institutional capacity	Amount of concessional finance mobilized and number of projects supported
Academic experts and research institutions	Provide independent analysis and policy evaluation	Conduct research on renewable energy financing barriers, SD outcomes, investor risks, and policy effectiveness	Stronger evidence-based policymaking	Publication of annual policy evaluation and renewable energy financing database
Local governments	Support land access, local permits, and community engagement	Simplify local permits, coordinate land issues, and improve communication	Lower project delay and stronger social acceptance	Reduced local permitting delays and fewer land-related disputes

		with affected communities		

Source: Developed by the Researcher(2026)

The action matrix is an illustration of how financing for renewable energy should be strengthened, through shared responsibility. MEMR and PLN are key issues for regulatory clarity, procurement and project implementation. In the context of financial innovation and risk mitigation, the Ministry of Finance, PT SMI, IIF, OJK, and commercial banks are important. Project developers and IPPs play a vital role in developing bankable projects. Concessional finance and technical assistance is required from international development partners and evidence-based policy evaluation from academic experts. Local governments and communities are also crucial, as renewable energy projects need local permits, social acceptance and access to land.

Thus, this study recommends that in addition to the need of more financing on renewable energy, there is a need for some coordinated implementation system. The government should minimize policy and regulatory risks, PLN should better prepare the procurement and readiness of the grid, financial institutions should design financing instruments that are appropriate, and project developers should prepare their projects. This division is required because the issue of financing renewable energy in Indonesia is not only due to lack of funding but also weak coordination among policy, financing, institution and infrastructure.

5.3 Limitations of the Study

This study is subject to a number of limitations. First, the research is largely qualitative, and there is no econometric testing to assess causal relationships between financing for renewable energy and sustainable development outcomes. Second, data is still scarce, especially on the volume of private sector investment flows and commercial financing data. Third, the study's scope is limited to the Indonesian electricity sector between 2015 and 2025, so that the results of the study cannot be considered as a representation of other sectors or countries. Fourth, the study considers only main renewable energy technologies (solar, wind, hydro, geothermal, biomass) and not other emerging technologies. Lastly, the renewable energy sector in Indonesia is dynamic and the findings may become less meaningful if it changes in the future.

REFERENCES:

ADB, 2025. (n.d.).

Aditya, I. A., Wijayanto, T., & Hakam, D. F. (2025). Advancing Renewable Energy in Indonesia: A Comprehensive Analysis of Challenges, Opportunities, and Strategic Solutions. *Sustainability*, *17*(5), 2216. https://doi.org/10.3390/su17052216

Ahlborg, H., Ruiz-Mercado, I., Molander, S., & Masera, O. (2019). Bringing Technology into Social-Ecological Systems Research—Motivations for a Socio-Technical-Ecological Systems Approach. *Sustainability*, *11*(7), 2009. https://doi.org/10.3390/su11072009

Alfi Sa'idah, Elsa Cahya Agustina, B., Nova Anggraini, L., Setya Wulandari, P., & Nuril Hidayati, A. (2025). Implementasi Green Sukuk Untuk Pembiayaan Energi Terbarukan. *Ekopedia: Jurnal Ilmiah Ekonomi*, *1*(4), 3209–3221. https://doi.org/10.63822/drf6w289

Al-Sarihi, A., Contestabile, M., & Cherni, J. A. (2015). *Renewable Energy Policy Evaluation Using A System Dynamics Approach: The Case of Oman*.

Apramadha, M. S., & Prasetyo, R. T. (2025). Unlocking renewable energy potential: Overcoming barriers and accelerating the transition. *Energy Justice*, *2*(1). https://doi.org/10.61511/enjust.v2i1.2025.1705

Arifin, S., Firdaus S. A., A. H., & Putri, A. R. E. (2022). Integrated Solar Energy Application System Development to Catalyze Public Participation Towards Bali Clean Energy Through Crowd-Based Business Models. *Indonesian Journal of Energy*, *5*(2). https://doi.org/10.33116/ije.v5i2.151

Asia-Climate-Pledges-Country-Profiles-2025-Indonesia. (n.d.).

Asian Development Bank. (2020). *Renewable Energy Tariffs and and Incentives in Indonesia: Review and Recommendations* (0 ed.). Asian Development Bank. https://doi.org/10.22617/TCS200254

Asquith, B. M., Meier-Haack, J., Vogel, C., Butwilowski, W., & Ladewig, B. P. (2013). *Side-chain sulfonated copolymer cation exchange membranes for electro-driven desalination applications*.

Atstāja, D. (2025). Renewable Energy for Sustainable Development: Opportunities and Current Landscape. *Energies*, *18*(1), 196. https://doi.org/10.3390/en18010196

Azhgaliyeva, D. (2019). Energy Storage and Renewable Energy Deployment: Empirical Evidence from OECD countries. In *Energy Procedia* (Vol. 158, pp. 3647–3651). Elsevier BV. https://doi.org/10.1016/j.egypro.2019.01.897

Azhgaliyeva, D., Kapoor, A., & Liu, Y. (2020). Green bonds for financing renewable energy and energy efficiency in South-East Asia: A review of policies. *Journal of Sustainable Finance & Investment*, *10*(2), 113–140. https://doi.org/10.1080/20430795.2019.1704160

Balsalobre-Lorente, D., Nur, T., & Topaloglu, E. E. (2025). Examining the sustainable development process through the economic complexity, technology, urbanization, and renewable energy in D-8 countries. *Quality & Quantity*, *59*(5), 4461–4501. https://doi.org/10.1007/s11135-025-02161-3

Bang, G., Hovi, J., & Skodvin, T. (2016). The Paris Agreement: Short-Term and Long-Term Effectiveness. *Politics and Governance*, *4*(3), 209–218. https://doi.org/10.17645/pag.v4i3.640

Barroco, J., & Herrera, M. (2019). Clearing barriers to project finance for renewable energy in developing countries: A Philippines case study. *Energy Policy*, *135*, 111008. https://doi.org/10.1016/j.enpol.2019.111008

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Burke, P. J., & Kurniawati, S. (2018). Electricity subsidy reform in Indonesia: Demand-side effects on electricity use. *Energy Policy*, *116*, 410–421. https://doi.org/10.1016/j.enpol.2018.02.018

CAT ,2019. (n.d.).

Charnovitz, S., & Fischer, C. (2015). *Canada–Renewable Energy:* Implications for WTO Law on Green and Not-So-Green Subsidies. *World Trade Review*, *14*(2), 177–210. https://doi.org/10.1017/S1474745615000063

Chen, H., Zhao, G., & Ramzan, M. (2025). The Path to Environmental Sustainability: How Circular Economy, Natural Capital, and Structural Economic Changes Shape Greenhouse Gas Emissions in Germany. *Sustainability*, *17*(13), 5982. https://doi.org/10.3390/su17135982

Climate Policy Initiative, 2016. (n.d.).

Connolly, K. (2025). Comparing the macroeconomic demand-side v supply-side impacts of offshore renewable energy. *Renewable Energy*, *243*, 122625. https://doi.org/10.1016/j.renene.2025.122625

Dutta, K. (2020). Empirical Analysis of Economic Cooperation. In *Advances in Finance, Accounting, and Economics* (pp. 213–225). IGI Global. https://doi.org/10.4018/978-1-7998-1730-7.ch011

Dwi Prio Christianto, R., Wening, N., Oktafiani, R., Setiawan, A., Purnomo, H., & Herawati, N. (2025). How does green innovation enhance business sustainability? Systematic review and case study at PT PLN Indonesia Power UBP Suralaya. *Journal of Innovation in Business and Economics*, *9*(01). https://doi.org/10.22219/jibe.v9i01.39544

Egli, F. (2020). Renewable energy investment risk: An investigation of changes over time and the underlying drivers. *Energy Policy*, *140*, 111428. https://doi.org/10.1016/j.enpol.2020.111428

Elkington, J. & Elkington John. (1999). *Cannibals with forks: The triple bottom line of 21st century business* (Pbk. ed). Capstone.

Emezirinwune, M., & Abdulsalam, K. (2024). *7 PUBLICATIONS 30 CITATIONS SEE PROFILE*.

ESDM,2025. (n.d.).

Farghali, M., Osman, A. I., Chen, Z., Abdelhaleem, A., Ihara, I., Mohamed, I. M. A., Yap, P.-S., & Rooney, D. W. (2023). Social, environmental, and economic consequences of integrating renewable energies in the electricity sector: A review. *Environmental Chemistry Letters*, *21*(3), 1381–1418. https://doi.org/10.1007/s10311-023-01587-1

Farjami, E., & Mohamedali, A. (2017). Evaluating interior surfaces including finishing materials, ceiling, and their contribution to solar energy in residential buildings in Famagusta, North-Cyprus, Turkey. *Renewable and Sustainable Energy Reviews*, *75*, 338–353. https://doi.org/10.1016/j.rser.2016.10.074

Gandhi, T. (2020). Asian Development Bank, *Asia-Pacific Trade Facilitation Report 2019: Bridging Trade Finance Gaps Through Technology*, Asian Development Bank (ADB). In *Journal of Asian Economic Integration* (Vol. 2, Issue 1, pp. 125–128). SAGE Publications. https://doi.org/10.1177/2631684620910518

Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2017). The Circular Economy – A new sustainability paradigm? *Journal of Cleaner Production*, *143*, 757–768. https://doi.org/10.1016/j.jclepro.2016.12.048

Hafner, M., Tagliapietra, S., & De Strasser, L. (2018). *Energy in Africa: Challenges and Opportunities*. Springer International Publishing. https://doi.org/10.1007/978-3-319-92219-5

Halimatussadiah, A., Kruger, W., Wagner, F., Afifi, F. A. R., Lufti, R. E. G., & Kitzing, L. (2024a). The country of perpetual potential: Why is it so difficult to procure renewable energy in Indonesia? *Renewable and Sustainable Energy Reviews*, *201*, 114627. https://doi.org/10.1016/j.rser.2024.114627

Halimatussadiah, A., Kruger, W., Wagner, F., Afifi, F. A. R., Lufti, R. E. G., & Kitzing, L. (2024b). The country of perpetual potential: Why is it so difficult to procure renewable energy in Indonesia? *Renewable and Sustainable Energy Reviews*, *201*, 114627. https://doi.org/10.1016/j.rser.2024.114627

Halimatussadiah, A., Kruger, W., Wagner, F., Afifi, F. A. R., Lutfi, R. E. G., & Kitzing, L. (2024). *The country of perpetual potential: Why is it so difficult to procure renewable energy in Indonesia?*

Halužan, M., Verbič, M., & Zorić, J. (2023). The crowding out of conventional electricity generation by renewable energy sources: Implications from Greek, Hungarian, and Romanian electricity markets. *Environmental Science and Pollution Research*, *30*(57), 120063–120084. https://doi.org/10.1007/s11356-023-30564-y

Hardini, P. B., & Rosdiana, H. (2025). *Carbon Tax in Indonesia as a Fiscal Instrument and Climate Justice: A Literature Review*.

Harlan, T., & Baka, J. (2024). Stacked energyscapes: Conceptualizing fossil fuel and renewable energy entanglements in low-carbon transitions. *Energy Research & Social Science*, *115*, 103648. https://doi.org/10.1016/j.erss.2024.103648

Hendriwardani, M., Geddes, A., Sumarno, T. B., & Hohenberger, L. (2022). *Using Public Funding to Attract Private Investment in Renewable Energy in Indonesia*.

Hersaputri, L. D., Yeganyan, R., Cannone, C., Plazas-Niño, F., Osei-Owusu, S., Kountouris, Y., & Howells, M. (2024). *Reducing Fossil Fuel Dependence and Exploring Just Energy Transition Pathways in Indonesia using OSeMOSYS (Open-Source Energy Modelling System)*. Engineering. https://doi.org/10.33774/coe-2024-8stz1

Iea. (2022). *An Energy Sector Roadmap to Net Zero Emissions in Indonesia*. OECD. https://doi.org/10.1787/4a9e9439-en

Iea. (2025). *Enhancing Indonesia's Power System: Pathways to meet the renewables targets in 2025 and beyond*. Iea. https://doi.org/10.1787/13a0321c-en

Iea, 2023. (n.d.).

IEEFA ,2024. (n.d.).

IEEFA, 2024. (n.d.-a).

IEEFA, 2024. (n.d.-b).

IESR, 2026. (n.d.).

IESR, A., Hapsari, A., Kurniawan, D., Tumiwa, F., Vianda, F., Padhilah, F. A., Wismadi, F. S., Puspitarini, D. H. D., & Bintang, H. M. (2023). *Authors (in alphabetical order):*

International Energy Agency & International Finance Corporation. (2023). *Scaling Up Private Finance for Clean Energy in Emerging and Developing Economies*. OECD. https://doi.org/10.1787/054f472d-en

IRENA. (2023). *Global landscape of renewable energy finance, 2023*. International Renewable Energy Agency.

JETP, 2025. (n.d.).

Judijanto, L., Destiana, R., Selan, D. D., Nugroho, B. S., & Mauludin, M. A. (2024). The Effect of Green Project Financing, Investment Sustainability, and Green Bonds Policy on the Growth of Renewable Energy Industry in Indonesia. *West Science Social and Humanities Studies*, *2*(06), 998–1009. https://doi.org/10.58812/wsshs.v2i06.974

Judijanto, L., Nampira, A. A., Auliani, R., & Sinaga, J. (2025). *A Bibliometric Review of Renewable Energy Financing and Sustainable Development*. *03*(04).

Julkovski, D. J., Sehnem, S., Bennet, D., & Leseure, M. (2021). Ecological Modernization Theory (EMT): Antecedents and Successors. *Indonesian Journal of Sustainability Accounting and Management*, *5*(2). https://doi.org/10.28992/ijsam.v5i2.303

Jumantoro, T. R. P., & Novemyanto, A. D. (2025). Implementasi Green Bond dalam Sektor Investasi Infrastruktur di Indonesia Guna Mewujudkan Sustainable Economic Development. *Mahkamah : Jurnal Riset Ilmu Hukum*, *2*(4), 109–126. https://doi.org/10.62383/mahkamah.v2i4.1191

Kabel, T. S., & Bassim, M. (2020). REASONS FOR SHIFTING AND BARRIERS TO RENEWABLE ENERGY: A LITERATURE REVIEW. *International Journal of Energy Economics and Policy*, *10*(2), 89–94. https://doi.org/10.32479/ijeep.8710

Khan, S. (2023). Faith and philanthropy. In *Elgar Encyclopedia of Nonprofit Management, Leadership and Governance* (pp. 211–213). Edward Elgar Publishing. https://doi.org/10.4337/9781800880092.ch66

Kim, W.-H. (2025). US tariff policy and a transformation of global trade architecture. *Asia and the Global Economy*, *5*(2), 100120. https://doi.org/10.1016/j.aglobe.2025.100120

Kurniawan, O. D. A., Sari, D. P., Wulandari, C., & Febriyano, I. G. (2025). *Evaluating Indonesia's Renewable Energy Transition Strategy: Policy Implementation Challenges Toward Net-Zero Emission Target 2060*.

Kurniawan, R., & Kurniawan, I. W. (2022). Developing Innovative Financing Scheme for Leveraging Energy Efficiency Deployment in Indonesia. *Indonesian Journal of Energy*, *5*(1). https://doi.org/10.33116/ije.v5i1.132

Ma, Z., & Jiang, X. (2025). The Impact of Green Finance on Energy Transition Under Climate Change. *Sustainability*, *17*(15), 7112. https://doi.org/10.3390/su17157112

Muyasyaroh, A. P. (2024). Rethinking Energy Security in Indonesia from a Net Zero Perspective. *Indonesian Journal of Energy*, *7*(1), 16–26. https://doi.org/10.33116/ije.v7i1.197

Naeem, M., Ozuem, W., Howell, K., & Ranfagni, S. (2023). A Step-by-Step Process of Thematic Analysis to Develop a Conceptual Model in Qualitative Research. *International Journal of Qualitative Methods*, *22*, 16094069231205789. https://doi.org/10.1177/16094069231205789

Nakano, S., Arai, S., & Washizu, A. (2017). Economic impacts of Japan's renewable energy sector and the feed-in tariff system: Using an input–output table to analyze a next-generation energy system. *Environmental Economics and Policy Studies*, *19*(3), 555–580. https://doi.org/10.1007/s10018-016-0158-1

Nepal, R., Liu, Y., Dong, K., & Jamasb, T. (2024). Green Financing, Energy Transformation, and the Moderating Effect of Digital Economy in Developing Countries. *Environmental and Resource Economics*, *87*(12), 3357–3386. https://doi.org/10.1007/s10640-024-00922-6

Nguyen, T. C., Chuc, A. T., & Dang, L. N. (2018). *Green Finance in Viet Nam: Barriers and Solutions*.

OECD. (2021a). *Clean Energy Finance and Investment Policy Review of Indonesia*. OECD Publishing. https://doi.org/10.1787/0007dd9d-en

OECD. (2021b). *Clean Energy Finance and Investment Policy Review of Indonesia*. OECD Publishing. https://doi.org/10.1787/0007dd9d-en

OECD. (2025). *OECD DAC Blended Finance Guidance 2025* (Best Practices in Development Co-Operation) [Best Practices in Development Co-operation]. https://doi.org/10.1787/e4a13d2c-en

OJK , 2025. (n.d.).

Omri, A., & Belaïd, F. (2021). Does renewable energy modulate the negative effect of environmental issues on the socio-economic welfare? *Journal of Environmental Management*, *278*, 111483. https://doi.org/10.1016/j.jenvman.2020.111483

ORF, 2023. (n.d.).

Overland, I. (2019). The geopolitics of renewable energy: Debunking four emerging myths. *Energy Research & Social Science*, *49*, 36–40. https://doi.org/10.1016/j.erss.2018.10.018

Pambudi, N. A., Firdaus, R. A., Rizkiana, R., Ulfa, D. K., Salsabila, M. S., Suharno, & Sukatiman. (2023). Renewable Energy in Indonesia: Current Status, Potential, and Future Development. *Sustainability*, *15*(3), 2342. https://doi.org/10.3390/su15032342

Phương, B. (2025). The Impact of Renewable Energy Policy Implementation on Green Economy Growth in Southeast Asia. *Southeast Asia*, *4*(2).

PLN, 2025. (n.d.).

Polzin, F. (2017). Mobilizing private finance for low-carbon innovation – A systematic review of barriers and solutions. *Renewable and Sustainable Energy Reviews*, *77*, 525–535. https://doi.org/10.1016/j.rser.2017.04.007

Prihantoro, W., Wardhana, Y. M. A., & Hamzah, U. S. (2025). Willingness and Ability to Pay for Renewable Energy in Jakarta. *Jurnal Ilmu Lingkungan*, *23*(4), 937–949. https://doi.org/10.14710/jil.23.4.937-949

Purvis, B., Mao, Y., & Robinson, D. (2019). Three pillars of sustainability: In search of conceptual origins. *Sustainability Science*, *14*(3), 681–695. https://doi.org/10.1007/s11625-018-0627-5

Rahman, Y., Syarifudin, F., Mardiyah, M., & Sukresna, I. M. (2024). *Potential For Financing New Renewable Energy Solar Energy in Supporting Green Banking*.

Rahmanitya, N., & Ardiansyah, P. (2023). Indonesia's Just Energy Transition Partnership (JETP) as a Strategy for Achieving Energy Security. *Journal of International Studies on Energy Affairs*, *4*(1), 1–14. https://doi.org/10.51413/jisea.Vol4.Iss1.2023.1-14

Rahmanta, M. A., Permana, A., Susanto, W., Sadono, E. D., Ikasari, I. H., & Muflikhun, M. A. (2023). The feed-in tariff (FIT) policy to improve renewable energy utilization: An analysis of FIT implementation in ASEAN countries from renewable energy growth, decarbonization, and investment perspective. *International Journal of Renewable Energy Development*, *12*(5), 864–880. https://doi.org/10.14710/ijred.2023.55929

Republic of Indonesia Presentation Book—March 2023 (green). (n.d.).

Respitawulan, A., & Rahayu, A. Y. (2020). Indonesia Renewable Energy Power Plant Pricing Policy Comparison. *Journal of Southeast Asian Research*.

Rfai, R. H., & Nohong, M. (2025). Systematic Literature Review on Green Bonds Role in Enchancing Share Value in Indonesian Capital Market. In M. Nohong, F. R. Cahaya, P. M. Tuan, A. Mannan, A. I. Anwar, R. R. H. Thaha, R. N. P. Nugraha, A. T. Harahap, M. T. Dharsana, & F. I. Hermansyah (Eds.), *Proceedings of the 9th International Conference on Accounting, Management, and Economics 2024 (ICAME 2024)* (Vol. 331, pp. 1992–2009). Atlantis Press International BV. https://doi.org/10.2991/978-94-6463-758-8_160

Rishanty, A., Anugrah, D. F., & Rahmawati, D. (2023a). *COAL PHASE-OUT: SOCIOECONOMIC IMPACT IN ACHIEVING JUST ENERGY TRANSITION IN INDONESIA*.

Rishanty, A., Anugrah, D. F., & Rahmawati, D. (2023b). *COAL PHASE-OUT: SOCIOECONOMIC IMPACT IN ACHIEVING JUST ENERGY TRANSITION IN INDONESIA*.

Rudolph, D., Maulidia, M., & Busyrah, H. (2025). Solar–water nexus: On local implications of the procurement and deployment of the first floating solar photovoltaics project in Indonesia. *Sustainability Science*, *20*(4), 1393–1406. https://doi.org/10.1007/s11625-025-01637-3

Saa, S. (2024). Policy analysis of green bonds in Indonesia: Strategies for achieving sustainable development. *Journal of Infrastructure Policy and Development*, *8*(10), 6535. https://doi.org/10.24294/jipd.v8i10.6535

Sambodo, M. T., Yuliana, C. I., Hidayat, S., Novandra, R., Handoyo, F. W., Farandy, A. R., Inayah, I., & Yuniarti, P. I. (2022). Breaking barriers to low-carbon development in Indonesia: Deployment of renewable energy. *Heliyon*, *8*(4), e09304. https://doi.org/10.1016/j.heliyon.2022.e09304

Sauter, P., Witt, J., Billig, E., & Thrän, D. (2013). Impact of the Renewable Energy Sources Act in Germany on electricity produced with solid biofuels – Lessons learned by monitoring the market development. *Biomass and Bioenergy*, *53*, 162–171. https://doi.org/10.1016/j.biombioe.2013.01.014

Schinko, T., Bohm, S., Komendantova, N., Jamea, E. M., & Blohm, M. (2019). Morocco's sustainable energy transition and the role of financing costs: A participatory electricity system modeling approach. *Energy, Sustainability and Society*, *9*(1), 1. https://doi.org/10.1186/s13705-018-0186-8

Setyawan, D. (2015). Assessing The Current Indonesia's Electricity Market Arrangements and The Opportunities to Reform. *International Journal of Renewable Energy Development*, *3*(1), 55–64. https://doi.org/10.14710/ijred.3.1.55-64

Setyowati, A. B. (2020). Mitigating Energy Poverty: Mobilizing Climate Finance to Manage the Energy Trilemma in Indonesia. *Sustainability*, *12*(4), 1603. https://doi.org/10.3390/su12041603

Shadikhodjaev, S. (2013). First WTO Judicial Review of Climate Change Subsidy Issues. *American Journal of International Law*, *107*(4), 864–878. https://doi.org/10.5305/amerjintelaw.107.4.0864

Sinar, U. (2023). *INDONESIA RENEWABLE ENERGY INVESTMENT OUTLOOK – SEMESTER 2 2023*.

Sisdwinugraha, A. P., Hapsari, A., Wijaya, D. F., Padhilah, F. A., Bintang, H. M., Surya, I. R. F., Adiatma, J. C., Halim, A., Hilmy, A., Bagaskara, A., Rosadi, A., Tampubolon, A. P., Arinaldo, D., Mursanti, E., Tumiwa, F., Wardana, M., Citraningrum, D. M., Mendrofa, M. J. S., Nabighdazweda, M. D., … Firdausi, S. N. (2025). *Navigating Indonesia's Energy Transition at the Crossroads: A Pivotal Moment for Redefining the Future*.

Sitompul, R. F., Endri, E., Hasibuan, S., Jaqin, C., Indrasari, A., & Putriyana, L. (2022). Policy Challenges of Indonesia's Local Content Requirements on Power Generation and Turbine Production Capability. *International Journal of Energy Economics and Policy*, *12*(1), 225–235. https://doi.org/10.32479/ijeep.12504

Suliman, M. S., Farzaneh, H., Zusman, E., Mulumba, A. N., Lestari, P., Permadi, D. A., & Janardhanan, N. (2024). Quantifying the Climate Co-Benefits of Hybrid Renewable Power Generation in Indonesia: A Multi-Regional and Technological Assessment. *Climate*, *12*(2), 23. https://doi.org/10.3390/cli12020023

Szendrei, T., Eross, A., Mohammed, M., & Ersoy, E. (2025). FiT for purpose? Investigating the effects of feed-in-tariffs on renewable energy penetration in Europe. *Applied Energy*, *395*, 126102. https://doi.org/10.1016/j.apenergy.2025.126102

Taghizadeh-Hesary, F., & Yoshino, N. (2019). The way to induce private participation in green finance and investment. *Finance Research Letters*, *31*, 98–103. https://doi.org/10.1016/j.frl.2019.04.016

Torro, S., Rusdi, R., Manda, D., Saleh, S., Akib, H., Paramitha Darmayanti, D., & Ardin, H. (2024). Assessing Public Awareness and Stakeholder Influence in Renewable Energy Implementation: A Case Study from Sulawesi, Indonesia. *Journal of Asian Energy Studies*, *8*, 95–109. https://doi.org/10.24112/jaes.080007

UNDP, 2025. (n.d.).

United Nations Department of Economic and Social Affairs. (2025). *Energy Statistics Pocketbook 2025*. United Nations. https://doi.org/10.18356/9789211069280

Wang, L., Pal, S., Mahalik, M. K., & Gozgor, G. (2025). Empowering sustainable development in emerging economies: The role of renewable energy and domestic investment. *Energy Economics*, *148*, 108631. https://doi.org/10.1016/j.eneco.2025.108631

World Bank, International Energy Agency (IEA), & International Carbon Action Partnership (ICAP). (2024). *Carbon Pricing in the Power Sector: Role and design for transitioning toward net-zero carbon development*. Washington, DC: World Bank. https://doi.org/10.1596/42091

Xu, X., & Wang, Q. (2025). Advancing Sustainable Development: Feed-In Tariff Subsidies and Renewable Electricity Growth in China. *Sustainability*, *17*(23), 10824. https://doi.org/10.3390/su172310824

APPENDICES

APPENDIX 1 INTERVIEW GUIDELINE

A. Respondent Background

1. Could you describe your current position and responsibilities in the energy or finance sector?
2. How long have you been involved in renewable energy or sustainable finance activities?
3. What is your institution's role in renewable energy development or financing in Indonesia?

B. Renewable Energy and Sustainable Finance in Indonesia

4. How do you assess the current state of renewable energy development in Indonesia?
5. What is your understanding of sustainable finance in relation to renewable energy projects?
6. How important is renewable energy financing for achieving Indonesia's sustainable development goals?

C. Renewable Energy Financing Mechanisms

7. What types of financial instruments are commonly used to finance renewable energy projects in Indonesia?
8. How effective are these financing mechanisms in attracting investment in renewable energy?
9. What are the main sources of renewable energy financing (government, private sector, international institutions)?

D. Challenges and Barriers

10. What are the key challenges in financing renewable energy projects in Indonesia?
11. How do regulatory and policy frameworks influence renewable energy financing?
12. What risks do investors face in renewable energy projects?
13. How does the continued reliance on fossil fuels affect renewable energy investment?

E. Impact on Sustainable Development

14. How does renewable energy financing contribute to economic development in Indonesia?
15. How does renewable energy financing influence social development, such as employment and energy access?
16. How does renewable energy financing contribute to environmental sustainability, particularly emissions reduction?

17. Can you provide examples of renewable energy projects that have contributed to sustainable development?

F. Policy and Future Strategies

18. How effective are current government policies in promoting renewable energy financing?
19. What policy reforms are needed to accelerate renewable energy investment?
20. What strategies should be adopted to strengthen sustainable finance in the renewable energy sector?
21. How do you envision the future of renewable energy financing in Indonesia?

G. Closing Question

Is there any additional information or recommendations you would like to share regarding renewable energy financing and sustainable development in Indonesia?