# WHO PAYS WHAT FOR INDONESIA'S GREEN TRANSITION?


**Editors:**


Adrian T. P. Panggabean
Albertus P. Siagian



MEDIA INDONESIA PUBLISHING

# WHO PAYS WHAT FOR INDONESIA'S GREEN TRANSITION?

Who Pays What for Indonesia's Green Transition?

Editors:
Adrian T. P. Panggabean
Albertus P. Siagian

Initiator: Climate Policy Initiative

Text Editor: Tim Media Indonesia Publishing
Photo Editor: Permana Pandega Jaya
Translator: Ellisabet Tiyas Utami
Layout and Cover Designers:
Marionsandes Ratulangie, Redya Surya Rachmandanu,
Bayu Pamungkas

Published by:
Media Indonesia Publishing

First Edition, April 2025

ISBN 978-623-6165-27-0

9 786236 165270

## TESTIMONIALS

"This book offers an essential guide for how our country can navigate the path of energy transition toward a greener future. It reminds us of the importance of justice, equity, commitment, and balance in energy transition. Whatever steps we take to align ourselves as part of the global community must be grounded in a clear understanding of our realities, so that energy transition does not become an elitist issue, but one truly rooted in everyday life. This book invites us to reflect deeply on that."

**Abdul Kohar**
Director of News/Editor-in-Chief
Media Indonesia

"This book creates space for Indonesia to craft its own narrative on how the energy transition should be financed, not merely as a loan recipient, but as a shaper of fair and context-specific funding schemes. This perspective is immensely valuable for anyone seeking to advance climate finance reform on a global scale."

**Heri Susanto**
Program Director
Yayasan Bicara Data Indonesia

"This book is quite unique as it addresses the complex political-economic aspects of handling global climate change, yet it presents these issues in a thematic series of writings that are relatively easy to digest. Its content provides a clear overview of Indonesia's energy transition, viewed through the lens of energy history and national interests. There are not many books written by Indonesians that cover this aspect."

**Fabby Tumiwa**
Executive Director
Institute for Essential Services Reform

## PREFACE

The Government of Indonesia ratified the Paris Agreement through Law Number 16 Year 2016, marking the beginning of the nation's journey as part of the global community in tackling climate change. One of the key efforts to mitigate climate change is through energy transition.

However, the global political landscape is increasingly uncertain. The United States has withdrawn from the Paris Agreement for a second time, while Europe is facing defense and security challenges following the outbreak of the Russia–Ukraine war. As a result, global climate finance flows to developing countries, including Indonesia, are potentially at risk of being disrupted.

There are two key takeaways from this global situation. First, it proves that the commitment of other countries to mitigating climate change can never be predicted by, and is not under the control of, Indonesia. This may weaken Indonesia’s willingness to continue its efforts, as the success of climate change mitigation ultimately depends on the collective actions of all nations.

Second, even if Indonesia maintains high climate ambitions, it cannot rely on foreign funding as the primary driver for financing climate-related projects in the country. Given that climate finance flows are shaped by global conditions beyond Indonesia’s control, such funding must be treated as an auxiliary mechanism, not the primary mechanism, for mobilizing climate finance.

These two issues are explored in greater depth throughout this book. In addition, given the context in which domestic funding is expected to serve as the primary mechanism, the book also examines Indonesia’s political economy, macroeconomic conditions, and domestic financial landscape. This provides insight into key challenges facing the country and assesses the feasibility of mobilizing domestic resources to support the energy transition.

In short, the ideas presented in this book show that, even without the energy transition agenda, Indonesia already faces complex structural challenges in achieving its development goals. While the book focuses the energy transition, it also invites readers to view this agenda as a timely reminder of the urgency to build and strengthen Indonesia from within, through deep structural reforms.

In this regard, energy transition can also be leveraged as a tool to support Indonesia's development goals. As one section of this book suggests, the transition presents an opportunity to invest domestic finance in manufacturing facilities that produce components for renewable energy systems, using homegrown technologies and employing Indonesian workers.

Moreover, the declining costs of clean technologies and the rising costs of fossil energy, due to national and international carbon taxes, mean that a cleaner power sector could boost the competitiveness of Indonesia's industries.

Given this potential, energy transition must be thoughtfully designed to align with Indonesia's national interests and deliver real development benefits. With a careful implementation, energy transition and economic development should no longer be a trade-off.

The energy transition is not just about moving from "dirty to clean," but also sometimes, about shifting from on-grid to off-grid systems. When energy provision becomes off-grid, it indirectly enables energy decentralization, which in turn can support broader economic decentralization. This presents an opportunity to address regional economic disparities and should also be seen as a potential political win.

Framing the energy transition as a political win is crucial because, as this book argues, most decision-makers are ultimately politicians. The transition will be difficult to implement if policymakers do not see clear political value in pursuing it.

Lastly, I would like to note that this book has sincerely tried to ground the energy transition discourse within Indonesia's national context and aspirations. This effort is essential to ensure that energy transition initiatives in Indonesia are built on a foundation of realistic thinking, so that current and future policies remain relevant. Relevance matters because it helps ensure that the energy transition agenda is both embraced by and receives support from the Indonesian public and government.

Although this book does not represent the official views of the editors and authors' institutions, I would like to express my gratitude to the editorial team and all the contributors who have shared their critical insights in developing it. They have skillfully addressed many crucial aspects of the energy transition agenda in Indonesia, particularly the political, economic, and financial dimensions.

Given the immensity of energy transition discussion, not everything could be included in this book. However, I am confident that the publication of this book will still enrich the discussion about energy transition in Indonesia. Looking at the long history of human civilization, I see energy transition as an evolution, an inevitability. The debate about energy transition is unavoidable and will remain relevant in the future.

Jakarta, March 25, 2025

Tiza Mafira

Director of Climate Policy Initiative Indonesia

## EXECUTIVE SUMMARY

Adrian T. P. Panggabean and Albertus P. Siagian

The globally resonant agenda of climate change mitigation has propelled a widespread call for implementing green projects across various sectors, particularly the energy transition. However, on the ground, Indonesia's ability and willingness to undertake energy transition projects are shaped by various factors, including geopolitical considerations, socioeconomic context, limited financing capacity, technological access constraints, and the country's vast geographic landscape.

This book is presented for a general audience to raise public awareness of the Indonesian context within the broader climate agenda. The hope is that both the public and policymakers will recognize the relevance of the climate agenda and adopt a realistic approach in formulating energy transition policies for Indonesia. A national interest perspective is the foundational lens through which this book was conceived. For the mechanism of public choice to function properly, the interests of ordinary citizens (not those of a small elite claiming to speak on their behalf, let alone external or foreign actors) should determine the direction, speed, and magnitude of any government policy related to climate change mitigation.

Climate change, by its very narrative, is a global issue. Its international dimension stems from the fact that the sources of emissions are spread across different parts of the world, while the resulting disasters are felt across national borders. As such, the solutions must also be on a global scale. The narrative is often framed under a "Just Energy Transition," which calls for the entire energy transition agenda to be grounded in the principles of justice. These include justice across generations (intergenerational equality), justice among income groups (interpersonal equality), justice between regions or jurisdictions (interregional or interjurisdictional equality), and equality in opportunity. The presence (or absence) of these four dimensions of justice has long been intertwined with Indonesia's energy history, from the colonial era to the present day. In addition, other non-economic factors also play a significant role, particularly the sociological, anthropological, and political constellation factors.

Given socioeconomic disparities and diverse transnational interests among countries, energy dynamics are inherently complex. For this reason, the book begins with a chapter that outlines the global dynamics of the climate agenda. This first chapter, authored by Adrian T. P. Panggabean and Albertus P. Siagian, offers a straightforward overview of the geoeconomic and geopolitical dimensions of the climate agenda.

The second chapter, also co-authored by Albertus P. Siagian and Adrian T. P. Panggabean, provides a brief overview of Indonesia's energy transition trajectory over the past 200 years to help general readers better understand the dynamics of energy development in the country. The chapter aims to identify the key factors that have shaped Indonesia's energy path thus far and draw historical lessons that can inform future energy transition efforts.

The chapter describes the evolution of energy governance in Indonesia from the colonial era to the Reformation era, which has been marked by significant foreign interests. It highlights the persistent symbiosis between the geoeconomic interests of developed countries and political power, as well as the recurring promises of technology transfer that, to this day, often remain unfulfilled. The cumulative effect of these dynamics is Indonesia's growing dependence on foreign debt and imported technology.

In the third chapter, Andreas N. Tjendro seeks to address a fundamental question. How much total investment is precisely needed to realize the energy transition agenda in Indonesia? This chapter could be quite complex for general readers, as it navigates a dense topography of terminology and jargons commonly associated with climate change discourse. Through a systematic analysis of various estimates published by multiple institutions, the chapter presents striking findings regarding the financing needs. The circulating figures are staggering, ranging from one to two times greater than Indonesia's present twin deficits (which is the combined current account and fiscal deficits).

As an illustration, the twin deficits have long been a persistent source of macroeconomic instability in Indonesia. The country has been struggling to resolve such deficits since its independence in 1945. In 2024, for instance, Indonesia's twin deficits were projected to reach approximately 3% of GDP. This represents only about half of the median figure for the energy transition finance that Indonesia needs each year until 2050.

Moreover, the estimated investment figures vary widely. Various tables presented in the chapter strongly suggest that the components and assumptions underlying these calculations are often misaligned with on-the-ground realities. As a result, several financial experts who provided feedback on the chapter have expressed doubts about Indonesia's capacity to meet the investment requirement. Meanwhile, chapter four until chapter six of the book delve into other relevant socioeconomic contexts.

Chapter four, authored by Sugiharso Safuan, explores the prospects for implementing Indonesia's energy transition, which continues to face fiscal deficits and fragmented economic development challenges. This chapter emphasizes that while energy transition is crucial for environmental sustainability, the path forward is fraught with significant economic and fiscal challenges. These include high upfront costs, reliance on foreign debt, and potential impacts on the national budget deficit and public debt ratio.

As Indonesia has long struggled to resolve its chronic budget deficit, further debts to finance energy transition efforts could lead to a sharp increase in public debt levels, higher interest rates, and greater pressure on the country's fiscal space. A larger deficit could also undermine economic resilience, particularly in the event of a future slowdown in economic growth.

Chapter five and chapter six, both authored by Martin D. Siyaranamual, examine the potential socioeconomic impacts of energy transition. Chapter five highlights the significant disparities in energy production, consumption, and access between different regions and income groups. Using data from Indonesia's National Socio-Economic Survey (SUSENAS), the author illustrates that the gaps across regions and income levels remain substantial and have yet to be bridged, even with the relatively low cost of fossil energy. The chapter then addresses how the potential negative impacts of the energy transition can be mitigated, aiming to bridge the existing disparities.

In chapter six, Martin D. Siyaranamual considers several steps that need to be taken and further developed to minimize the potential adverse effects of renewable energy transition on the manufacturing sector. As the proposals presented here are still at a qualitative level, a further study on cost-benefit analysis could provide insights on the trade-offs of these suggestions.

In chapter seven, Fadli Rahman examines how energy transition policies in Indonesia can be adapted to the Indonesian context, ensuring that the climate agenda is both effective and relevant. Through an analysis of energy transition models in several European and Asian countries, the author demonstrates that there is no one-size-fits-all model for developing and implementing energy transitions worldwide. Each country has its own unique approach. The author then outlines eight actions that need to be taken to implement an energy transition in a way that is distinctively suited to Indonesia's conditions. These steps may help facilitate a faster, more effective, and sustainable energy transition process.

From chapter eight to ten, the focus shifts to the micro dimensions of the energy transition, specifically the financing aspects of the climate agenda (or climate finance). Several market-based funding options for energy transition projects in Indonesia are discussed here, including bank loans, blended finance options, and the stimulation of energy transition projects through carbon trading.

In chapter eight, Andreas N. Tjendro assesses the ability of Indonesia's banking sector to finance energy transition projects. Methodologically, by considering the current macroprudential regulations in the banking sector, the chapter concludes that the banking sector lacks the capacity to finance Renewable Energy Power Plant (REPP) projects, which are estimated to require USD11 billion per year until 2050. This is significant, considering it accounts for only 15% of the median estimate for the full energy transition financing requirement, which is projected to be between USD73–76 billion per year until 2050.

Chapter nine, authored by Naila Firdausi and Wisnu Wibisono, explores the prospects for financing energy transition through blended finance. This chapter outlines the development, definition, and scope of the current modality of blended finance. International commitments to blended finance for Indonesia appear substantial. However, nearly all figures presented are in the form of commitments (promises). The realization of these commitments falls within two extremes. Mystery lies on the left end of the spectrum, as the figures are difficult to find or not publicly disclosed. On the right end of the spectrum is irony, as the realized amounts are surprisingly small and, in many cases, insignificant.

The book concludes by discussing the situation and prospects of carbon trading in Indonesia. Chapter ten, co-authored by Akhmad R. Shidiq and Adrian T. P. Panggabean, uses the classic analytical technique known as policy process analysis to highlight a long list of issues, challenges, and obstacles faced by Indonesia's carbon market. The chapter concludes with three main points. First, the government must create carbon commodities through clear and binding regulations for the Technical Approval of Upper Emission Limits (PTBAE) and the Technical Approval of Upper Emission Limits-Business Actors (PTBAE-PU). Political will alone is not enough. Qualified professionals must oversee market preparation. Second, the government needs to choose a carbon market design that fits Indonesia's socioeconomic context, focusing on a niche market that will distinguish it from other Asian carbon markets. Third, and equally important, is the need to carefully calculate the incentives and disincentives in the carbon market within the broader asset market. The goal is to prevent price arbitrage practices and market manipulation, which could create asymmetry across the entire asset market.

From the overall chapters, three key takeaways can be drawn. First, climate, environmental, and energy issues never stand alone or exist in isolation from global dynamics and interests. It is a well-established principle in international relations that energy and environmental issues are closely linked to national security concerns. Therefore, a balanced approach is needed to ensure that climate issues and energy transition are viewed holistically, especially considering their social, economic, and political contexts in the short and medium term. In the long term, all analyses and projections will likely appear optimistic. However, the most important effect is the short-term impact, as the short-term disequilibrium will ultimately determine the long-term outcomes.

Second, issues of justice and institutions, whether regarding regulations, government policies, governance/business processes, and/or organizational structures, emerge as key elements across all chapters. Regulations and governmental bodies/structures have indeed been established to accommodate the evolving climate change and clean energy issues. However, will governance and business processes (defined as how policy documents or paperwork move from one desk to another within the large government bureaucracy) change? And if they do change, to what extent will these changes occur to ensure that business processes are both efficient and equitable?

Third is the issue of limited financing supply. It is clear from almost all chapters that the current financing supply is insufficient. It can be said that there is virtually no available financing to support the extremely costly climate agenda. The only available source of funding is foreign debt. However, both the fiscal conditions (on the government side) and liquidity conditions (on the private sector side) make it impossible for Indonesia to bear additional debt. If the trajectory and pace of financial reforms in Indonesia over the past 50 years are used as a benchmark, it will take more than a decade to close even half of the total climate finance gap.

# TABLE OF CONTENTS

# 1

# How to Respond to the Global Narrative on Climate Action?

Adrian T.P. Panggabean and Albertus P. Siagian

## Introduction

As an equatorial country, the presence of glaciers on the mountaintops of the Papua region is quite unexpected for Indonesia. It was discovered when a Dutch sailor saw the snow on the peaks of the Papuan mountains in 1623. As stated in the book entitled Twentieth Century Indonesia, written by American scientist Wilfred T. Neill in 1973, the observable snow from the faraway coast indicated that there was still much snow then. Unfortunately, the glaciers have now been melting significantly and are starting to disappear. This natural exotism of Indonesia may sadly be only a memory in the future.

Not only melting snow, wildfires also increasingly break out in Sumatra and Kalimantan. The smoke has irritated bilateral relations between Indonesia, Malaysia, and Singapore to the point where Singapore often expresses its wish to help put out the wildfires.

Some of Indonesia's outermost islands are prone to sinking due to the rising sea levels. If these islands disappear, Indonesia's borders will change. In line with the UN Convention on the Law of the Sea (UNCLOS) in 1982, Indonesia's maritime boundaries are determined by the outermost islands (Buntoro, 2018). If the borders of this republic change, it will have direct implications for the country's sovereign territory.

The above are just a few intriguing and often-cited examples related to the effects of climate change. However, like other global issues, Indonesia must be vigilant in examining the climate change issue because it may have non-physical impacts, especially on geoeconomics and geopolitics. Therefore, issues on climate change must be examined intelligently, carefully, and strategically by all segments of society.

## Climate Change from a Historical Perspective

According to data, the accumulation of greenhouse gas (GHG) emissions in the atmosphere has changed the climate system on Earth, which is called climate change. According to Our World in Data, about 62% of the $CO_2$ accumulation since the beginning of the Industrial Revolution in 1751 came from the North American and European regions,[1] which now hold the status of developed countries.

European colonies also historically emitted emissions. However, they did not contribute as much. Furthermore, the emissions from these colonies came more from the colonizers' economic decisions, not the colonized people themselves. A study found that the Dutch colonial government and business players deforested Indonesia's archipelago during the colonial era for their interests (Itawan, 2022). The colonial rulers also operated steam ships and trains in the archipelago during that era. As a result, both their deforestation and dirty transportation contributed to atmospheric emissions. It was quite likely that the same pattern happened in other colonial regions in Asia, Latin America, and Africa.

Based on this fact, developing countries voice that the responsibility in the global energy transition, a form of global climate change mitigation, should differ from one country to another because each country's contribution to the accumulation of GHGs that drive climate change varies. In this context, developed countries, as the major contributors to the accumulation of global emissions for two hundred years since the Industrial Revolution, are expected to contribute the most to the global energy transition funding. And if they refuse to fund, then it will only strengthen the ongoing impression that developed countries only prioritize their own self-interest.

Another noteworthy argument is the issue of intergenerational responsibility among the people of developed countries themselves, often called ecological debt. The current generation living in developed countries is not the previous generation that arbitrarily releases considerable emissions. Should the 'sins' of their predecessors be considered as 'hereditary sins' that must be borne by the current generation? And in the context of the intergenerational dimension of cost, should the 'accumulated emission sins' of developed countries be inherited by their current generation?

Undoubtedly, the current generation in developed countries has gained intergenerational benefits. Economic growth through the dirty emissions produced by the previous generations in developed countries has enabled these countries to reach their current development. This is the intergenerational dimension of benefit.

Notably, the convenience gained by the current generation in developed countries is inseparable from intensive natural exploitation by former colonial countries in their relations with developing countries. Thus, developing countries seem to have a rightful position to ask what these rich countries have paid.

## Unravelling Expectations and Reality in Energy Transition Funding

One of the significant elements in the energy transition is prioritizing the use of new and renewable energy (NRE) power plants in the future. So far, there are two different perspectives on this. First is the complementarity perspective, in which the development of NRE power plants is to increase the total installed capacity in the country. The second is the substitution perspective, in which NRE power plants 'development replaces fossil-fueled power plants' installed capacity, which will shut down or cease early. Regardless of the perspective, both have one thing in common, which is a very high energy transition cost.

Another element in the energy transition is the early decommissioning of the existing fossil-fueled power plants. Because this early decommissioning will not bring any commercial income, covering the associated costs through debt is not appropriate. It should be funded through grants instead. Additionally, because the technology of some NRE power plants is still expensive, shifting to such power plants may erode the purchasing power of low-income consumers.

Who should provide the grants? If we want to be consistent with the view of intergenerational cost-benefit, the answer is developed countries. Firstly, these developed countries have caused most of the current climate change, which creates the urgency for the early retirement of these fossil-fueled power plants. Secondly, these developed countries have benefited from their historical emissions, as evidenced by their current high economic development level.

Then what about the cost of building NRE power plants? The answer depends on the perspective taken. In the second perspective above, namely the substitution perspective, constructing NRE power plants should be seen as an inseparable part of fossil-fueled power plants' early retirement program. It is because it is never logical for a growing country to phase out some power plants without making a replacement. Early retirement without a replacement will only reduce electricity production when electricity demand keeps increasing. This situation hurts the economy, society, and national security. Thus, NRE power plant development (as a replacement for the retired fossil ones) should be covered by grants from developed countries.

According to the first perspective, namely the complementarity perspective, the development of NRE power plants aims to increase the total installed capacity in a country. Therefore, the developing country may fund the costs, especially if the NRE power plants generate commercial income.

The next question is how much the interest rate should be? The answer depends on the situation. In the current world, where the cost of building NRE power plants is still more expensive than fossil-fueled power plants, developing NRE power plants is presumably an opportunity loss for developing countries. Therefore, the appropriate interest rate is concessional.

However, in the future, when the cost of building NRE power plants is cheaper than fossil-fueled power plants, for example, due to technological progress, constructing NRE power plants may become an opportunity gain. Therefore, it is acceptable to charge a market-rate interest rate.

To fund and finance the energy transition, the International Partners Group (IPG), whose members are mainly developed countries, is committed to channeling a sum of funds to the Indonesian government through a platform called the Just Energy Transition Partnership or JETP (Muliawati, 2023b). However, most of the promised funds are in the form of debt. By the end of 2023, only around IDR5 trillion had been given as grants. Meanwhile, around IDR156 trillion was planned to be disbursed to Indonesia as debt (Zahira, 2023). As a result, a cynical assumption has emerged among the most educated social group that climate and energy transition is a debt disguised as global welfare.

The same pattern occurs at the global level. The 2015-2020 United Nations (UN) report reveals that only about 18% of the total debt (in the context of climate change) lent by developed countries to developing countries used concessional interest rates (Sanchez et al., 2024). Most of debt offered by developed countries was a market-rate loan. This pattern strengthens the impression that the discussion on climate is simply a financial business proposition wrapped in altruistic values.

Most developed countries argue that the high interest rates imposed on developing countries are a consequence of the poor credit rating of these countries. Accordingly, high investment risk in developing countries must be compensated with a high interest rate. However, a growing number of global financial and investment practitioners are also starting to understand that a sovereign credit rating is more than just reflecting the macroeconomic situation in the country.

In reality, debt ratings are one of the geoeconomic instruments. Often, debt-rating companies face difficulty providing objective answers when financial professionals seek reasons for the differences between countries with a 'Single A' rating and countries with a 'Triple B' rating. On the other hand, a rating difference of even just one notch already potentially leads to a cost-of-fund gap of 100-200 basis points. Hence, although the rating difference seems insignificant, the impact at the field level can be significant because developing countries with a low rating will not be able to implement energy transition projects with such a market-rate loan.

Whether due to the objections of developing countries to the high interest rates or other factors, the idea of blended finance then emerged as one of the climate finance options. Through this mechanism, (cheap) funds from the government budget are proposed to be incorporated with (expensive) funds offered by developed countries and/or private corporations. The goal is to make the cost of energy transition projects cheaper.

However, this model raises a new conceptual question. Why should 'cheap funds' from taxes be allocated to finance (or presumably subsidize) global externalities? Domestic tax revenues should be used to address much more urgent domestic problems (which are more closely related to the real constituencies of a country), such as poverty alleviation, unemployment problems, health programs, universal education, expanding access to cheap and affordable energy, public security, and national defense.

The aspiration of developing countries, like Indonesia, is that the energy transition must be accompanied by a paradigm shift in relations between developed and developing countries, which includes changes in the funding mechanism and technology transfer from developed to developing countries.

## Investment and Technology Dependence

Climate change mitigation idealizes a rapid global energy transition. However, the quick transition potentially causes profound disruption for developing countries. Furthermore, the fast transition requires new technologies that developing countries have not yet acquired.

Consequently, for the sake of implementing a quick energy transition, developing countries may be trapped in a new dependency, namely dependency on clean technology from developed countries as technology owners. This technological dependency will again benefit countries that provide technology.

Take, for example, the energy storage case. With Indonesia's mountainous topography and considerable convertible ex-mining lands, pumped storage technology might be more suitable (Siagian et al., 2023). Additionally, this technology, which is similar to hydroelectric technology, has been around for a long time and Indonesia's domestic manufacturing industry has been able to produce most of its components, except for turbines and generators (Winata et al., 2021). Moreover, this technology can store abundant energy at a single charge.

Nonetheless, the Indonesian government is more focused on realizing the vision of battery storage as energy storage, following the trend abroad, as it will be popular for electric vehicles. This intention consequently raises several practical questions.

First, why does the government prioritize energy storage technology that requires nickel (critical minerals) mining on Indonesian soil, but then gives the mining permit to foreign companies? The nickel mine on Obi Island is an example. The mining is controlled by a Chinese company that is partnering with an Indonesian mining company (Kahozy et al., 2024). Ironically, China itself is applying a protectionist policy on its own critical minerals. Rare earth metals (critical minerals) within China's territory are labelled as China's state property (Tabeta, 2024).

Second, why choose nickel? This choice is highly at stake, given that the battery storage technology is highly dynamic and nickel may not always be prominent in future developments.

Third, who will the government rely on for nickel downstream technology? News reports show that 90% of nickel downstream factories collaborate with China (Muliawati, 2023a). Besides that, South Korea's Hyundai 'contributes' to Indonesia's nickel downstream by opening an electric car battery manufacturing plant in Indonesia (Kusmayadi, 2024).

Cooperation between Indonesia and other countries is nothing novel. However, the cooperation has not resulted in a complete technology transfer. For example, Indonesia has long collaborated with various Japanese automotive companies, but Indonesia has always been a car assembler, not a car engine manufacturer. Indonesia never obtains a car engine technology transfer from Japan. Indonesia has only been used as a market for Japanese car sales. Japan still controls technology and the market. Further, Japan often supports the construction of toll roads in Indonesia so cars are always in demand. This pattern is often found in various sub-sectors of the Indonesian manufacturing industry.

If there is no significant transformation in Indonesia's industrial development blueprint, the same pattern may occur again in the energy transition agenda. Technologies related to the energy transition in Indonesia may be proposed and designed in such a way by parties that do not represent the interests of the wider Indonesian community, so that Indonesia may later depend on certain foreign investments. Meanwhile, Indonesia may not necessarily get all the benefits, just like today.

Here is another example. A Reuters report found that some climate-related grants from the European Union and Japan require recipient countries to purchase goods and services related to climate projects from companies in the donor countries. Ultimately, this 'free' money from developed countries flows back to companies in these developed countries (Sanchez et al., 2024). In other words, dependence on foreign investment and technology is legally formalized, so such dependence occurs unendingly.

Many intellectuals, at least those monitored through social media and mainstream media news, consider that the Indonesian government not critical enough. The government only cares about the higher tax revenue or export value potential when inviting foreign investment. However, whether Indonesia's technological mastery has truly benefited from foreign investment so far is rarely discussed and examined. This is a critical policy neglect, considering that the technology provides the most significant added value to the goods. Knowledge of how to fish is more important than the fish itself.

## Uncertainty in the Energy Transition Speed

How fast the global energy transition should be undertaken is also a question mark because countries have diverging interests. Natural resources can provide economic income and create market power for a country, but these resources are not evenly distributed among nations on the planet. Many of these natural resources are concentrated in certain places only.

Consequently, this uneven distribution of natural resources creates unequal market power among places within a country or among countries. Places abundant in natural resources may have specific market power and interest in the global market.

For instance, the members of OPEC (Organization of the Petroleum Exporting Countries) have crude oil reserves. These countries use this natural blessing to wield market power that benefits them, and sometimes, this power is used as an economic weapon against other countries. The oil embargo in the 1970s is one example.

Learning from this case, economic, political, and socio-economic factors may determine the speed of global energy transition in the future. For example, fossil fuel exporting countries may be interested in preserving their international oil, gas, and coal trade, contributing much to their economic growth thus far.

Macroeconomic disruption borne by fossil energy exporting countries, such as exchange rate disruption and inflation caused by the turbulence in their oil, gas, and coal trades, may also influence the speed of the global energy transition. From the perspective of these countries (all of which greatly influence the success or failure of climate change mitigation), a slower energy transition is preferable because the disruption risk is easier to manage. A slower pace will provide sufficient time for export diversification for fossil fuel exporters and preparation of the industrial downstream.

Intriguingly, these fossil energy exporting countries are also the ones who can determine the pace of global energy transition. Based on the previous argument, the inequality of natural resources in the world has endowed resource-rich countries with market power. Hence, these countries will likely use this power to slow the global energy transition speed, jeopardizing the global effort to achieve the climate target.

However, the interest of some countries in limiting the speed of the global energy transition is at odds with the agendas of a select few nations. By the end of the Cold War in the early 1990s, the world economy was centered in developed countries, especially the United States, Western Europe, and Japan. However, after the Cold War ended, the economic transformation undertaken by Deng Xiaoping made China a new financial hub. Advances in China's technology and manufacturing industry have enabled it to control various supply chains, including NRE.

Therefore, it is not difficult to understand that the energy transition is a global agenda driven by developed countries and well utilized by China. The energy transition will increase the demand for renewable products, benefiting these countries.

However, these countries do not always have all the raw materials, namely critical minerals, needed to produce NRE products. Considering that resource-rich countries are interested in regulating their export (as mentioned before), developed countries and China, are trying to obtain these resources directly from the producing countries in various ways.

For example, China is trying to gain access to nickel for batteries by seeking permission to become one of the nickel miners in Indonesia (Kahozy et al., 2024). Another example is the European Union, which is also trying to gain access to nickel by asking Indonesia to abandon its downstream efforts and to ease raw nickel export to the European Union (Davies, 2022). In mid-2024, the United States invited Indonesia to join a coalition of 14 countries, including the European Union, for critical minerals. The goal is obviously to co-opt critical mineral sources.

Competition in accessing these limited natural resources is a justifiable effect of the global energy transition. Inept technology and weak-performing manufacturing industries are often inherent in developing countries, so they potentially become the objects (passive players) and not subjects (active players) in the competition and utilization of these commodities.

## Energy Transition and Electricity Infrastructure Across Countries?

Conceptually, the global energy transition will lead to the dominant use of renewable energy. However, unlike oil, gas, and coal, which can be used in non-electric forms (such as gasoline in cars, gas in stoves, and coal in factory furnaces), renewable energy (mainly wind and solar) can only be generated into electricity. This means the global energy transition will lead to the dominant electricity use in global energy consumption.

The global energy transition requires the massive development of electricity-supporting infrastructure, especially electricity transmission and distribution (T&D) networks. Since not all large islands in Indonesia have sufficient renewable energy potential to support electricity demand within the island's territory, the inter-island T&D network in Indonesia is increasingly needed. This enables the distribution of renewable energy between islands so that each island can meet its electricity needs.

The construction of a T&D network of this scale is certainly costly. The reliable technology needed for this T&D network to pass through the vast ocean is also undoubtedly complex. Considering fiscal and technological limitations, Indonesia will likely rely on foreign involvement.

From a global perspective, not every country necessarily has sufficient renewable energy potential to support its electricity demand. Therefore, cross-country T&D networks are also increasingly needed.

One of the most recent examples is the proposed subsea power cable from Australia to Singapore via Indonesia. Due to the limited potential of renewable energy in its small territory, Singapore wants to import electricity from solar power plants in Australia. Australia is trying to get the Indonesian government's permission to build the subsea power cable from Australia to Singapore via Indonesian territory (Yanwardhana, 2021). However, the Indonesian government has not provided any decisions.

Unlike movable ships carrying oil, gas, and coal, T&D networks transmitting electricity are immovable. Because the subsea cable infrastructure is anchored in a fixed location, such infrastructure will be a strategic tool for some parties, but will be a risk for others.

For example, fiber optic cables from the United States were permanently installed in Singapore before entering Indonesian territory (Yanwardhana, 2021). This connection has turned Singapore into a regional cable hub, where Singapore has a strategic position towards Indonesia. In geopolitical terms, Singapore has a choke point that potentially becomes a bargaining chip against Indonesia.

Therefore, Indonesia must be careful in determining its attitude towards the plan for foreign infrastructure (in the form of a T&D network) that passes through Indonesian territory. Remember that cooperation between countries is usually established because of other strategic 'friendships'. Continuing the example above, Singapore is reportedly a partner (although not a member) of the Five Eyes intelligence alliance, of which Australia is a member (Dorling, 2013).

## How Credible Are Other Countries' Commitments?

Another factor that needs consideration when formulating Indonesia's participation in climate mitigation is the credibility of other countries' commitments. This is crucial because it can drive all parties to think twice about earnestly participating in climate change mitigation efforts.

In developed countries, oil and gas companies (e.g., Exxon from the United States) initially denied the climate impact of their excessive use of oil and gas products (Hall, 2015). The United States President Donald Trump also withdrew his country from the Paris Agreement commitment (Daley, 2020) and redid it in his second term. In Europe, the Russo-Ukrainian War disrupted the gas supply needed by the power generation fleet in Western Europe, so the region revived coal as an alternative (Jack, 2023). The other most recent example is the withdrawal of the United States' largest banks from the Net-Zero alliance.

In reality, each country cannot confirm the credibility of other countries' commitments. This is pitiful because a country's energy transition efforts will not have much impact on tackling global climate change as long as other countries have not made enough energy transitions. Despite the efforts made by a handful of countries to limit or even reduce their emissions, climate change will remain unaddressed so long as the rest of the countries continue to use dirty energy and emit considerable emissions.

In other words, the benefit of a country's energy transition efforts, pragmatically measured by whether climate change is mitigated or not, is uncertain because it depends on the unpredictable actions of other countries.

Energy transition efforts also have financial implications. Without grants from developed countries, developing country governments will increase their fiscal spending and/or fiscal debt. Reducing the fiscal surplus (or even an increase in fiscal deficit) is definitely a cost. To give a context, low and middle-income countries had fiscal deficits of 4.0% and 5.4% of their gross domestic product (GDP) in 2023 already on average.[2]

When the fiscal cost of energy transition efforts is relatively certain, but its environmental benefits are not certain, developing countries will be more hesitant to participate in climate change mitigation efforts. This is an example of a game theory dilemma in the issue of climate change. If left alone, each country may pragmatically feel safer not to participate in climate change mitigation.

What is the impact? Since climate change is a global issue which causes and effects are both cross-border and require a global solution, the failure to implement the global energy transition will make climate change a self-fulfilling prophecy if each country does not participate.

## Energy Transition: Global Eco-democracy or Eco-authoritarianism?

The reluctance of developing countries to participate in climate change mitigation efforts can be seen through their emission reduction targets. Most low-income countries set emission reduction targets relative to business-as-usual (BAU) in the current year (ECBI, 2020). The BAU emission in the current year is a variable that can essentially be fabricated because the figure is a projection, not a measurement. By making an emission reduction target compared to BAU emissions, it is then unclear if the emission reduction is due to a real reduction in actual emissions or simply stemming from the highly fabricated BAU emissions from the start. Thus, from the beginning, these countries essentially create a room for themselves to make a good impression without concrete effort.

In contrast, most high-income countries set their emission reduction target relative to their actual emissions in the past, also known as absolute target (ECBI, 2020). By setting their emission reduction target against the measured emissions, these countries cannot hide behind a false impression. Additionally, with their economic advancement, these countries are more capable of undertaking energy transition anyway. Thus, these countries know that emission reduction target is a relatively achievable agenda for them from the start.

Interestingly, no international system currently compels countries to make profound commitments to mitigate climate change or punish countries for not doing enough emission reduction. Each country still has room to engage in something not necessarily in line with global efforts to reduce climate change. Given that climate change mitigation will only be effective if most or all countries participate, will an international system be created to enforce this? Who will establish it? Who will dominate decision-making in that system? What are the stick-and-carrot principles and mechanisms made in that system?

For reference, important international institutions nowadays are led and controlled by a handful of countries. The most straightforward example is the United Nations (UN). Veto rights in the UN are only held by the five victors of World War II, three of which are in a coalition in all geopolitical decisions and the remaining two are independent. Another example is the Bretton Woods institution. The leader of the World Bank traditionally comes from the United States, while the International Monetary Fund (IMF) leader comes from European countries allied with the United States. The operational funds of international institutions will also naturally be borne by developed countries that are financially capable. This means that the institutions' decisions may tend to reflect the interests of the countries that provide the most significant funding.

Suppose the international climate system is enforced by global institutions that do not voice the interests of all nations equally. Will the system be obeyed by countries whose interests are not represented? If the system is not followed by countries that consider their interests are not represented, will someone fill the void and then unilaterally take on the role of 'world police'? Will economic sanctions be imposed on a country if it is deemed unwilling to comply with the international system? If sanctions are imposed on a country, will the decision be based on fair rules or will it be more of an economic weapon controlled by rich and powerful countries?

Many fundamental questions arise as long-term anticipation regarding the possibility of institutionalization of climate issues at the global level. In brief, developing countries wonder if this climate issue will become an eco-democracy or an eco-authoritarianism institution.

For reference, up to now, around 60% of the world's low-income countries have experienced or are experiencing financial penalties from the United States as economic sanctions imposed on them. In the current era, the United States government, as reported by statistics that often appear in the media, is increasingly implementing economic sanctions, which are around three times more often than in previous eras. These sanctions serve as a form of political and economic pressure, so that the 'target country' is forced to align itself with the United States' interests without having to go through war (Stein et al, 2024). Apart from the United States, other developed countries in Western Europe are also capable of, have been, and are imposing economic sanctions on other countries.

Revisiting the issue of climate change, one day, each country may have to follow a global carbon tax scheme. Currently, aspirations regarding this are beginning to surface (Pirlot, 2021). Will the scheme be designed unilaterally? If it is designed as a multi-party, how much bargaining power do developing countries have in determining the scheme?

All of the above then raises a specific question. Is the issue of climate change (and the energy transition that accompanies it) the result of collective awareness of all nations? Or is this a top-down sponsored agenda? Developed countries initially pioneered scientific estimates of the validity of climate change because they had the technological capability to measure, detect, and analyze global climate data. But will they stop there?

## Conclusion

As a big and independent nation, Indonesia must think big and independent too. This means that Indonesia must be able to redefine the issue of climate change from its perspective and selectively translate it into derivative programs based on its national conditions and interests.

However, it is essential to acknowledge that as part of the international community, Indonesia must consider external conditions realistically. Regardless of the Indonesian nation's sympathy or antipathy towards the climate agenda, this agenda will continue to be echoed globally. Ultimately, Indonesia alone cannot unilaterally control this agenda. Diplomatically, Indonesia is a follower of the narrative and not a narrative-maker on many global agendas. If it is inevitable, Indonesia should take advantage of it, while certain preconditions must be met first.

First, Indonesia needs to increase its technological mastery. By mastering technology, Indonesia can shift its profile, from previously needing other countries to being needed by other countries.With a stronger bargaining power at the international level, Indonesia will be more able to exert its stance, which more reflects the nation's interests. Additionally, by mastering technology, Indonesia can turn the table, from energy transition being a risky endeavor into it being  a business and economic opportunity for the nation.

To master technology, Indonesia needs to expand its fiscal capacity. From the fiscal revenue side, the tax base must be expanded by taxing those who have not paid taxes so far. From the fiscal expenditure side, fossil subsidy spending and other inefficient spending must be cut. Then, from the fiscal space created, the government can direct the funds for acquiring technology.

Firm fiscal is the key solution. Unfortunately, Indonesia's fiscal condition has never been strong. Its fiscal balance has always been in deficit since Indonesia's independence. If its fiscal position were strong, the government could use its budget to pay foreign polytechnics, their instructors, and technology consultants to open branches in Indonesia. The government would also be able to invite foreigners to open manufacturing plants in Indonesia, with funds partially borne by the government, as long as they agree to transfer their technology to local engineers. Technicians who graduate from the polytechnics can also be employed in the manufacturing plants for on-the-job training. Competent and creative human resources are needed because they are the ones who determine the nation's ability to absorb the ever-evolving technology.

Indonesia must strategically plan technology acquisition in core fields that underlie many other fields and can continue to be relevant in the future. Indonesian engineering researchers must also identify technological gaps and find ways to improvise locally. The goal is for Indonesia to replicate and eventually substitute imported goods, including replacing foreign workers. Besides that, Indonesia can later develop its unique products for the global market.

Second, the government must be able to become an entrepreneurial state (Mazzucato, 2013). The government ideally has and can use its fiscal power to fund the above, including 'taking the plunge' in taking technical risks from trial-and-error that arise from acquiring the technology and buying technology patents from foreign countries.

Third, the design of climate change mitigation and adaptation in Indonesia should follow the local conditions and the nation's capabilities. Thus, from Indonesia's perspective, the involvement of foreign parties in the issue should always be viewed merely as an option or bonus. In this way, dependence on foreign parties is sidelined from the start. However, it must be realized that there will most likely be a group of foreign parties who question this standpoint.

A strong technological mastery should enable the Indonesian diplomacy to ward off this objection. Japan, Korea, and China successfully acquired technology through various internal restoration and modernization policies as early as possible during the Meiji, Park Chung Hee, and Deng Xiaoping eras. As a result, those three countries can now internalize global issues, including climate change, in their own way.

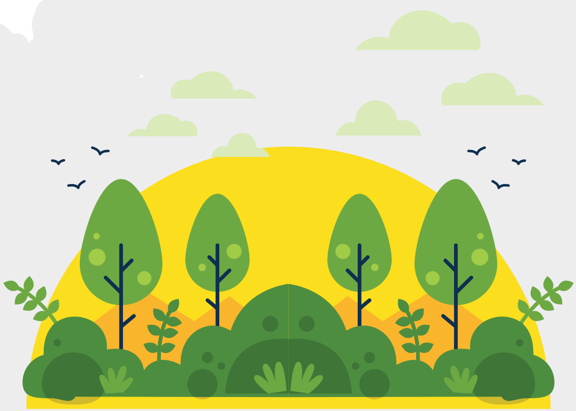
Often, developed countries cite the technological deficiency in developing countries, including Indonesia, as a reason to criticize the effectiveness of the internal policies in the respective countries. This then becomes a pretext for the entrance of foreign involvement, which often reconfigures other internal orders in the nation.

By designing climate change mitigation plans based on local conditions, Indonesia is encouraged to seek, focus on, and maximize domestic market opportunities before entering foreign markets. As a country with a large population and territory, Indonesia should be able to invest and trade among itself with its own capital.

The following are examples of how Indonesia's energy transition agenda may be fully internalized. First, the technocratic calculations around energy transition in Indonesia are done mainly by the Indonesian government itself. Second, the money invested in Indonesia's energy transition projects comes mainly from Indonesia, giving financial returns to Indonesian investors. Third, local people work in local renewable component factories to produce components deployed in local projects, so Indonesia can employ its own people and does not have to import products.

Hence, everything is by and for Indonesia from conception to final implementation. The examples above might happen if Indonesia has a high mastery of technology. Further, the better technology Indonesia has, the more likely the products will become truly competitive. Consequently, not only foreign customers but also Indonesia's domestic customers want these products (because they are of better quality than the imported version). Therefore, the use of domestic products for Indonesia's needs is not only by design but also because of the strength of the market itself.

Fourth, there is nothing wrong with focusing domestically. With a population equivalent to almost a quarter of the southern hemisphere's population and a geographic condition equivalent to one-eighth of the earth's equator, focusing domestically is indirectly contributing globally already. However, the domestic focus needs to start with a solid and locally grounded philosophy, accompanied by sound and operational principles. Economist Joan Robinson and sociologist Leah Greenfeld once said that economic development in a country is indeed a manifestation of and driven by the nationalism of its people (Robinson, 1962; Greenfeld, 2003).



2

# Should the Bitter History of Energy Transition Continue in New and Renewable Energy?

Albertus P. Siagian and Adrian T. P. Panggabean

## Introduction

According to Greek mythology, human civilization began after Prometheus gave fire to humans. Fire is a form of energy. In other words, energy is the beginning and protector of human society. Therefore, the dynamics of the energy market should become a critical concern for all parties. In reality, the dynamics of the energy market are complex. They cannot be simplified to just a standard interaction between supply and demand, which creates a combination of price and quantity.

This chapter aims to describe various political economic variables often considered ceteris paribus in economic analysis. Political economic variables play a significant role in Indonesia's energy market evolution. These variables have influenced Indonesia's energy trilemma: affordability, security, and sustainability. The next evolution in Indonesia's energy market, namely the transition to new and renewable energy (NRE), may progress quicker only after the cost of NRE gets lower than the cost of fossil energy. But learning from historical facts, this chapter predicts that how quickly such a situation occurs depends on not only technology, but also political economic variables.

However, the pace of Indonesia's energy transition will be strongly influenced by several key factors, namely political-economic calculation, the country's ability to prioritize domestic interests over foreign ones, the establishment of international cooperation frameworks that place national interests first, the quality of governance, the availability of a sound and appropriate financing scheme, the effectiveness of price intervention mechanisms, and the nation's capacity for technology transfer.

Historically, Indonesia's energy evolution has been heavily influenced by two key variables, namely political-economic calculation and Indonesia's failure to place the interests of society above foreign interests. Further, Indonesia's political economic calculation has been heavily shaped by the interests of resource rent (which is a legacy of the *win-gewest* mindset from the colonial era), resource nationalism factor, and short-term political electability factor.

## Colonial Era: Foreign Exploitation Period

Until the 18th century, biomass, such as firewood, was the most utilized energy in the Dutch East Indies (later known as Indonesia). Then, entering the 19th century, modern energy besides biomass began to be utilized. Initially, coal mining began in Pengaron (South Borneo) in 1849 (Sasongko, 2012). The following year, the Colonial Government Decision Number 45 Year 1850 immediately stated that coal mining in the Dutch East Indies could only be controlled by the Dutch (Rupaidi, 2023). The Dutch heavily used the coal, especially in its transportation system, which still relied on steam technology at that time.

Then came other more modern energy, which requires more modern technology and greater financial capital. After Dutch colonialism took place for so long in the Indies, the Netherlands began to feel the benefits of colonialism and collect sufficient financial capital.

Understandably, in 1885, the first oil mining in the Indies, namely in Langkat (North Sumatra), was undertaken by a Dutch investor, named Aeilko Jans Zijker, and not the local people because the Dutch had more financial capital (Yuniarto, 2023). As in coal, in 1889, the Dutch colonial government immediately stated that all oil mining concessions must be obtained from them, not local sultans anymore (Amir, 2017).

The company Aeilko founded became Shell's forerunner (Yuniarto, 2023). Since then, the oil and gas industry in the Indies had been controlled by foreign companies until Indonesia's independence. Standard Oil Company of New Jersey, forerunner of Exxon, had had oil exploration since 1912 (Kosasih, 2024). Then the Standard Oil Company of California (the forerunner of Chevron) had done the same since 1924 (Umah, 2021). These companies had been around the nation before Indonesia was even established.

The oil was then sold to those who could afford it, namely the international market (for their interests) and the Dutch colonial government (for colonialism). Although the oil was mined in the Indies, no benefit poured to the local inhabitants. In the mindset of the Dutch colonial government, the Indies were seen only as a revenue-generating region or *win-gewest* in their language (Marks, 2007).

Then, towards the end of the 19th century, electricity came in. The first power plants in the Indies were built to serve the electricity needs of the Dutch colonial government's sugar and tea factories (Ningsih et al., 2021). Most of these were hydropower plants.

When the Japanese military came to the Indies during World War II, they immediately took over this power plants. They also brought in Japanese companies, such as Mitsui, to operate oil mines in East Borneo (Hafidz, 2008). This shows how important it is to control a nation's energy sources.

For Japan, oil-producing cities like Tarakan were vital. At that time, Tarakan could cover 16% of Japan's annual oil needs (Nortier, 1980). Japan had tried to buy Tarakan oil from the Dutch colonial government before World War II broke out, but the Dutch refused (Henriarso, 1974). In fact, the Dutch continued militarizing the city until the eve of World War II (KNIL, 1949). Finally, when the Japanese military came to the Indies in 1942, Tarakan was one of the first cities to be seized (Santosa, 2004). When the Allied military successfully fought back in 1945, Tarakan was also one of the first cities to be retaken (Santosa, 2004).

## Post-Independence Upstream Oil and Gas: Symbiosis of Foreign Interests and Debt

After Indonesia's independence, the government attempted to claim the colonizer's energy assets under the nation's control through nationalization, contract revisions, and establishment of domestic companies that continued the colonizer's energy operations. Since energy plays an important role, the energy market is filled not only by commercial actors, such as private companies, but also by non-commercial actors, namely the government.

The government's presence in the market ideally ensures that the market serves society's interests optimally and evenly. However, when they prioritize short-term and narrow political interests, they will only perpetuate the *win-gewest* mindset, which does not benefit the people, just like in the colonial era.

Also, in Indonesia's energy market, foreign parties, companies, international organizations, and even governments are important actors. The long-standing foreign control of Indonesia's energy assets during the colonial period has left a structural pattern that Indonesia cannot easily replace overnight. The foreign nations undoubtedly are unwilling to abandon this pattern overnight.

After World War II, the symbiosis between foreign interests and debt transformed with two additional elements: corruption and mismanagement. Historically, Indonesia had to go through its first two formative decades since its independence with many military conflicts, whether against the former Dutch colonizers, domestic separatist groups (due to the rampant rebellions in the regions), or the Trikora and Dwikora geopolitical conflicts. Consequently, the Indonesian military became a prominent actor that the government needed to manage the nation and state assets.

Multiple military conflicts gave Indonesia's Old Order government a pretext that the republic was in a state of emergency so that the military, with Soekarno's blessing, could use the state-owned oil and gas company to generate money to support military operational costs since 1957. This was one of the justifications for placing military personnel as leaders of the state-owned oil and gas company, PT Permina (Yuniarto, 2023; Crouch, 1986; Robison, 2009).

The government and military's dependence on oil revenue was a sign that the Old Order government's fiscal budget was limited. Tax revenue from the people was also too small then as most people still had very low incomes. Hence, like in the colonial era, crude oil was sold to those with higher purchasing power instead, namely the international market.

In the international market, Japan was one of the most interested buyers. The country imported PT Permina's oil and became the first export destination for

PT Permina. After PT Permina's export revenue increased, so did PT Permina's bankability. It was then primed to receive loans. Utilizing this momentum, Japan (again) gave loans to the company. In 1960, Japan lent USD53 million (Joshua, 2016). Next, it lent USD200 million to support PT Permina's oil business and finally, USD3 billion for Permina's gas business, and finally, USD3 billion was invested in Perminna's gas business (Henriarso, 1974).

On paper, this debt was narrated to help PT Permina conduct oil and gas exploration in Indonesia. Besides, Japan knew that few other countries dared to provide loans to Indonesia as a young nation. However, as a matter of fact, this debt must be repaid to Japan by committing PT Permina to supplying 58 million kiloliters of oil over ten years and 7.5 million metric tons of LNG annually for 20 years (Henriarso, 1974).

Intriguingly, this debt agreement was arranged by Shigetada Nishijima, a former intelligence assistant to Admiral Tadashi Maeda in World War II, who at that time succeeded in charming Soekarno by allowing his official residence to be used to formulate Indonesia's proclamation text (Joshua, 2016).

The increasing role of state-owned enterprises in the oil and gas sector endangered foreign oil companies that had survived in Indonesia since the colonial era. Therefore, the United States government pressured the Indonesian government to arrange a meeting between Indonesian representatives and these companies (Shell, Caltex, and Stanvac) in Japan in 1963. As a result, these companies could continue operating as long as they became contractors for Indonesia's state-owned oil and gas enterprises. This model came from Ibnu Sutowo's idea, later known as the Work Contract agreement (Joshua, 2016).

During the New Order government, state-owned oil and gas companies, namely PN Pertamin and PN Permigas, were merged with PT Permina to become Pertamina. Since Pertamin and Permigas were heavily influenced by the leftists (because Chairul Saleh managed both), the government then appointed the leader of Permina, a high-ranking military officer (Ibnu Sutowo), at that time, to lead Pertamina. Pertamina continued its previous 'role' which was, assisting the government and the military (Joshua, 2016).

Two oil price booms (in 1973-1974 due to the Arab-Israeli War and 1979-1980 due to the Iran-Iraq War) could have been used as a growth momentum for Pertamina and Indonesia. However, the opportunity was wasted. Pertamina's increasing export revenue was used to finance business expansion unrelated to oil and gas, including funding the Krakatau Steel factory and establishing another company that eventually became Pupuk Kaltim. This business expansion also required contractors, where certain business groups that were close to power at that time often became contractors. This expansion exceeded the reasonable limits of Pertamina's export revenue (Argamaya, 2012; Joshua, 2016). This imbalance was what, among other things, caused the stagnation of Pertamina's development as an oil and gas business that held great potential to dominate the Southeast Asian region.

From the demand side, Pertamina's excessive expansion through various mega projects started to push Pertamina to seek more debt. From the loan supply side, the oil price boom weakened the economy of oil and gas importing countries, causing banks in developed countries to start looking for new debtors from other countries, including Pertamina from Indonesia (Joshua, 2016).

Three problems, namely over-expansion, over-leveraged, and over-privileged, exacerbated by corrupt practices, created severe financial problems. According to official news, George Shultz, then the United States Secretary of the Treasury, met President Soeharto in 1974 to discuss a 'monetary policy' solution. As a result, Pertamina's failure to pay debts was resolved through the intervention of Bank Indonesia, which drained foreign exchange reserves accumulated from oil export revenues. The stagnation of Pertamina, which was the primary source of the State Budget, disrupted Indonesia's development momentum (Argamaya, 2012; Joshua, 2016).

All of these episodes contributed to Pertamina's failure to invest in technology for itself. Pertamina's technological capabilities in exploration and exploitation were not well developed. Pertamina was always spoiled by receiving oil quotas from contractors and was not forced to work hard to do their own oil drilling. Even in 1976, Pertamina's natural gas came more from its contractors than from its own production (Joshua, 2016).

This Pertamina flaw caused oil wells in Indonesia not to increase (Erianto, 2022b). Its production relied on existing oil wells while its reserves declined (Amir, 2017). The peak of Pertamina's last production through primary recovery was in 1977 and it reached its last peak through secondary recovery with steam injection in 1993 (Pradnyana, 2010). Since mid-2000, national oil production has never reached 1 million barrels daily (Amir, 2017).

The 1998 monetary crisis then knocked Indonesia into a debt trap. The IMF asked Indonesia to overhaul its oil and gas sector through deregulation, liberalization, and privatization, as stated in Article Number 18 in the Letter of Intent dated January 20, 2000 (Umar, 2012). Apparently, the overhaul of Indonesia's oil and gas regulations was accompanied by lobbying from international oil and gas companies to the U.S. government, urging USAID to intervene and provide 'technical assistance' in drafting Indonesia's new Oil and Gas Law (Pakkanna, 2021).

Since Law Number 22 Year 2001 was enacted, the Indonesian oil and gas sector has been divided into upstream and downstream subsectors. The downstream subsector has been further divided into processing, transportation, storage, and trade (Umar, 2012). In the upstream sector, Pertamina has been 'demoted' from being a regulator and player to merely a player (Pradnyana, 2010). As a player, Pertamina must now compete against international oil and gas companies that are more adept in this business (Umar, 2012).

Indeed, compared to Pertamina, international oil and gas companies were and still are more adept in this business. For example, the past oil price boom benefitted them the most because around 84% of Indonesia's oil exports in 1972 were produced by Stanvac and Caltex (Joshua, 2016). Only 16% was produced by Pertamina. The oil and gas sector reform since the 1998 crisis only restrengthens their presence in Indonesia.

## Post-Independence Downstream Oil and Gas: Liberalization and Subsidy

When the Dutch left Indonesia, the colonial government inherited an extensive rail-based transportation system, which resembled European civil transportation architecture. However, the New Order government, which was pro-West, became inclined to a road-based transportation system, which resembles the continental United States' transportation architecture. Even this government seemed to curb the railway network intentionally because trains were deemed' social' transportation, symbolizing a particular ideology. Moreover, Japan preferred to provide development loans for toll road expansion rather than railways. It was because more toll roads would create a higher demand for cars as Japan was a major car seller in Indonesia then. Thus, both the New Order government and foreign stakeholders indirectly created a high demand for oil and gas derivative products.

Law Number 22 Year 2001 also made investment requirements in the oil and gas sector easier. Downstream players do not need significant capital because they do not need to play upstream (Umar, 2012). As a result, the private sector is enabled to do gas station business. However, because no domestic private sector business has experience in gas stations due to the Pertamina's long-standing monopoly, foreign private companies, such as Shell, Total, and BP, have better capability to play in the gas station business in Indonesia. Since November 2005, Pertamina is no longer the only gas station player (Umar, 2012). Moreover, as mandated by the policy reform, the fuel subsidy reduction is allegedly designed so that foreign players can compete on price with Pertamina in the gas station business (Umar, 2012).

Since 2004, Indonesia has imported oil to cover its increasing domestic demand, draining foreign reserves (Erianto, 2022b). The presence of foreign companies has apparently not been able to increase oil upstream production. The fuel subsidy policy reform has also been unable to tame the soaring downstream consumption. In its heyday, oil and gas generated 63% of Indonesia's fiscal revenue, but in 2015, the oil and gas contribution was only around 8% (Amir, 2017).

The midstream sector, or oil refining, has also been minimally strengthened. When demand for oil derivative products increases, imports of oil derivative products also increase. This has backfired on the State Budget. Before 1997, imports of oil derivative products were lower than exports. In 2021, imports of oil derivative products were higher (21.9 million tons) than exports (3.7 million tons). There was a massive deficit in oil derivative products (Erianto, 2022b). In 2021, crude oil imports were higher (13.7 million tons) than exports (6.0 million tons). There was a deficit of 7.7 million tons of crude oil. The deficit in oil derivative products was more significant than in crude oil (Erianto, 2022b).

## Coal: Dependency Surplus and Governance Deficit

Although coal mining came first, coal was even less popular than oil in Indonesia in its early days. Coal was once essential as fuel for trains and ships. However, coal consumption for trains and ships began to fade in the 1950s-1960s because oil-based fuel replaced it. In the 1960s, coal exploration in Indonesia also declined. This situation hampered the Soviet Union's plan to build a steel factory in Indonesia despite their closeness to the Old Order government (Ministry of Energy and Mineral Resources, 2013).

In the 1970s, Indonesia's coal sector declined, unlike Indonesia's oil sector, which experienced an oil boom. After previously being able to produce 2.030 million tons in 1941, Indonesia only produced 0.149 million tons in 1973. Through a Presidential Letter dated September 16, 1976, the government requested that power plants in Indonesia started switching to coal to sustain coal demand and production (Erianto, 2022a).

At almost the same time, Indonesia coincidentally could no longer rely solely on hydropower plants inherited from the Dutch colonial era. Coal was more readily available and its processing was simpler than that of diesel power plants, which required refining first. As a result, coal-fired power plants were considered a more practical option. The switch from hydropower to coal-fired power plants boosted the demand for coal. In the early 2020s, around 82% of coal sold domestically was used for coal-fired power plants (Erianto, 2022a).

Since 1980, foreign investment has also been permitted in the coal sector. In 1981, PT Tambang Batu Bara Bukit Asam (TBBA) was given more authority to integrate the business. Consequently, in 1986, Indonesia's coal production returned to pre-independence production levels, which was 2.4 million tons, where 50% of which was undertaken by PT TBBA (Erianto, 2022a). Then, coal production increased to 765 million tons in 2023 (Agung, 2024).

Indonesia's abundant coal reserves enable the country to engage in exports. Incidentally, China and India also need ample coal to run their industries. Around 75% of national production is now exported rather than sold domestically. Based on the coal mining analysis data from Indonesia Investment, the situation compels the government to implement a domestic market obligation (DMO) policy to ensure that exports are accomplished without sacrificing domestic needs.[3]

The surge in coal production comes at the right time, considering that Indonesia's oil and gas production continues to decline. In the early 21st century, around 64% of Indonesia's primary energy production was oil and gas and only 35% was coal. Now, based on the 2021-2022 Indonesian Energy Balance from the Statistics Indonesia, in the early 2020s, only 17% of energy production was from oil and gas, while 79% was from coal.[4] However, much like in colonial times, the export-oriented mindset persists.

Like oil and gas, coal can also be a fiscal mainstay for the government. According to the Coal Mining Analysis from Indonesia Investment, coal mining now contributes 85% of fiscal revenue from the mining sector.[5] Coal also generates export taxes, income taxes, and royalties or other profit-sharing systems for the government.

## Price Intervention: The Impact of Liberalization on Energy Sustainability and Affordability

Another key aspect of Indonesia's energy history is government intervention in energy prices. This price intervention is undertaken because the government sees energy as essential to the well-being of the people. During the Old Order government's 22 years, subsidized oil-based fuel prices were adjusted thrice. During the New Order, which lasted 32 years, the prices were adjusted 20 times. In the Reformation era, the government made price adjustments 45 times (Permatasari, 2022a; Permatasari, 2022b). This means that the subsidized fuel price was adjusted every 7 years in the Old Order, every 18 months in the New Order, and every six (6) months in the Reformation era. The question is: why is it happening more often?

First, since Indonesia became an oil importer in 2004, fuel prices have become sensitive to global prices and fuel subsidies have increasingly become an object of attention (Umar, 2012).

Second, the Old Order and New Order governments indirectly formed a social paradigm that Indonesia is an 'oil-rich country', so oil should be available cheaply (Pradnyana, 2010). In the Reformation era, the government tried to maintain the above illusion with subsidies. Unfortunately, because imports were getting stronger in the Reformation era, the government's efforts to maintain the illusion had to be paid for dearly with increasingly frequent subsidies. Ironically, 70% of subsidies are actually enjoyed by 40% of the middle to upper-income community (Pradnyana, 2010). It has even been often reported that subsidized fuel was actually sold to foreign buyers illegally in the middle of the sea to exploit price arbitrage opportunities between countries. This practice remained in place until 2024 (Grahadyarini, 2024).

Some estimate that fuel and electricity subsidies consume around 50% of fiscal revenues from the oil and gas sector (Pradnyana, 2010). Therefore, the subsidies allocated through the State Budget are not only poorly targeted but also drain fiscal revenues from oil and gas. Ironically, fiscal revenues from oil, gas, and coal could have been used to, among other things, increase Indonesia's readiness in the energy transition (for example, by funding research and development in NRE technologies).

Price intervention is also implemented through Domestic Market Obligation (DMO) for some energy, such as crude oil and coal. DMO requires that a portion of the production be sold domestically (for example, to PLN) with a specific upper price limit. This is to ensure sufficient energy supply for vital installations at an affordable price. Consequently, as reflected in the energy trilemma framework, Indonesia's energy sustainability is low.

## NRE: The Price of Sustainability and Technology Dependence

As the population and per capita income rise, energy consumption will also increase. If emissions from the energy sector need to be reduced, reducing the energy sector’s emission intensity is the key.

Based on the World Energy Council's index, Indonesia's energy trilemma (which involves balancing affordability, security, and sustainability), is most challenged in the area of energy sustainability. This is a natural consequence of policy pressures that prioritize energy affordability and security at the expense of sustainability. However, this is not a problem unique to Indonesia. In general, developing countries face similar challenges.

Current technological advancements have lowered the cost of NRE, but not enough to make energy affordable for most people in many developing countries. The price of electricity per kilowatt-hour (kWh) produced by fossil fuels remains much cheaper than that of renewable energy. However, when technological advancements lower the cost of energy storage in the future, all three aspects of the energy trilemma can be achieved simultaneously without a trade-off.

For some, NRE is also a matter of decentralizing and democratizing energy access. With transportable fossil energy as the backbone, Indonesia's energy planning and distribution have followed a "central-to-regional" approach. Consequently, transportation costs have become a crucial factor. Due to Indonesia's fragmented island geography, energy prices still vary across different regions despite implementing the "One Fuel Price" policy. NRE allows people to freely rely on the energy potential in their surrounding nature. This issue of decentralizing and democratizing energy access is actually a derivation of the broader challenges of decentralization and democracy, which gained widespread attention during the Reformation Era.

However, there are political challenges to achieving the energy transition. Stakeholders who have benefited from the dominance of fossil energy will seek to preserve the status quo. These groups have strong lobbying power, backed by financial resources, intellectual influence, and political clout. Additionally, existing stakeholders benefit from established transportation infrastructure, equipment, and factory systems, all of which are designed to rely on fossil energy. (Hobley et al., 2019).

The coal sector is a prime example. Many politicians, retired military personnel, former high-ranking government officials, and business conglomerates are deeply involved in this industry. Moreover, coal industry players often fund national and regional election campaigns, making it widely known that elected officials are already indebted to these groups politically (Indonesia Corruption Watch, 2018; Primayogha et al., 2020; Singgih et al., 2023).

Additionally, there are technical challenges. In the system of Java-Bali, which is home to around 60% of Indonesia's population, PLN already has an oversupply of electricity. Even with subsidies keeping electricity prices low, demand remains sluggish, leaving a power surplus. As a result, NRE struggles to gain a foothold in the market.

PLN's electricity oversupply is primarily attributed to overly optimistic demand projections, leading to excessive planning and over-procurement of power plants.

According to John Perkins, who represented a US consulting firm, the issue of overly high electricity demand projections dates back to the early 1970s. His company was tasked with forecasting electricity demand growth in Java at an unreasonably high rate of 17% per year. This was done to persuade PLN to expand its business and to justify U.S. loans to the company (Perkins, 2004). However, over the past 15 years, the role of the United States has been replaced by China and Japan. The IEEFA found that since 2015, electricity demand growth has been consistently overestimated by as much as 34%. As of 2021, about 58% of Indonesia's total installed coal-fired power capacity was financed through debt from China and Japan (Adhiguna et al., 2021).

There is also a pricing challenge. While renewable energy costs is declining, fossil fuels remain difficult to compete with due to their low cost. One key factor is the affordability of coal-fired power plants (CFPPs) in Indonesia. Foreign observers often point to this as a significant obstacle to the country's energy transition. However, a closer look reveals that in the past, these same foreign entities also benefited from the widespread adoption of CFPPs.

The Paiton CFPP complex, for example, supplies about 20% of the electricity demand in Java and Bali (Kartini, 2023). However, according to data from Tempo Data Science and the Global Energy Monitor, ownership of the Paiton power plants was partially held by foreign companies: Paiton-1 by General Electric (the U.S.), Paiton-2 by Siemens (Germany), and Paiton-3 by International Power (the U.K.).[6]

Now, the U.S., Germany, the U.K., Japan, and several other foreign countries—members of the International Partners Group (IPG)—are collaborating with Indonesia through the JETP to fund the energy transition. This partnership includes plans for the early retirement of CFPPs (Muliawati, 2023). From Indonesia's perspective, this ironically means that both the construction and closure of CFPPs rely on foreign money.

Further, in mid-2024, the United States invited Indonesia to join the Mineral Security Partnership (MSP), a coalition of 14 Western countries and the European Union to secure the supply of critical minerals—recognizing, in part, Indonesia's strategic control of nickel resources. This initiative has been framed under the appealing label of 'sustainability.' As a condition for joining, Indonesia is expected to align its nickel production with the standards of the U.S. and its Western allies rather than those of non-Western countries. In response, Indonesia is assured that it will be granted the broadest possible opportunities for cooperation with Western nations. Will Indonesia's bitter history repeat itself through the lens of climate and energy transition?

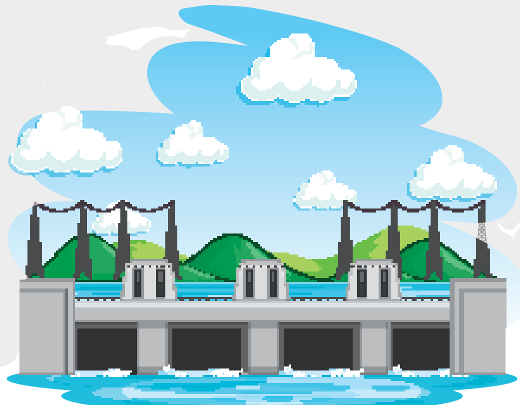
## Conclusion

From a historical perspective, six factors have played the most dominant role in shaping Indonesia's energy market dynamics. First, its natural geography is an archipelago. The second one is technological absence and thus dependence. The third one is the lack of skilled professionals and supporting infrastructure in the energy sector. Fourth, political economic factors, such as constitutional mandates (including natural resource nationalism) and natural resource rent for the government's fiscal. Fifth, factors related to practical politics, including business monopolies, corruption, weak governance, and political electability considerations.

Sixth, geopolitical factors. On the one hand, foreign entities actively seek to maintain their hegemony. On the other hand, there is path dependence. These dynamics lock Indonesia into existing patterns. This is reflected in foreign meddling in formulating foreign interests on the formulation of energy laws and regulations.

Thus far, despite the government's efforts to introduce various energy plans and targets, their implementation and achievements are often shaped by the six factors above. So long as this situation persists, the Indonesian people risk losing out as they fail to fully reap the economic and environmental benefits of the country's energy resources.

To avoid remaining trapped in the same situation and to minimize unnecessary complexity, Indonesia must stay true to its ideological principles outlined in its constitution and enforce them firmly. This ensures that vital energy resources and any energy transition genuinely serve the nation's most important interests.



# 3

# How Much Financing Is Needed for Indonesia's Energy Transition?

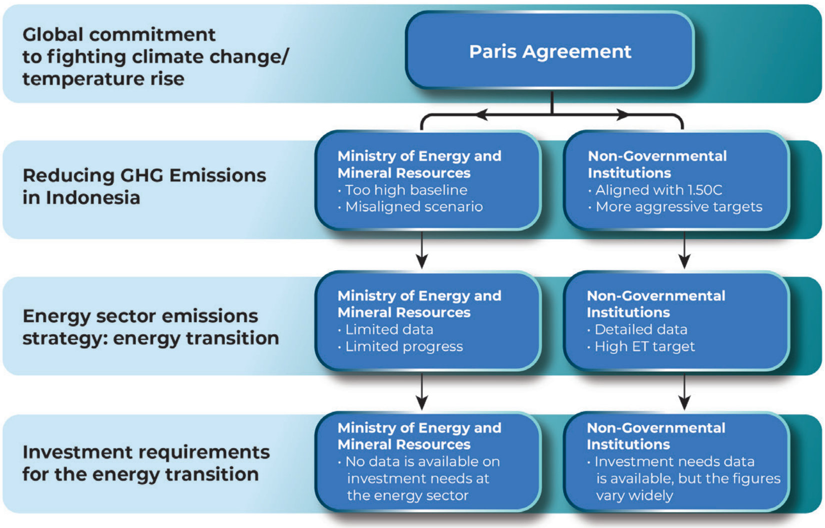
Andreas N. Tjendro

## Introduction

As a member of the United Nations Framework Convention on Climate Change (UNFCCC) and a signatory to the 2015 Paris Agreement, Indonesia has committed to reducing greenhouse gas (GHG) emissions internationally. These commitments are outlined in its Nationally Determined Contributions (NDCs) and Long-Term Low-Emission Development Strategies (LTS) and implemented through various domestic policies across multiple sectors. These efforts focus on transitioning to renewable energy, adopting low-emission fuels, improving energy efficiency, and increasing electrification in the energy sector.

The energy transition will require substantial investment in the coming decades, with the total amount depending on emission scenarios and renewable energy pathways through 2050. However, the exact investment needed remains uncertain as estimates are marred by data limitations, varying and often inconsistent targets, and significant differences in calculation methods.

Figure 1 Thematic Issues from Climate Commitments to Investment Needs




Note: 1.5S is the scenario for limiting the maximum temperature increase to 1.5°C.

*Author, derived from various sources*

This chapter examines the scale of investment required by compiling publicly available information. The discussion begins with the Paris Agreement and then explores the investments needed for Indonesia's energy transition to meet its commitments. Estimating financing demand is challenging as it involves a complex metric chain that spans various thematic issues, including GHG emissions, the renewable energy mix, and overall investment needs.

Inconsistencies in historical data are typical across the Ministry of Energy and Mineral Resources (MEMR) documents, especially compared to reports from non-governmental organizations in Indonesia. Similarly, scenarios and pathways for reducing emissions and increasing the renewable energy mix often vary between MEMR documents and those from other organizations.

Lastly, MEMR's published documents lack clarity regarding investment needs. Fortunately, other organizations have provided more detailed investment requirements for Indonesia's energy transition, though their estimates vary widely.

## Indonesia's Commitment to Reducing GHG Emissions

As outlined in various official documents, Indonesia has committed to reducing greenhouse gas (GHG) emissions. GHG emissions are measured in tons of $CO_2$ equivalent ($tCO_2e$) or, more commonly, in millions of tons ($MtCO_2e$). The national GHG inventory, in fact, includes seven types of gases, with carbon dioxide ($CO_2$) being the most significant contributor. However, all other gases are also accounted for by converting them into $CO_2$-equivalent units based on their global warming potential (GWP) relative to $CO_2$.

Table 1 Indonesia's Various Commitments to Reducing GHG Emissions

| Commitment | Metric | Target | Reference Document |
|---|---|---|---|
| First NDC (2016) by 2030 | Percentage reduction in GHG emissions compared to the BAU scenario in 2030 | CM1 Scenario: 29% reduction (unconditional)<br>CM2 Scenario: 41% reduction (conditional on international assistance) | The Paris Agreement: to keep the global average temperature increase well below 2°C above pre-industrial levels |
| LT-LEDS (2021) by 2060 | Absolute GHG emissions in 2050 and beyond | LCCP scenario<br>2030: peak at 1.24 $GtCO_2e$<br>2050: decline to 540 $MtCO_2e$<br>2060: Net Zero Emissions (NZE)<br>Two other scenarios, CPOS and TRNS, are not aligned with IPCC-1.5S. | IPCC-1.5S (2018): to limit global warming to 1.5°C with minimum overshoot, requiring global NZE around 2050 |
| Enhanced NDC (2022) by 2030 | Percentage reduction in GHG emissions compared to the BAU scenario in 2030 | CM1 Scenario: 31.89% reduction (unconditional)<br>CM2 Scenario: 43.20% reduction (conditional on international assistance) | First NDC (2016) and LT-LEDS (2021) |
| Energy Sector Roadmap to NZE (2022) by 2060 | Absolute GHG emissions by 2060 (only in the energy sector) | Net zero emissions (NZE) by 2060 and with an accelerated target by 2050 | Collaboration with the International Energy Agency (IEA) to develop the roadmap |

Note: BAU = Business As Usual; CM = Counter-Measure; LCCP = Low-Carbon Scenario Compatible with Paris Agreement; CPOS = Current Policy Scenario; TRNS = Transition Scenario

*Author, derived from various sources*

Indonesia's First NDC (2016) represents the country's commitment to the Paris Agreement (2015). The emission reduction targets use relative metrics, making them more achievable. For example, the BAU emissions projection can be set at a high level. The BAU scenario itself is based on historical emissions and forecasts of GDP growth, population, and sectoral output from 2010 to 2030.

The LTS (2021) was developed in response to the growing need for more ambitious and long-term emission reductions following the IPCC Special Report on Global Warming of 1.5°C (IPCC-1.5S) in 2018. The report emphasized that achieving net zero emissions (NZE) around 2050 is crucial to keeping global warming below 1.5°C with minimal overshoot. Since then, countries and non-state actors—including Indonesia—have announced their commitments to reaching NZE by 2050, with Indonesia targeting 2060. This shift toward NZE goals has made emission targets more concrete and less susceptible to manipulation.

The Enhanced NDC (2022) was released six years after the First NDC (2016) and following the LTS (2021). It builds on both documents and includes a slight increase in the emission reduction targets set in the First NDC. However, the data and emission targets in the Enhanced NDC are not fully aligned with those in the LTS.

The Energy Sector Roadmap to NZE (2022) was developed in collaboration with the International Energy Agency (IEA) and outlines a path to achieving NZE in the energy sector by 2060, with an accelerated pathway aiming for NZE by 2050.

| Table 2 | Actual Data and Emission Pathways Across Different NDCs and the LTS |
|---|---|

| Scenario/GHG Emission Level ($MtCO_2e$) | 2010 (Actual) | 2030 (Target) | 2050 (Target) |
|---|---|---|---|
| **First NDC – BAU** | **1,334** | **2,869** | **n/a** |
| **First NDC – CM1** | **1,334** | **2,034 (29% reduction)** | **n/a** |
| **First NDC – CM2** | **1,334** | **1,787 (41% reduction)** | **n/a** |
| **Enhanced NDC – BAU** | **1,334** | **2,869** | **n/a** |
| **Enhanced NDC – CM1** | **1,334** | **1,953 (31,89% reduction)** | **n/a** |
| **Enhanced NDC – CM2** | **1,334** | **1,632 (43,20% reduction)** | **n/a** |
| **LTS– CPOS** | **~1,120** | **~1,550** | **2,454** |
| **LTS– TRNS** | **~1,120** | **~1,240** | **1,526** |
| **LTS– LCCP** | **~1,120** | **~1,240** | **540** |

Note: The Energy Sector Roadmap to NZE is not included in the table, as it focuses solely on GHG emissions from the energy sector.

Author, derived from various sources

## Emissions Baseline Remains Too High

The LTS revised actual 2010 emissions downward from 1,334 $MtCO_2e$ (as stated in the First NDC) to 1,120 $MtCO_2e$, a reduction of about 200 million tonnes. However, the Enhanced NDC retained the 2010 emissions level from the First NDC. A lower actual emissions figure for 2010 would have led to lower business-as-usual (BAU) emissions projections for 2030—the baseline scenario for reductions—and more ambitious CM1 and CM2 reduction targets, also by about 200 million tonnes. Instead of lowering BAU emissions projections, the Enhanced NDC increased the reduction targets by 2-3% compared to the First NDC. As a result, the net increase in reductions amounted to only about 100 million tonnes, making the targets less ambitious.

## Unsynchronized Emissions Scenarios

The LTS sets more ambitious reduction targets through 2050, outlining more aggressive multi-year pathways to 2030 and 2040 than those in the First NDC. It projects 2030 emissions ranging from 1,240 $MtCO_2e$ (TRNS, LCCP) to 1,550 $MtCO_2e$ (CPOS). However, the Enhanced NDC, released after the LTS, does not align with its scenarios. Instead, it projects higher 2030 emissions, reaching 1,632 $MtCO_2e$ (CM2) and 1,953 $MtCO_2e$ (CM1).

Therefore, Indonesia has projected six emission scenarios—three from the Enhanced NDCs and three from the LTS—not including the additional three scenarios from the Energy Sector Roadmap to NZE. Of these six, only the LTS-LCCP scenario is aligned with the Paris Agreement.

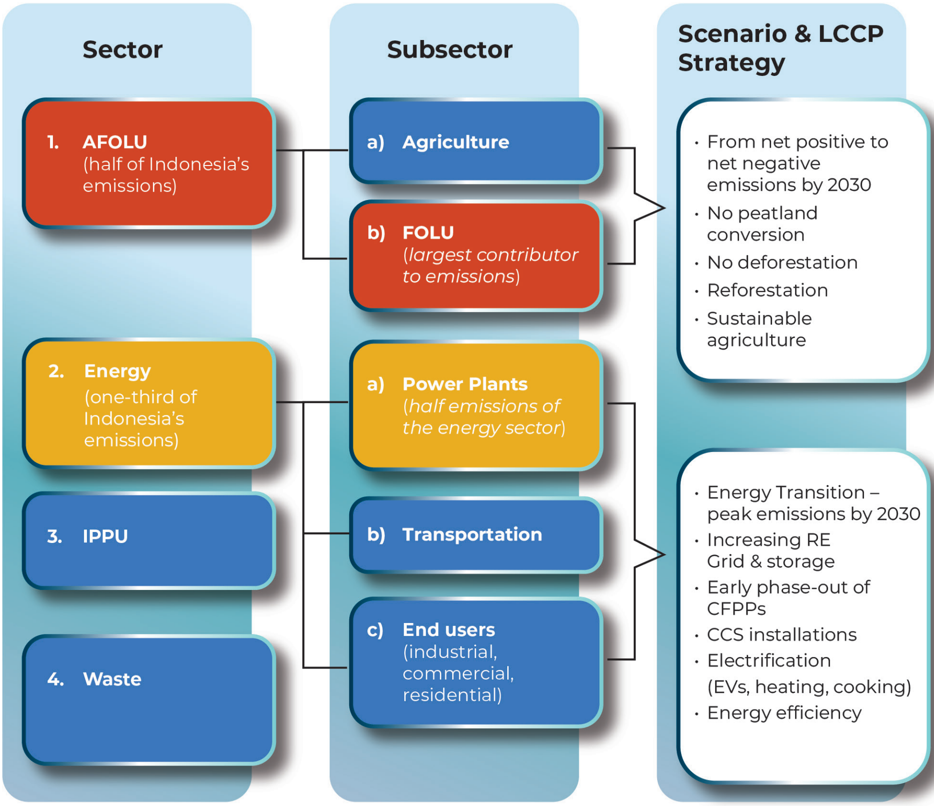
By 2030, Indonesia has a substantial opportunity to meet its Enhanced NDC targets (CM1 or CM2), achieving emission reductions of 31.89% and 43.20%, respectively—figures that may look impressive on paper. However, these targets would still result in a 74% increase in emissions under CM1 and a 46% increase under CM2 compared to the revised 2010 emissions level of 1,120 MtCO2e. Additionally, both scenarios would exceed the long-term emission pathway outlined in the LTS to stay on track with the Paris Agreement's 2050 targets.

The missed opportunity to align the Enhanced NDC with the LTS may have created a false confidence that Indonesia is still on track to meet its emission reduction commitments. However, in the ten years since the 2015 Paris Agreement, Indonesia has increased its investment in fossil fuels while making little progress in renewable energy development and transition.

## Four Key Sectors Driving National GHG Emissions

Indonesia's GHG emissions inventory is based on four sectors defined by the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The Intergovernmental Panel on Climate Change (IPCC) provides scientific expertise on climate change to support the UNFCCC.

Figure 2 Sectoral Emissions and LCCP Focus on AFOLU and Energy Sectors




*Author, derived from various sources*

The first sector is Agriculture, Forestry, and Other Land Use (AFOLU). The first subsector is agriculture, which includes emissions from rice cultivation, commercial plantations, and livestock farming. The second subsector is forestry and other land use, often abbreviated as FOLU, which covers emissions from land use, such as deforestation, land clearing for agriculture, and soil degradation. FOLU also accounts for GHG removals through reforestation and sustainable forest management, making it a potential net carbon sink.

The second sector is the energy sector, which includes emissions from fuel combustion in electricity generation (power plants), transportation, and other energy uses across industrial, commercial, and residential sectors. It also covers fugitive emissions released during fossil fuel extraction and processing.

The third sector is Industrial Processes and Product Use (IPPU), which includes emissions from cement and metal production, chemical manufacturing, and products that release GHGs. In the IPCC classification, initiatives related to electrification and energy efficiency in the industrial subsector may also be categorized under IPPU.

The fourth sector is waste, which includes emissions from disposal, processing, decomposition, and solid waste incineration in landfills and effluent.

To meet the national emission reduction targets outlined in the NDC and LTS, Indonesia has developed and implemented initiatives across all sectors while adjusting emission reduction targets at the sectoral level.

## LTS-LCCP Scenario: Focus on AFOLU and Energy Sectors

The NDC and LTS outline six emission scenarios, with LTS-LCCP being the most aspirational, aiming for NZE by 2060 or earlier. This goal is pursued through a two-pronged approach. First, the AFOLU sector will be transformed from a net emitter to a net carbon sink by 2030. Second, the energy sector's peak emission level should be reached by 2030. Under this scenario, national emissions would reach 1,240 $MtCO_2e$ by 2030, then gradually decrease to 540 $MtCO_2e$ by 2050.

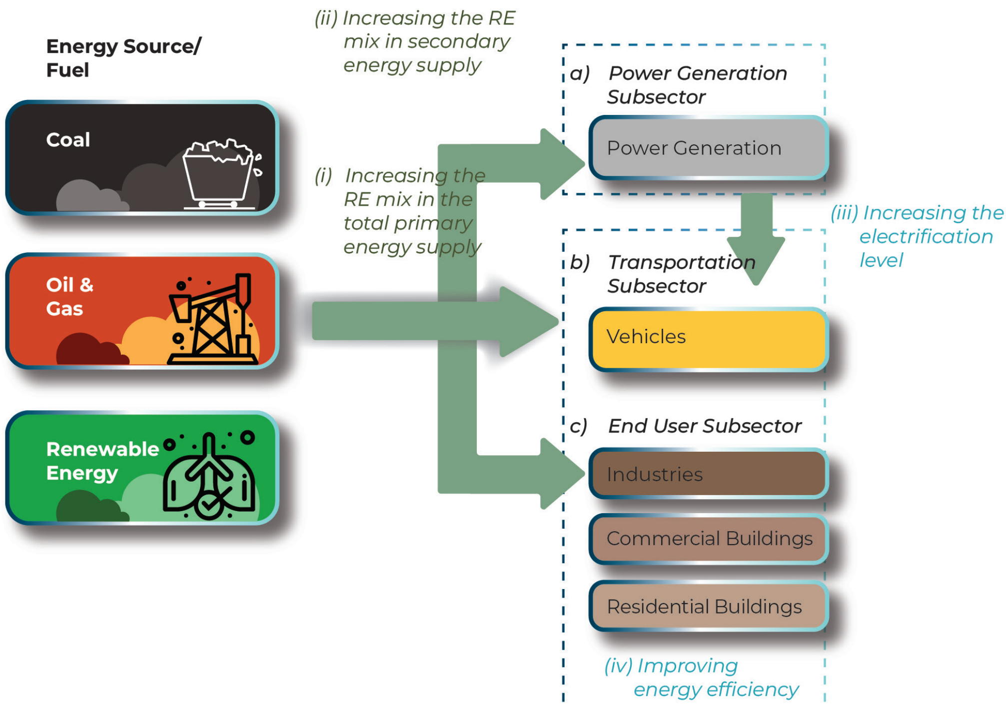
Indonesia's most critical initiative in combating climate change is transforming the FOLU sector from the largest emitter into a net carbon sink by 2030. The second key initiative is the energy transition, which is the primary focus of this chapter.

With the AFOLU sector expected to become a net carbon sink by 2030, the energy sector will remain the most prominent net emitter by a significant margin. The LCCP scenario assumes that energy sector emissions will peak in 2030, whereas the TRNS scenario projects emissions will continue to rise through 2050.

## Energy Sector Emissions Strategy: Energy Transition

The energy sector covers the entire value chain, from primary energy production to final energy consumption. Each stage in this chain contributes to GHG emissions, with some emitting more than others. Power generation is the largest emitter, accounting for nearly half of all energy sector emissions, followed by the transportation and industry subsectors.

Figure 3 Energy System Transition




*Author, derived from various sources*

### Energy Transition = Renewable Energy + Electrification + Efficiency

The energy transition aims to decarbonize the energy system through four key strategies. First, the share of renewables in the Total Primary Energy Supply (TPES) mix must increase. This involves expanding renewable energy use in electricity generation and all end-user sectors, including transportation, industry, commercial, and residential. The progress is measured by the percentage of renewable energy (in joules) relative to total energy (also in joules).

Second, the share of renewable energy in total electricity/power generation (TEPG) should be increased. This means boosting the use of renewables specifically for electricity production. The metric is the percentage of electricity generated from renewable sources (in Joules) relative to total electricity generation (in Joules).

Third, the share of electrification in overall energy use should be increased. This means expanding electricity consumption (sourced from fossil fuels or renewables) across all end users. The metric is the percentage of electrical energy (in Joules) relative to total energy consumption (in Joules).

Fourth, energy efficiency in overall consumption should be improved. This applies to all energy use by end users—both fossil fuels and renewables. The metrics include Joules per US dollar, Joules per vehicle kilometer, Joules per square meter, and similar efficiency measures.

## Diversity of Renewable Energy Mix Metrics

The most common metric for tracking the energy transition is the share of renewable energy in TPES. It provides a comprehensive view of the entire energy sector. However, monitoring and improving this metric is challenging because it depends on two other metrics: the share of renewables in total power generation (TEPG), the electrification rate, and the adoption of renewable fuels in end-users—such as replacing petroleum with biodiesel in transportation.

The second metric, the share of renewable energy in TEPG, is the second most commonly used indicator. It focuses specifically on the electricity generation sector, which is responsible for about half of the energy sector's emissions. This metric is more observable to monitor and improve since the necessary actions—such as replacing coal-fired power plants (CFPPs) with renewable sources—are relatively straightforward. However, it is an incomplete measure and becomes less meaningful if the electrification rate in end-users remains low.

Two other renewable energy mix metrics are commonly referenced in the literature. First, the share of renewables in total final energy consumption (TFEC) measures the portion of renewables consumed by end users, including fuel and electricity. Second, the share of renewables in total installed capacity (TIC) tracks progress in deploying renewable power plants.

Several documents have cited renewable energy mix metrics without clearly specifying which ones were used. Some even appear to have used incorrect metrics. This chapter aims to clearly define and apply renewable energy mix metrics to avoid ambiguity in both writing and calculations.

## The Complexity of Renewable Energy Mix Targets and Pathways

The NDC and LTS include projections or targets for the renewable energy mix, though they are not as detailed as the GHG reduction goals outlined in those documents. The Energy Sector Roadmap to NZE offers a more comprehensive look at the pathways for achieving a renewable energy mix.

Indonesia's First NDC identifies the development of clean energy sources as a key decarbonization strategy for the energy sector, measured by an increase in the renewable energy mix within the TPES. Meanwhile, the Enhanced NDC maintains the same renewable energy mix target while introducing a new goal to reduce energy intensity by 1% annually. It also outlines additional strategies, such as a mandatory biodiesel program (100% B40 by 2030) and an accelerated transition to electric vehicles in the transportation sub-sector. However, in both NDCs, the renewable energy mix target is presented without being explicitly calculated based on the GHG emission reduction target.

Table 3 Indonesia's Commitments to the Energy Transition

| Document | Metric | Target | Commitment Level |
|---|---|---|---|
| First NDC (2016) by 2030 | New and Renewable Energy (NRE) Mix in TPES | Without scenario sharing<br>2025: 23%<br>2050: 31% | The NRE mix target is not connected to emission scenarios (BAU, CM1, CM2). |
| ENHANCED NDC (2022) | Renewable Energy (RE) Mix in TEPG | LCCP Scenario<br>2050: 43% | No renewable energy target, only an "expected scenario." |
| Roadmap (2022) | Renewable Energy (RE) Mix in TEPG | NZE Acceleration Scenario by 2050<br>2030: ~60%<br>2040-2060: ~90% | RE pathways to be achieved in support of the NZE acceleration scenario |

*Author, derived from various sources*

The LTS outlines multi-year renewable energy pathways to 2050 based on three emission scenarios (CPOS, TRNS, LCCP). However, these pathways are presented in absolute renewable energy units rather than as a share of the energy mix. The only reference to the renewable energy mix is the projected 43% share of renewable electricity generation by 2050.

Ultimately, only the Energy Sector Roadmap to NZE outlines renewable energy mix pathways for each of the three emission scenarios (STEPS, APS, NZE). However, these figures are provided only for TEPG, not TPES. Additionally, the three pathways in this roadmap differ from those in the LTS.

Indonesia has projected multiple renewable energy pathways in its NDC, LTS, and Energy Sector Roadmap toward NZE, but they remain unaligned and vary in detail. The NDC provides minimal detail, with its renewable energy mix targets directly taken from the National Energy Policy (2014) without being linked to emission scenarios (BAU, CM1, CM2).

## Lack of Reporting and Progress on the Renewable Energy Mix

Both NDCs set renewable energy mix targets but do not include historical data. Therefore, this article uses the Biennial Update Report (BUR) to determine past figures. The BUR is a mandatory report that Indonesia submits to the UNFCCC every two years to track progress on GHG emission reductions. So far, three BURs have been published (2015, 2018, 2021), with the third BUR providing data on the renewable energy mix in 2019. Meanwhile, the fourth BUR was expected to be released in 2024.

The LTS and the Energy Sector Roadmap to NZE include some historical data on the renewable energy mix, but the most recent figures are from 2021, with no official updates since then. Consequently, by 2025, there is no reported information on renewable energy progress for the past two to four years.

The renewable energy mix target in TPES (23% by 2025) was considered achievable in the First NDC (2016). However, Indonesia is unlikely to meet this target with the mix at just 11% in 2019 and only one year remaining until 2025.

Meanwhile, there is still time to achieve the renewable energy mix target in TEPG (43% by 2050, with an accelerated goal of 60% by 2030 and around 90% by 2050).

However, without regular reporting, it will not be easy to assess whether Indonesia is on track to increase the renewable energy mix in TEPG from 19% in 2021 to these ambitious levels.

Since the energy sector accounts for one-third of total national emissions, failing to meet renewable energy mix targets for the energy transition could jeopardize the country's ability to fulfill its GHG emission reduction commitments.

Table 4 Gaps in Data for Monitoring Renewable Energy Mix Progress

| RE Mix | History | | | Target | | |
|---|---|---|---|---|---|---|
| | 2019 | 2021 | 2022-2024 | 2025 | 2030 | 2050 |
| **Total Primary Energy Supply (TPES)** | **11% (third BUR)** | **N/A** | **N/A** | **23% (NDC)** | **-** | **31% (NDC)** |
| **Total Electricity/ Power Generation (TEPG)** | **16% (LTS)** | **19% (*Roadmap*)** | **N/A** | **-** | | **43% (LTS-LCCP)** |
| | | | | | **~60% (Roadmap-NZE acceleration)** | **~90% (Roadmap-NZE acceleration)** |

*Author, derived from various sources*

## Measuring Investment Needs

The Ministry of Energy and Mineral Resources (MEMR) provides limited details on the investment required for the energy transition. The second BUR (2018) initially estimated financing needs at USD247 billion between 2018 and 2030 or USD19 billion annually. In the third BUR (2021), this estimate increased to USD281-285 billion for the same period or USD22 billion annually. However, this funding is intended to reduce emissions nationwide, not just in the energy sector.

The LTS-LCCP (2021) estimated a total investment of USD745.8 billion between 2020 and 2050 or about USD24 billion annually. Again, this figure covers national emission reductions, with no specific breakdown for the energy sector or individual energy transition initiatives.

Fortunately, other institutions have simulated Indonesia's energy transition in alignment with the official MEMR scenario. Five organizations, including the IEA, collaborated with the MEMRto develop its roadmap.

All IPCC-1.5S-aligned scenarios from these agencies follow an emissions pathway that peaks in the 2030s, with the energy sector reaching net zero emissions (NZE) by 2050, except for JETP and CPI, which focus solely on the power generation subsector. These agencies project a significantly higher renewable energy mix than Indonesia's NDC and LTS to achieve NZE in the energy sector. For instance, the LTS-LCCP scenario targets a 43% renewable energy mix in TEPG by 2050. In contrast, the IEA aims for around 90%, and the Institute for Essential Services Reform (IESR) and the International Renewable Energy Agency (IRENA) project up to 100% renewable energy mix in TEPG.

Table 5 RE Pathway to Net Zero Emissions in Indonesia, Developed by the IEA and MEMR

| Scenario | Description | Emission Line | RE Mixed Path ET |
|---|---|---|---|
| *Stated Policies Scenario (STEPS)* | **Reference scenarios based on officially established policies and regulations** | **Not aligned with the 1.5°C target/ $CO_2$ emissions from energy and industry sectors rise by nearly 60% by 2050** | **Power plants: ~30% (2030) ~55% (2050) ~60% (2060)** |
| *Announced Pledges Scenario (APS)* | **NZE by 2060, with substantial reductions in energy sector emissions** | **Aligned with LTS but not with the 1.5°C target/ emissions from electricity peak around 2030 and near zero by 2050** | **Power plants: ~35% (2030) ~85% (2050) ~90% (2060)** |
| *NZE by 2050 (NZE Acceleration)* | **Accelerated NZE by 2050** | **Aligned with the 1.5°C target/ NZE by 2050** | **Power plants: ~60% (2030) ~90% (2040-2060)** |

*Author, derived from various sources*

Table 6 IRENA's RE Pathway to NZE

| Scenario | Description | Emission Line | RE Mixed Path |
|---|---|---|---|
| *Planned Energy Scenario (PES)* | **A reference scenario based on current and planned policies, reflecting the most likely trajectory** | **Not aligned with the 1.5°C target/energy sector emissions rise by ≥ 80% by 2050** | **Primary Energy: 16% (2030) 24% (2050)** |
| *Transforming Energy Scenario (TES)* | **Accelerated energy transition scenario** | **Not aligned with the 1.5°C target/Emissions: - peak in mid-2030s - 18% below current levels by 2050** | **Primary Energy: 21% (2030) 45% (2050)** |
| *1.5C Scenario (1.5-S)* | **An accelerated energy transition scenario aiming for a global NZE target by 2050** | **Aligned with the 1.5°C target/Emissions: - peak in mid-2030s - one-third of current levels by 2050** | **Primary Energy: 23% (2030) 70% (2050)** |

*Author, derived from various sources*

All agencies clearly outline the connection between emission pathways and renewables, the initiatives required to achieve NZE in the energy sector, and the necessary investment. They also set more ambitious renewable energy mix targets, offering greater detail and coherence, elements lacking in the NDCs and LTS.

The first institution is the International Energy Agency (IEA), a global organization focusing on energy policies in its member countries. In September 2022, the IEA published An Energy Sector Roadmap to Net Zero Emissions in Indonesia in collaboration with the MEMR.

The second institution is the International Renewable Energy Agency (IRENA), an intergovernmental organization that supports countries in transitioning to a sustainable energy future. In October 2022, IRENA developed a renewable energy pathway to NZE in the Indonesia Energy Transition Outlook.

Table 7 Energy Transition Pathway to NZE in Indonesia, Developed by IESR

| Scenario | Description | Emission Line | RE Mixed Path ET |
|---|---|---|---|
| *Current Policy Scenario (CPS)* | **Fossil-based systems** | **Not aligned with the 1.5°C target/ emissions 2x over the next 30 years** | **Primary Energy: 15% (2030) 25% (2050)** |
| *Delayed Policy Scenario (DPS)* | **Renewable-based system** | **Not aligned with the 1.5°C target/Emissions are decreasing slowly.** | **Primary Energy: 15% (2030) 90% (2050)** |
| *Best Policy Scenario (BPS)* | **Deep decarbonization of the energy system** | **Aligned with the 1.5°C target/ NZE by 2050** | **Primary Energy: 20% (2030) 100% (2050)** |

*Author, derived from various sources*

The third institution is the Institute for Essential Services Reform (IESR), an independent think tank based in Indonesia that advocates for domestic and regional sustainable energy policies and practices. This is outlined in Deep Decarbonization of Indonesia's Energy System: A Pathway to Zero Emissions by 2050 (May 2021).

The fourth institution is the Just Energy Transition Partnership (JETP), an international collaboration that supports countries in transitioning from fossil fuel-based energy systems to cleaner renewable sources. JETP Indonesia aims to peak emissions in the power generation sector by 2030 and achieve net zero emissions by 2050 by accelerating the early phase-out of coal-fired power plants and ensuring that at least 34% of all power generation comes from renewable energy by 2030.

The fifth institution is the Climate Policy Initiative (CPI), an analytical and advisory organization with deep expertise in finance and policy. CPI aims to help governments, businesses, and financial institutions drive economic growth while addressing climate change. In August 2023, CPI published *Landscape of Indonesia Power Sector Finance*, which outlines investment needs and commitments for the energy transition based on the MEMR Roadmap toward NZE. However, CPI does not simulate its pathway.

## Wide Range of Investment Needs Estimates

Investment needs vary widely among agencies. First, each agency develops its NZE pathway. Second, the pathways include different initiatives. For example, through three key strategies, Indonesia's LTS-LCCP envisions near-total decarbonization of the power generation sector by 2050. Firstly, 43% of power generation will come from renewable sources such as hydro, geothermal, solar, wind, and biomass. Secondly, 76% of coal-fired power plants (CFPPs) will be equipped with Carbon Capture and Storage (CCS) or Carbon Capture, Utilization, and Storage (CCUS) to achieve zero emissions. Thirdly, Biomass Energy with Carbon Capture and Storage (BECCS) will contribute 8% of the power generation mix, aside from 43% of renewables.

Another example is JETP, which, in addition to the power generation sector initiatives mentioned above, has also introduced financing for the early phase-out of coal-fired power plants (CFPPs). Meanwhile, IEA, IRENA, and IESR calculations extend beyond the power generation sector to the broader energy sector, recognizing the need for electrification and energy efficiency investments.

Table 8 Energy Transition Initiatives and Their Investment Needs

| Initiative | | IEA NZE | IRENA 1.5-S | IESR BPS | JETP | CPI | MEMR |
|---|---|---|---|---|---|---|---|
| *Renewable Energy Mix in 2050* | TPES | ~85% | 70% | 100% | n/a | 87% | 31% (NDC) |
| | TEPG | ~95% | 85/90/ 100% | 100% | 34% (2030) | n/a | 43% (LTS) |

| Initiative | | IEA NZE | IRENA 1.5-S | IESR BPS | JETP | CPI | MEMR |
|---|---|---|---|---|---|---|---|
| *Power Plants* | **Renewables** | a | A | a | a | a | a |
| | **Fossil** | a | A | a | | | a |
| | **+CCS** | a | A | | | | |
| | **Early phase-out** | | | | a | | |
| *Electricity Network & Flexibility* | **Transmission & distribution** | a | A | a | a | | a |
| | **Battery & storage** | a | A | a | | | a |
| *Electrification* | **EV infrastructure (chargers & batteries)** | a | A | a | | | |
| | **Heating & cooking** | a | A | a | | | |
| *Clean fuel* | **Biofuel** | a | A | | | a | a |
| | **Hydrogen** | a | A | a | | | |
| | **Synfuels** | | | a | | | |
| *Energy Efficiency* | **Buildings, industry, transportation** | a | A | | | | |
| *Annual Investment (billion USD)* | | 90 (2026-2030) and 85 (2046-2050) | 73-76 (2018-2050) | 20-25 until 2030) and 60 (2030-2040) | ≥ 97 (Total 2023-2030) or 12 annually ≥ 580 (Total 2023-2050) or 21 annually | 16.1 (until 2060) | 28.5 (2022-2060) based on the MEMR presentation at COP 27 |

*Author, derived from various sources*

Based on the data above, annual investment varies significantly, ranging from USD12 billion to USD90 billion by 2030 and USD21 billion to USD85 billion from 2030 to 2050. This wide variation can be better understood by categorizing the five pathways into two distinct types.

The first category includes pathways with broad sector coverage (the energy sector) and a high renewable energy mix target, as calculated by IEA, IRENA, and IESR. Estimated annual investment needs range from USD60 billion to USD90 billion. The second category focuses on narrower sector coverage (power generation subsector) and a lower renewable energy mix target, as calculated by JETP, CPI, and MEMR. Annual investment needs are estimated between USD16.1 billion and USD28.5 billion.

By taking the median of the above estimates, this chapter concludes that investment needs fall into two categories, which are the broad and ambitious target of USD73–76 billion per year (based on IRENA's 1.5-S scenario) and the narrower, more practical target of USD21 billion per year (based on JETP).

## Availability of Historical Investment Data in Energy Transition

The MEMR provides limited details on historical investment in the energy sector. The LTS includes some national-level figures, covering more than just the energy sector, but presents them in graphs without further explanation. Fortunately, non-governmental organizations offer additional insights into actual investment in Indonesia’s energy sector.

These figures vary and are not directly comparable due to differences in scope and investment periods. However, without official government data, this chapter relies on the best available information. Currently, annual investment in the energy sector stands at USD20 billion, while the estimated need is USD73–76 billion per year, requiring a 3.6x to 3.8x increase. For the power generation subsector, current investment ranges from USD5 billion to USD12 billion per year, whereas the estimated need is USD25 billion per year, requiring a 2.1x to 5.0x increase.

Table 9 Investment in Indonesia's Energy Sector

| Institution | Sector | Investment Coverage | Investment Amount |
|---|---|---|---|
| IEA | **Energy sector** | **Not just renewable energy, but also fossil fuels** | **Actual investment USD20 billion/ year (2016-2020)** |
| IRENA | **Power generation subsector** | **Not just renewable energy, but also fossil fuels** | **Actual investment USD12 billion/year (2019)** |
| CPI | **Power generation subsector** | **58% renewables; 42% on-grid fossil fuels** | **Monitored commitments USD35.6 billion (2015-2021) or USD5 billion/year (all) or USD2 billion/year (RE)** |

Note: IESR, JETP, and the MEMR do not report on actual investments.

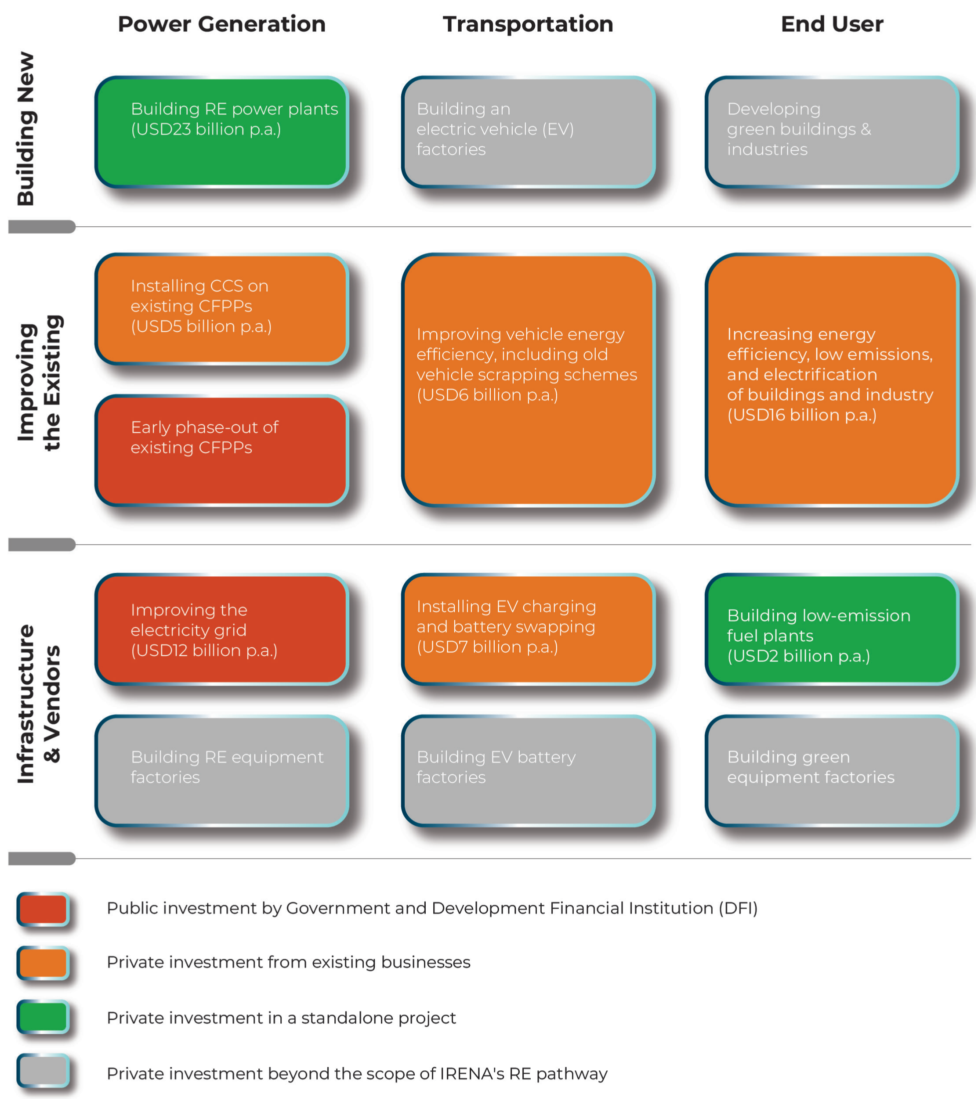
*Author, derived from various sources*

## Financing Options to Meet Investment Needs

This chapter examines investment needs across the energy sector ecosystem to identify the most effective financing strategies for the energy transition. The investment estimates are based on IRENA's 1.5-S scenario, specifically RE90, which targets a 90% renewable energy mix in TEPG by 2050. This scenario represents the median estimate among all energy sector pathways aligned with the 1.5S target and provides the most detailed breakdown of energy transition investment initiatives.

The energy ecosystem is structured around a matrix of energy subsectors—including power generation, transportation, and end users—and value chains, encompassing new producers, upgrades of existing producers, vendors, and infrastructure. However, some initiatives within this ecosystem do not have defined investment values as they are not explicitly included in the renewable energy pathways outlined in the IRENA scenarios.

Figure 4 Energy Sector Value Chain Matrix




*Author, derived from various sources*

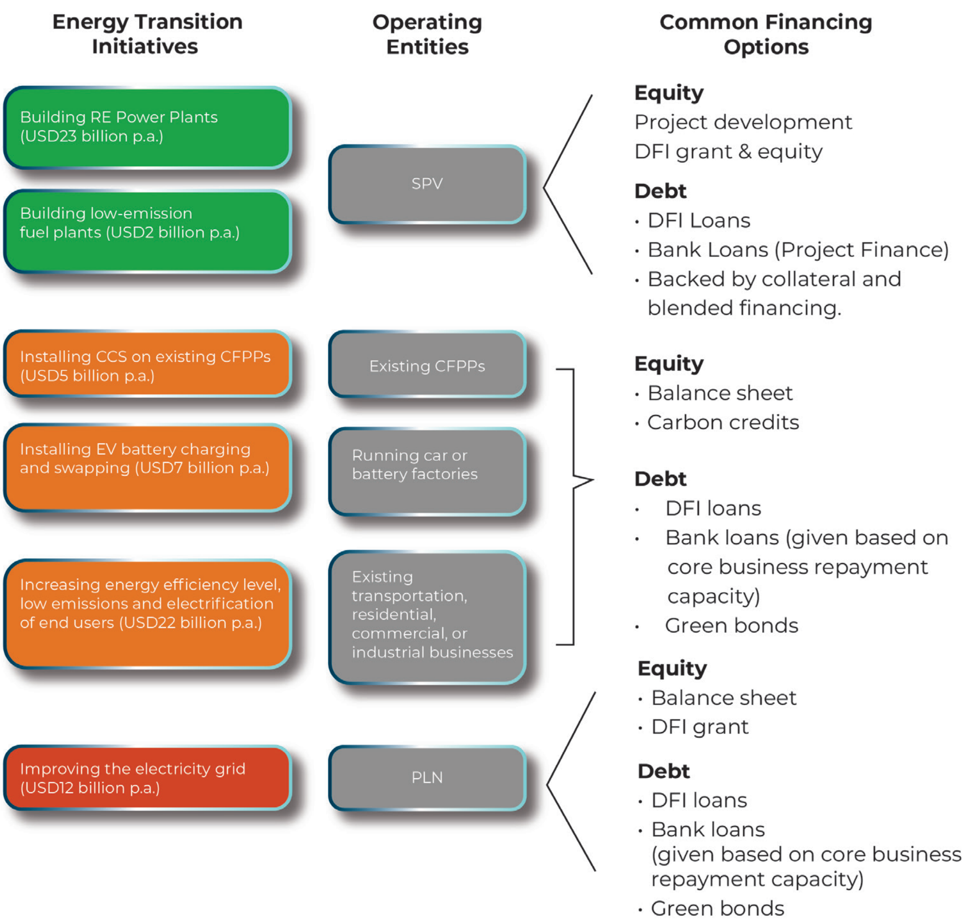
The most significant investment must focus on making existing businesses greener —reducing emissions, improving energy efficiency, and increasing electrification— in the power generation sector (USD5 billion p.a. for CCS), transportation (USD6 billion p.a. for vehicle energy efficiency), and end users (USD16 billion p.a. for buildings and industry). Financing for these initiatives will come from existing business equity, bank loans, and green bonds, backed by the company's overall repayment capacity. Carbon credits generated from these efforts may also be leveraged to strengthen repayment capacity.

Similarly, financing for electric vehicle (EV) infrastructure (USD7 billion p.a.) will likely be integrated into the broader EV industry, including battery manufacturers and EV makers, rather than operating as a standalone business model.

Another private investment needs involves developing renewable power plants (USD23 billion per year) and renewable or low-emission fuel plants (USD2 billion per year). Unlike upgrades to existing businesses, these new core projects require dedicated financing. Financing will primarily come through project finance structures using a Special Purpose Vehicle (SPV), with equity provided by project developers and debt financing through bank loans. Government or development financial institution (DFI) guarantees and blended funding may be used to mitigate higher risks. However, green bonds and carbon credits are generally unsuitable for SPV structures.

Some initiatives are better suited for public financing. For example, the electricity grid (USD12 billion per year) is monopolized by Perusahaan Listrik Negara (PLN), which can raise funds through bank loans and green bonds. In contrast, the early phase-out of CFPPs would lead to financial losses for plant owners, making it unsuitable for private financing. Therefore, government support and funding from development financial institutions (DFIs) will be essential.

Figure 5 Mapping Energy Transition Initiatives with Financing Options




Note: Lenders, such as DFIs and commercial banks, can issue green bonds to finance their loans for energy transition initiatives.

*Author, derived from various sources*

## Conclusion

Indonesia has made international commitments to reduce GHG emissions by submitting its NDC and LTS under the Paris Agreement (2015) and later aligning with IPCC-1.5S (2018). However, the emission scenarios outlined in the NDC and LTS have several issues, as summarized in Table 7. The MEMR was expected to release the second NDC and fourth Biennial Update Report (BUR) in 2024 and they should address some of these challenges.

Table 10 List of Issues and Recommendations

| Topic | Issue | Recommendation for the MEMR | Forum |
|---|---|---|---|
| *1. Emission reporting* | **(i) Actual emissions (2010, 2020) and BAU scenario (2030) remain too high** | **Updating NDC emissions (2010, 2020) and BAU scenarios (2030) to align with LTS** | **Second NDC (2024)** |
| | **(ii) Unsynchronized emissions scenario** | **Aligning three NDC scenarios (BAU, CM1, CM2) with LTS (CPOS, TRNS, LCCP)** | **Second NDC (2024)** |
| *2. RE metrics standardization* | **(i) RE mix targets in NDC are not aligned with LTS** | **Aligning RE mix targets in NDCs with RE pathways in LTS scenarios and/ or roadmaps** | **Second NDC (2024)** |
| | **(ii) LTS uses absolute RE units** | **Providing the RE mix, not just absolute RE units** | **Next LTS version (if any)** |
| | **(iii) NDC uses TPES; LTS uses TEPG** | **Using both RE-TEPS and RE-TEPG** | **Second NDC (2024)** |
| *3. Energy Transition Reporting* | **(i) Insufficient data on historical RE mix** | **Reporting the RE mix more regularly and including all four RE metrics.** | **Fourth BUR (2024)** |
| | **(ii) Insufficient data on other metrics** | **Reporting electrification & energy efficiency metrics** | **Fourth BUR (2024)** |
| | **(iii) Insufficient comparison to targets** | **Reporting all metrics in time series format and against targets** | **Fourth BUR (2024)** |
| | **(iv) BURs are only published every three years.** | **Publishing data on the web more frequently/ periodically** | **The MEMR website** |
| *4. Investment reporting* | **(i) Insufficient data on past investments** | **Reporting past investments, specifically for the energy transition** | **Fourth BUR (2024)** |
| | **(ii) Insufficient details about investments** | **Reporting investments at the initiative level** | **Fourth BUR (2024)** |
| | **(iii) Scarce and restricted data** | **Reporting investments in time series format on the web** | **The MEMR website** |

*Author, derived from various sources*

Non-governmental organizations offer alternative energy sector pathways for Indonesia that align with IPCC-1.5S. IEA, IRENA, IESR, and JETP provide more detailed scenarios and investment requirements. While their approaches may have some limitations, these scenarios have been instrumental in estimating the investment needs for energy transition.

The investment needs estimated by various agencies vary significantly. Based on the IRENA 1.5-S scenario, the median estimate is USD73–76 billion annually. This figure falls between the broad and ambitious energy sector pathways aligned with 1.5S (IEA, IRENA, and IESR) and is close to the average estimate. This median scenario provides a detailed investment breakdown, making it helpful in exploring different financing options. Furthermore, IRENA's estimated USD25 billion per year for Renewable Energy Generation and Fuels (REGF) aligns with the investment ranges projected by the narrower scenarios focused on electricity generation from JETP, CPI, and the MEMR.

Estimates of the financing gap vary across agencies. However, they all agree that investment in energy transition must increase by 2 to 5 times compared to recent energy sector investments (including fossil fuels) to achieve NZE by 2050.

Energy transition financing can come from existing businesses decarbonizing their operations (self-financing). It can also come from the government and development financial institutions (DFIs) investing in infrastructure. New business models can also play a role, including blended financing, project financing, bank loans, and green bonds for established creditworthy businesses. In addition, projected carbon credits generated through the successful implementation of these initiatives may also strengthen repayment capacity.

# 4

# Fiscal Challenges in Energy Transition

Sugiharso Safuan

## Introduction

Indonesia ratified the Paris Agreement through Law Number 16 Year as part of its commitment to tackling climate change. The agreement seeks to limit global temperature rise to below 2.0°C, aiming to keep it under 1.5°C. It also requires participating countries to establish their own Nationally Determined Contributions (NDCs) to help achieve these targets.

Indonesia's Enhanced NDC aims to cut $CO_2$ emissions by 31.89% by 2030 compared to the business-as-usual (BAU) baseline, with the potential to reach 43.20% with international support. The Ministry of Energy and Mineral Resources is responsible for achieving around 11% of this reduction from the energy sector. In comparison, the Ministry of Environment and Forestry delivers approximately 17 percentage points of this reduction, from the forestry sector.

The Paris Agreement also highlights the need for swift emission reductions through mitigation efforts, incentives to curb deforestation-related emissions, and sustainable forest management. Building on this, at the 2021 UN Climate Change Conference (COP 26), 197 countries signed the Glasgow Climate Pact, which calls for phasing down coal use, speeding up the shift to low-emission energy systems, and ending inefficient subsidies for fossil fuel-based electricity. Governments are also expected to support the poorest and most vulnerable communities affected by climate change.

Energy transition refers to the systematic shift from traditional, carbon-intensive sources like coal, oil, and natural gas to more sustainable and renewable options like wind, solar, and hydropower. This transition involves various strategies and policies designed to decarbonize the energy system, reduce greenhouse gas emissions, mitigate climate change, and enhance energy security. To achieve this, governments are promoting a shift away from fossil fuels (especially coal and oil) toward cleaner, renewable alternatives (like solar, wind, hydro, geothermal, bioenergy, and tidal energy). Overusing fossil fuels not only harms the environment, but also affects vulnerable communities and ecosystems. By advancing renewable energy programs, governments aim to build a more equitable and sustainable energy future.

However, reducing reliance on fossil fuels presents economic and social challenges and new opportunities. This chapter focuses specifically on the fiscal challenges associated with energy transition.

## Fiscal Management Before 1980

From the revenue side, Indonesia's reliance on export revenues contributed to a volatile fiscal revenue stream. Before the oil boom in the 1970s, Indonesia depended heavily on agricultural exports, which were highly volatile and susceptible to global price fluctuations (Glassburner, 1978). This dependence on unpredictable revenue streams frequently led to shortfalls in government finances.

Indonesia's reliance on oil revenues in the 1970s was also a problem. While rising oil prices temporarily eased fiscal pressures, the relief was short-lived. When prices dropped, it created an imbalance between income and spending. This dependence on a single export commodity (oil) led to significant budget volatility (Booth, 1998).

Meanwhile, on the spending side, the sizeable fiscal deficit before 1980 was primarily driven by excessive military spending and infrastructure projects that exceeded the government's budget capacity at that time.

Another key issue was subsidies. Indonesia's commitment to energy subsidies in the state budget began in the 1960s and 1970s. Initially, the government introduced these subsidies to keep energy affordable for the public and support industrial growth. In the early 1970s, the oil boom soared revenues, enabling the government to expand subsidies for petroleum products and keep domestic fuel prices low to stimulate industry further. However, this substantial commitment to energy subsidies deepened in the 1980s as the government became increasingly reliant on oil revenues, justifying subsidies to sustain economic stability and regulate domestic fuel prices.

When volatile and weak fiscal revenue was combined with excessive fiscal spending, it resulted in a fiscal shortfall. To cover this shortfall, the government frequently resorted to printing money through Bank Indonesia, which lacked the autonomy to refuse such requests. This further fueled hyperinflation, eroded people's purchasing power, and ultimately led to a prolonged economic crisis until the late 1960s (Hill, 2000).

Such hyperinflation occurred around 1964. Budget deficits still surged as government revenues remained weak and printing money increasingly became the default solution to finance spending, further fueling inflation (Feith & Castles, 1970). This economic collapse was unprecedented. Chronic inflation, which had persisted since the early 1950s due to rapid monetary expansion in the early 1960s, spiraled into severe hyperinflation, reaching 135% in 1964 and nearly 600% in 1965 (Grenville, 1981). Meanwhile, Indonesia’s political and democratic decline since 1957 further undermined Bank Indonesia’s ability to function as an independent central bank, even as central banks in other countries were beginning to adopt greater independence.

Although regulations stipulated that the money supply should not exceed five times the foreign exchange reserves held by Bank Indonesia, the central bank’s independence ended. Bank Indonesia became a de facto instrument of the central government, printing ever-increasing amounts of money to cover the growing budget deficit, clearly violating existing deficit spending limits. During this period, Indonesia’s fiscal deficit expanded rapidly as government spending surged while revenues remained stagnant, further deepening the fiscal imbalance (Prawiro, 1998).

Printing money was not the only way to cover the deficit. Soekarno's administration also relied heavily on external loans to fund infrastructure projects and military expenditures, leading to a substantial foreign debt burden (Booth, 1998).

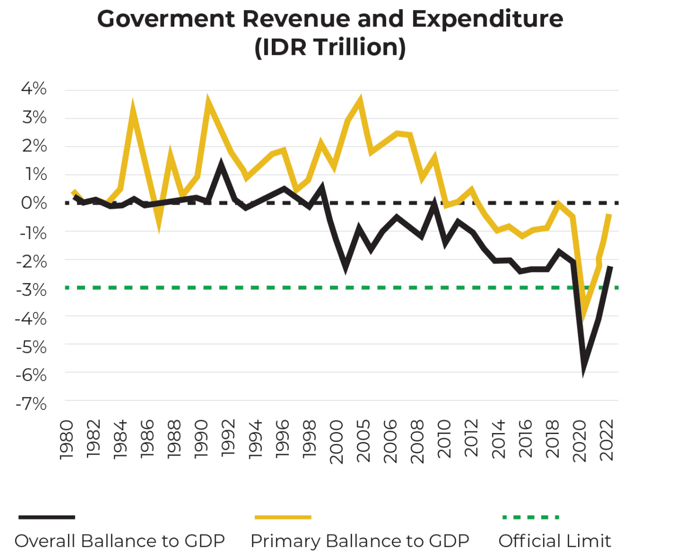
To sum up, during the pre-1980 era, Indonesia's weak fiscal condition was driven by heavy reliance on volatile commodity-based export revenues, extensive infrastructure, and military spending beyond fiscal capacity, accompanied by excessive subsidies. This was further exacerbated by taking wrong mitigations, such as printing money and raising excessive debt. Efforts to address these issues began in the post-1980 era.

## Fiscal Management After 1980

In the 1980s, following the oil price shock, the government allocated a significant portion of the budget to fuel subsidies to shield consumers from rising energy costs. This period marked the start of large-scale, long-term fuel subsidies in the State Budget. By the early 2000s, as Indonesia transitioned from an oil exporter to an importer, fuel subsidies reached record levels due to global oil prices. However, this fiscal pressure ultimately prompted government reforms in the 2000s and 2010s to reduce subsidy allocations gradually.

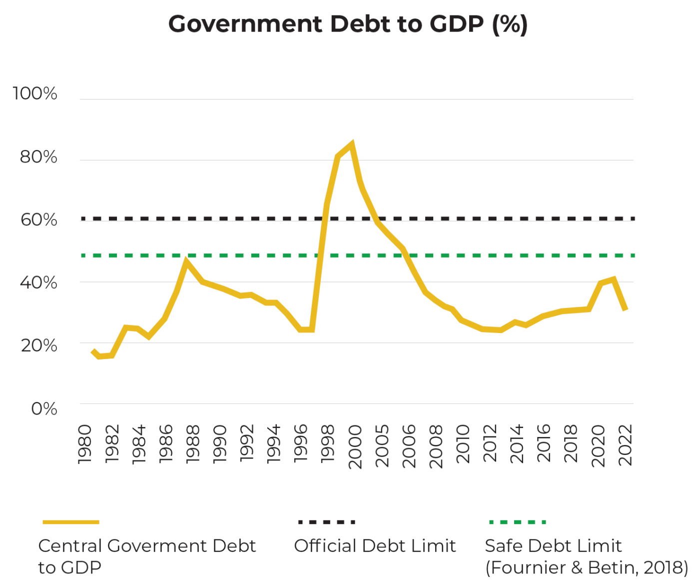
After the 1997–98 economic crisis, Indonesia undertook significant budget reforms, notably introducing fiscal rules through the 2003 State Finance Law. This law capped the annual deficit at 3% of GDP and total debt at 60% of GDP. Between 2003 and 2011, Indonesia successfully maintained its budget deficit within these limits, averaging a deficit-to-GDP ratio of around 0.97% and frequently achieving primary surpluses, except in 2009. Thanks to strict fiscal management in the preceding years, Indonesia was able to expand government spending from 2011 onward while complying with its fiscal rules.

Figure 1 Indonesian State Budget and Government Debt (1980-2022)




(a)

*Source: CEIC*




(b)

*Source: IMF, OECD*

The dynamics of government revenue and spending from 1980 to 2022 are illustrated in Figure 1(a). The figure shows a steady decline in both the overall balance to GDP (OB/GDP) and the primary balance to GDP (PB/GDP) since the end of the Asian financial crisis in 1998, with OB/GDP falling faster. The sharpest decline occurred during the COVID-19 pandemic, when OB/GDP dropped to its lowest point of -7%, falling below the -3% threshold. Meanwhile, PB/GDP also declined, though at a relatively slower pace. The primary balance reflects the difference between government revenue and expenditure before interest payments. A negative primary balance shows that expenditures (excluding interest) surpass revenues. The primary balance is a crucial measurement of fiscal health and sustainability. This ratio helps assess whether a country is on a sustainable fiscal path, which is especially vital for countries with high debt-to-GDP ratios.

OB/GDP measures a country's overall fiscal balance as a percentage of GDP. A positive overall balance indicates a fiscal surplus, meaning the government collects more revenue than it spends. Conversely, a negative balance signifies a fiscal deficit, where government spending exceeds revenue. This ratio is a key indicator of fiscal health, sustainability, and the efficiency of government spending. A high deficit-to-GDP ratio signals fiscal stress, while a low deficit or surplus reflects prudent fiscal management. As shown in the figure, both fiscal health indicators improved after COVID-19. The 2023 and 2024 State Budgets recorded a government budget deficit of less than 3% annualy.

Figure 1(b) illustrates the government debt-to-GDP ratio compared to the official debt ceiling and the safe debt threshold. During the Asian financial crisis (1997–1998), Indonesia's debt-to-GDP ratio surged dramatically, exceeding 80%. In the following years, the government made significant efforts to reduce debt, bringing the ratio below 40% by 2010. However, from 2015 onward, the ratio rose gradually due to fiscal expansion. It spiked again in 2020 as the government increased borrowing to finance the budget deficit during the pandemic. By 2022, the debt ratio had declined but remained above pre-pandemic levels.

As reflected in the government's balance sheet and debt levels, Indonesia's fiscal health follows a cyclical pattern shaped by economic crises, such as the Asian financial crisis and the COVID-19 pandemic. While the government successfully reduced debt levels after 1998, recent years have seen a growing fiscal deficit and increased borrowing. The recovery in 2022 suggests a potential return to fiscal discipline. However, the future trajectory of debt and deficits will largely depend on the pace and strength of the economy's recovery from the pandemic shock.

According to an IMF publication (2021), a debt-to-GDP ratio between 40% and 50% for developing countries is often considered the tipping point at which debt may become unsustainable. This is primarily due to higher borrowing costs and a heavy reliance on foreign lenders, which heighten vulnerability to economic shocks.

A high public debt ratio (PDR) is often linked to greater macroeconomic instability. It signals concern about a country's ability to repay its obligations. When debt levels rise excessively relative to the size of the economy, it can raise concerns about the risk of default or the need for drastic fiscal measures, which can negatively impact economic stability (IMF, 2019).

Therefore, a public debt ratio (PDR) is a key indicator of a country's fiscal health. A higher PDR suggests that a country may face challenges in servicing its debt without implementing major economic reforms, increasing taxes, or cutting public spending, which can impact economic growth and stability (IMF, 2021).

Further, persistently high debt-to-GDP ratios have signaled potential macroeconomic instability as large debt payments can consume a significant portion of a country's budget, reducing funds available for essential public services and investments (Reinhart & Rogoff, 2010). In contrast, lower debt-to-GDP ratios allow for greater flexibility in adopting countercyclical fiscal policies, such as stimulus spending during recessions, without raising concerns about debt sustainability. High debt ratios, however, constrain this flexibility (World Bank, 2021).

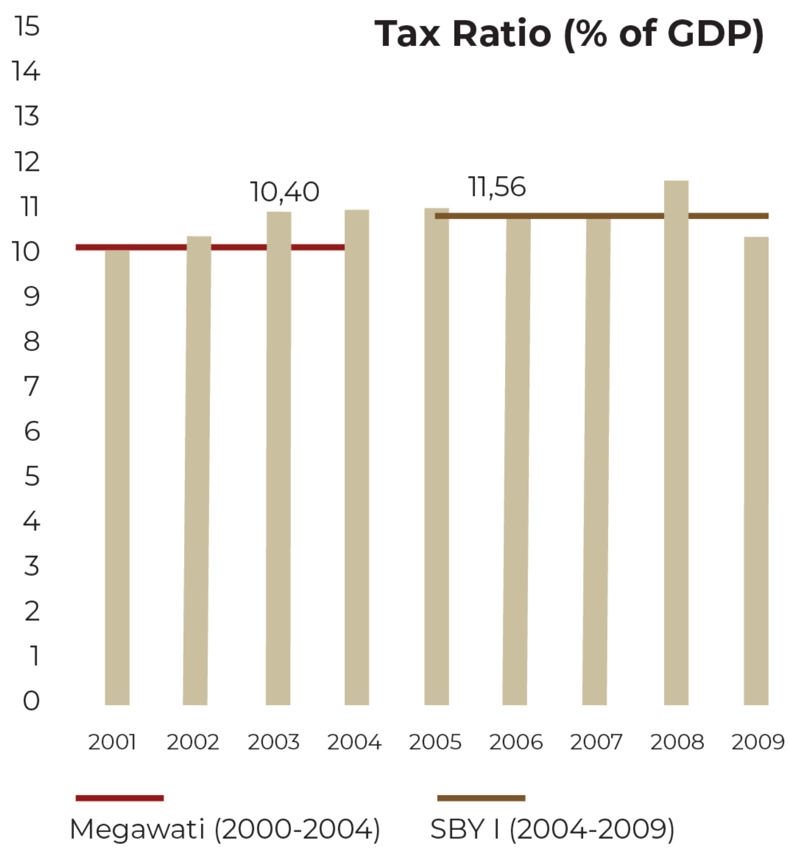
A high public debt ratio (PDR) does not necessarily indicate poor fiscal or economic conditions as long as the government can manage public spending effectively. Ideally, debt payments should leave enough fiscal space for essential public services and key investments, which impact growth and stability, without raising taxes. However, Indonesia has struggled with a persistently low tax ratio, which has been a long-standing issue since the 1980s.

A low tax ratio and limited fiscal space can weaken a country's fiscal resilience. In general, a higher tax ratio is essential for ensuring debt sustainability and maintaining fiscal stability. Along with the PDR, a country's fiscal sustainability and stability depend on its tax-to-GDP ratio and key factors such as economic growth, interest rates, and government spending policies.

In many cases, a tax ratio of at least 15% to 20% of GDP is necessary to effectively manage debt levels and ensure sufficient government revenue to meet debt obligations. The tax ratio varies depending on a country's economic conditions, tax collection capacity, and external factors such as borrowing costs. Therefore, maintaining an appropriate tax ratio is crucial for balancing debt levels and preventing debt from becoming unsustainable, especially when the debt-to-GDP ratio approaches the upper end of 40%–50%.

Based on these criteria, Indonesia's economy remains highly vulnerable to shocks. Although the debt-to-GDP ratio is below 40%, the country's tax ratio has consistently ranged between 10% and 11% over the past four decades—well below the recommended minimum of 15%. This suggests that Indonesia's current and future economic conditions are susceptible to domestic and international shocks. This vulnerability could become even more pronounced if Indonesia pursues a costly energy transition program.

Figure 2 Tax Ratio Development (2001–2023)




*Source: CEIC*


11,04
10,20
10,30
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
SBY II(2009-2014)
Jokowi (2014-2019)
Jokowi II (2019-2023)*

## Financing Energy Transition in Developing Countries

Global warming and the effort to address it through energy transition financing remain subjects of ongoing debate among experts, policymakers, and analysts, particularly regarding its economic impact. Some argue that developing countries generally have limited fiscal space. The policy of transitioning from coal to renewable energy could result in monetary losses in developing countries. Additionally, reallocating a portion of the budget to fund the energy transition in the short term may exacerbate the budget deficit. This is due to several factors.

First, high upfront costs. Renewable energy projects require substantial initial investments before generating long-term savings or revenue. These upfront costs include building renewable energy plants, modernizing the power grid, and expanding energy storage capacity.

Second, reduced fossil fuel revenues. Countries that depend on fossil fuel exports or tax revenues from fossil fuel consumption may experience a decline in government income as these energy sources are phased out.

Third, subsidies and incentives. Governments often provide subsidies and tax incentives to promote the adoption of clean energy, adding strain on the budget. Fourth, debt payments. Rising debt levels and interest payments can further pressure the fiscal balance if governments rely on borrowing to fund energy transition projects.

According to this argument, persistent budget deficits—where the government consistently spends more than it earns over a long period—can seriously affect economic and financial stability. Additionally, budget deficits can limit the government's ability to stimulate economic growth during periods of economic slowdown.

An increasing budget deficit can also lead to a current account deficit, a phenomenon known in economic literature as the double deficit hypothesis. This theory suggests that when the government runs a budget deficit, it often finances it by borrowing from domestic and foreign sources. If the deficit is funded through foreign borrowing, it can lead to higher capital inflows. As foreign capital enters the country, the domestic currency may appreciate it, making exports more expensive and imports more affordable.

When this happens, the current account balance declines, leading to a deficit. Over time, a persistent current account deficit can cause the exchange rate to depreciate.

This is precisely what happened in Indonesia. Indonesia's exchange rate trends provide a relevant example of the relationship between double deficits and exchange rate depreciation. Before COVID-19, the swap rate between the U.S. dollar and the Indonesian rupiah was typically around 300 basis points (bps), reflecting an annual depreciation rate of 3%. After the pandemic, the swap rate (and the depreciation rate) fell to around 2% per year.

## Implications of Chronic Budget Deficits for Climate Finance

Long-term budget deficits can have several negative consequences. One significant impact is the rise in public debt. Persistent deficits lead to a continuous buildup of government debt. The government must borrow from domestic and international sources to finance its deficits. As debt levels increase, so do interest payments, placing additional pressure on government finances. This, in turn, can limit funding for essential public services such as healthcare, education, and infrastructure (Blanchard, 2019).

This situation can lead to long-term economic instability (Reinhart & Rogoff, 2010). Rising debt levels also heighten the risk of a debt crisis, where a country may struggle to meet its repayment obligations, increasing the likelihood of default.

The second impact is rising interest rates, which are especially concerning when debt is sourced from foreign lenders. As countries continue borrowing to finance their deficits, they may face higher interest rates on their debt. Investors demand higher returns when lending to nations with elevated debt levels due to the increased risk of default. Higher interest rates can also crowd out private investment because borrowing becomes more expensive for businesses and households. Therefore, it potentially slows economic growth (Afonso & Jalles, 2016).

The third impact is inflationary pressure. When governments finance budget deficits by printing money (monetary financing), it can drive inflation. An increase in the money supply without a corresponding rise in goods and services leads to higher prices, potentially escalating into hyperinflation in extreme cases, as seen in Zimbabwe (Reinhart & Rogoff, 2010). Indonesia also experienced hyperinflation when Bank Indonesia lacked independence from the government (Thed, 1996). Inflation erodes consumer purchasing power, diminishes savings, and disproportionately affects low-income households. It can also weaken the national currency and, in cases of excessive debt, trigger a balance of payments crisis, especially in emerging markets (Krugman, 1988).

The fourth impact is reduced fiscal space. Persistent budget deficits limit a government's ability to respond effectively to economic crises. When fiscal space is constrained, countries may find it challenging to implement countercyclical measures, such as stimulus spending or tax cuts, during downturns due to high debt levels and existing budget pressures (International Monetary Fund, 2020). Moreover, limited fiscal flexibility makes it harder to manage economic shocks, increasing vulnerability to crises (Ostry et al., 2015). This can prolong recessions and complicate the path to recovery.

The fifth impact is the risk of a confidence crisis. Persistent deficits and high public debt levels can undermine investor trust, raising concerns about a country's ability to meet debt obligations. Default and a loss of confidence can trigger severe consequences, including restricted access to international capital markets, economic contraction, and political instability (Panizza, Sturzenegger, & Zettelmeyer, 2009).

Political and social instability may also arise. High debt levels can also lead to political instability, especially when governments are forced to implement austerity measures to restore their fiscal balance. These measures, often involving cuts to public services and social programs, can spark public discontent and unrest (Alesina & Ardagna, 2010). Argentina's 2001 default is a striking example of how a sovereign debt crisis can trigger economic hardship and social turmoil.

The sixth negative impact is slower economic growth. Empirical studies show that persistent high budget deficits can hinder long-term economic growth. As debt levels rise, more resources are diverted to interest payments instead of productive investments (Kumar & Woo, 2010). Additionally, increasing interest rates and inflation caused by ongoing deficits can reduce investment and consumer spending, further slowing economic expansion.

High debt levels can significantly hinder economic growth, especially when debt exceeds a critical threshold of 90% of GDP (Reinhart & Rogoff, 2010). Slower growth, in turn, exacerbates the debt burden, creating a vicious cycle of rising debt and increasing macroeconomic instability.

Several studies, including those by the Organisation for Economic Co-operation and Development/OECD (2020), the World Bank (2021), and IRENA (2020), have found that energy transition programs contribute to rising debt-to-GDP ratios. Adopting energy transition initiatives at the corporate level has also been linked to higher debt ratios (Ziai, 2021; Ghose et al., 2024).

Another study (Zhao et al., 2022) found that the negative impact of climate finance on national debt was less severe in countries with more excellent political stability. This suggests that a stable political environment is crucial in effectively managing debt for climate-related initiatives.

## Energy Transition Programs and Economic Linkages

Many argue that energy transition programs promote macroeconomic stability, economic growth, and job creation in the medium to long term. These programs, which are often imported-content intensive, can also generate significant backward and forward linkages within the economy. Understanding these linkages is essential to assessing the broader economic impact of energy transition. However, what does the reality look like?

"Imported-content intensive" refers to a product, project, or industry that heavily depends on imported components, materials, or technology for production or implementation. This term is often used to describe sectors or projects where a significant portion of inputs comes from foreign suppliers, making them more reliant on international trade and vulnerable to exchange rate fluctuations, trade tariffs, and supply chain disruptions.

Examples of renewable energy projects with relatively imported content intensive include those heavily relying on solar panels, wind turbines, or battery technologies—components that may not be widely produced domestically. This high dependency can drive up initial costs and contribute to a current account deficit, particularly in countries importing many expensive components to support their transition to renewable energy.

Backward linkage refers to the connections between an industry or program and its suppliers of goods, services, and inputs. In the energy transition context, backward linkages involve the demand for materials, technologies, and services essential for developing and maintaining renewable energy sources.

Empirical research shows that wind energy projects create strong backward linkages with industries supplying turbines, metals, construction services, and wind energy technologies. As a result, energy transition programs can drive demand in these upstream sectors, boosting employment and economic growth in their supplier industries (McKinsey & Company, 2020; Gallagher et al., 2021). However, if these suppliers are based abroad, the economic benefits primarily flow to industries in those countries.

Meanwhile, forward linkages involve the impact of a program on downstream sectors that rely on their output. In the energy transition context, forward linkages occur when renewable energy is supplied to other industries, enabling them to produce goods and services using cleaner energy. Some empirical studies have shown that manufacturers, transportation, and digital services are forward linkages in industries adopting renewable energy. They benefit from lower energy costs, reduced emissions, and increased productivity (IRENA, 2022; Sovacool et al., 2020). However, if transportation and digital equipment suppliers are based abroad, the energy transition will primarily benefit those countries' transportation producers, manufacturers, and digital device producers.

In the short term, climate change and policies to mitigate its impact can affect central banks' ability to maintain monetary stability. Gradual warming, shifting climate patterns, and more frequent extreme weather may lead to financial losses, declining wealth, and slower GDP growth. The Copenhagen and Paris Agreements signal continued growth in climate finance, driving positive economic effects in recipient countries and benefiting others through increased international trade. Moreover, a well-balanced allocation of climate finance between mitigation and adaptation efforts can effectively reduce global climate vulnerability without significantly altering annual emissions growth. This balanced approach promotes sustainable development while preserving economic stability.

In the long run, climate finance can support countries in transitioning to more sustainable economic models, mitigating the adverse effects of climate change on financial stability and public finances. This transition can create more resilient economies, making them less vulnerable to climate-related shocks (Roman, 2018; Dafermos, 2018).

Climate action advocates, including Indonesia, argue that the energy transition offers numerous benefits. For example, mitigating climate change can help save the Earth from global warming (IPCC, 2021), while energy security ensures a more reliable and secure energy supply (IRENA, 2020), encourages green investment and job creation, and improves the overall quality of life (WHO, 2018). However, implementing renewable energy development programs presents significant challenges for many countries.

Following the thread of this discussion, it can be concluded that if the government is committed to reducing emissions through an energy transition program, the short-term policies could exacerbate the budget deficit. A prolonged deficit can lead to several economic challenges in the short and medium term, including rising public debt, higher interest rates, inflationary pressures, reduced fiscal flexibility, and the risk of default, which can undermine credibility. Additionally, it may contribute to a double deficit, further affecting the exchange rate.

However, in the long run—at least in theory—climate finance can support these countries in transitioning to a more sustainable economic model, mitigating the adverse effects of climate change on financial stability and public finances, and ensuring a more reliable and secure energy supply.

Therefore, policymakers must carefully balance the need for fiscal stimulus with public finance sustainability, especially in the short, medium, and long term, so that Indonesia can avoid the adverse outcomes of a persistent deficit.

## Energy Transition in the Indonesian Context

Indonesia's commitment to addressing climate change is outlined in Government Regulation Number 79 Year 2014 on National Energy Policy. One of its articles highlights the importance of transitioning to new and renewable energy sources and sets specific targets to support this shift.

First, renewable energy is expected to account for at least 23% of Indonesia's energy mix by 2025 and at least 31% by 2050, provided economic conditions allow. Second, petroleum's share is set to be reduced to 25% by 2025 and 20% by 2050. Third, coal usage is also targeted to decline with a maximum share of 30% in 2025 and 25% in 2050. Lastly, natural gas contribution is expected to be at least 22% in 2025 and at least 24% in 2050. These targets reflect the government's priority to maximize renewable energy usage (while considering economic feasibility), to reduce reliance on petroleum, and to optimize the use of natural gas and new energy.

At the UN Climate Change Conference (COP 26) in 2021, Indonesia announced its ambitious goal of reaching net zero emissions (NZE) by 2060. Therefore, the Ministry of Energy and Mineral Resources (MEMR) collaborated with the International Energy Agency (IEA) to develop a detailed roadmap to support this target and a policy analysis assessing the impact of the target on Indonesia's energy sector.

According to the roadmap, using new and renewable energy (NRE) is expected to reduce $CO_2$ emissions by up to 93% compared to BAU emissions by 2060. While the roadmap outlines detailed scenarios and considers several alternative scenarios, it does not specify the budget for the energy transition programs.

The United Nations Conference on Trade and Development (UNCTAD) estimated that 48 countries' energy transition would require approximately USD5.8 trillion annually from 2023 to 2030 or about 19% of their combined GDP (UNCTAD, 2023). For Indonesia, this transition represents a massive undertaking with far-reaching implications, not just in the short term but also for long-term development. In 2023, Indonesia's GDP stood at IDR20,892.4 trillion.

Assuming Indonesia's GDP grows by an average of 5% per year, the estimated cost to meet the NDC target by 2030 is projected to be IDR4,539.95 trillion or roughly USD50 billion annually. As an illustration, USD50 billion per year would represent around 3.6% of GDP in 2024. As a comparison, Indonesia's projected twin deficit (a combination of the State Budget deficit and the balance of payments deficit) in 2024 is estimated to be about 3% of GDP.

Significant steps toward the energy transition (aimed at reducing greenhouse gas emissions and increasing the use of renewable energy) include policy reforms, investment in renewable energy infrastructure, and efforts to reduce dependence on fossil fuels. The Indonesian government has taken several strategic actions to raise funds for renewable energy projects, such as issuing green bonds and green Islamic bonds, establishing international partnerships, and seeking financial support. Cooperation has also been forged with global institutions, like the World Bank, the Asian Development Bank (ADB), and the Green Climate Fund, to secure grants and low-interest loans. Additionally, the government is working to promote the implementation of carbon markets and carbon taxation, along with developing related fiscal policies and incentives.

The Indonesian government has been working to secure funding for renewable energy projects and climate change mitigation by partnering with international financial institutions. So far, loan commitments have amounted to approximately USD1.2 billion since 2016. The loans cover clean energy development, energy efficiency improvements, and sustainable infrastructure (World Bank, 2022). Additionally, the ADB has provided around USD1.5 billion in loans for renewable energy projects, including geothermal power development, solar energy initiatives, and the modernization of the electricity grid to facilitate clean energy (ADB, 2023). In total, loans from international financial institutions are estimated to be around USD2.7 billion.

## Use of State Budget and Debt to Finance NRE Projects

Under the National Energy Policy, Indonesia aims to have 23% of its energy mix from energy sources by 2025. The government's commitment is reflected in the budget allocations in the 2023 and 2024 State Budgets. In the 2023 State Budget, Indonesia allocated IDR352 trillion (12%) for energy subsidies. This amount was slightly reduced to IDR329.9 trillion (10%) in the 2024 State Budget. This shift in funds shows Indonesia's efforts to manage subsidy costs while gradually increasing investment in renewable energy. With this management, in the 2023 State Budget, Indonesia's total revenues were IDR2,673.2 trillion, while total spending was IDR3,123.7 trillion, resulting in a deficit of 2.30% for the year.

Additionally, loan interest payments have increased from IDR441.4 trillion (14% of the State Budget) in 2023 to IDR497.3 trillion (15% of the State Budget) in 2024. As of August 2024, Indonesia's foreign debt was recorded at USD425.1 billion, reflecting annual growth of around 7.3%. This increase is attributed to both the public and private sectors. The foreign debt in August 2024 was also affected by the depreciation of the US dollar against most other global currencies, including the rupiah.

Debt is a consequence of expansive state spending. While significant government spending can stimulate the economy, this spending cannot be met entirely from state revenues (such as taxes, customs, non-tax revenue, and grants). In 2022, Indonesia's GDP reached IDR19,588.4 trillion, growing by 5.31%. In 2023, GDP grew by about 5.05%, reaching IDR20,892.4 trillion. According to the IMF, Indonesia's debt-to-GDP ratio remained below 40%, which is still within a safe range for developing countries.

Between 2023 and 2024, energy subsidies were reduced by 2%, while fiscal space increased by 2%. This indicates that the Indonesian government is working to enhance budget flexibility while balancing its obligations to support development goals or address fiscal challenges. The increase in fiscal space amounts to IDR117.8 trillion, a rise of 22.6%.

This increase was significant as it provided the government with additional resources for discretionary spending. The rise in flexibility from 17% to 19% of total government spending reflected greater budget flexibility, giving the government more room to address emerging needs, finance development projects, or manage economic uncertainty.

In addition, funding for renewable energy projects in Indonesia partly comes from government debt. In recent years, the Indonesian government has used specific debt instruments, such as green bonds and green Islamic bonds, to finance environmentally

Table 1 The 2023-2024 State Budgets of Indonesia

| | 2023 Outlook (IDR Trillion) | 2024 Proposed Budget (IDR Trillion) | Delta (%) |
|---|---|---|---|
| A. State Revenue and Grant | 2,637.2 | 2,802.3 | 6,3% |
| I. Domestic Revenue | 2,634.1 | 2,801.0 | 6.3% |
| 1. Tax Revenue | 2,118.3 | 2,309.0 | 9.0% |
| 2. Non-Tax Revenue | 335.6 | 492.0 | 46.6% |
| II. Grant | 0.6 | 0.4 | -33.3% |
| B. State Expenditure | 3,123.7 | 3,325.1 | 6,4% |
| I. Central Government Expenditure | 2,298.2 | 2,467.5 | 7.4% |
| 1. Personal spending | 432.5 | 481.4 | 11.3% |
| 2. Material spending | 418.2 | 410.9 | -1.7% |
| 3. Capital spending | 258.9 | 244.4 | -5.6% |

| | 2023 Outlook (IDR Trillion) | 2024 Proposed Budget (IDR Trillion) | Delta (%) |
|---|---|---|---|
| 4. Interest payment | 437.4 | 497.3 | 13.7% |
| 5. Subsidy | 271.4 | 282.7 | 4,2% |
| 6. Grants spending | - | - | 0.0% |
| 7. Social assistance | 146.5 | 152.3 | 4.0% |
| 8. Other expenditure | 333.4 | 377.4 | 13.2% |
| II. Regional Transfer | 769.6 | 814.7 | 5.9% |
| C. Primary Balance | (49.1) | (25.5) | -48.1% |
| D. Surplus/Deficit | (486.5) | (522.8) | 7.5% |
| % Surplus/Deficit to GDP | (2.30) | (2.29) | -0.4% |

| | 2023 State Budget | | 2024 State Budget | |
|---|---|---|---|---|
| | Amount (IDR Trillion) | % of Government Spending | Amount (IDR Trillion) | % of Government Spending |
| Education | 233.9 | 8% | 237.3 | 7% |
| Health | 169.8 | 6% | 186.4 | 6% |
| Regional Transfer and Village Funds | 814.8 | 27% | 857.6 | 26% |
| Others | | | | |
| Personnel Spending | 442.5 | 14% | 481.4 | 14% |
| Debt Interest Payment | 441.4 | 14% | 497.3 | 15% |
| Energy Subsidy and Compensation | 352.2 | 12% | 329.9 | 10% |
| Other Subsidies | 86.1 | 3% | 96.9 | 3% |
| Total of Mandatory Spending | 2540.7 | 83% | 2686.8 | 81% |
| Total Discretionary Spending (Fiscal space) | 520.5 | 17% | 638.3 | 19% |
| Total Spending | 3061.2 | 100% | 3325.1 | 100% |

*Source: Ministry of Finance*

friendly projects, including renewable energy initiatives. This measure ensures that debt is used productively and efficiently for projects that positively impact the environment and support sustainable development. So far, Indonesia has received around USD3.2 billion (IDR49.6 trillion) in loans and grants to support its commitment to the Paris Agreement.

## Conclusion

Indonesia's energy transition seeks to reduce reliance on fossil fuels and align with global climate commitments, particularly under the Paris Agreement. While the transition is crucial for environmental sustainability, the journey ahead is filled with economic and fiscal challenges.

Financing this transition presents significant fiscal challenges, including high upfront costs, reliance on international borrowing, and potential impacts on the country's budget deficit and public debt levels.

The budget deficit, which could become more chronic due to financing the energy transition through fiscal channels, may increase public debt. This would raise interest rates and further strain Indonesia's fiscal space. Chronic deficits could also weaken economic resilience significantly if, one day, economic growth slows down. These financial pressures could limit fiscal flexibility and the government's ability to respond effectively to economic shocks.

It is indisputable that the energy transition offers long-term benefits, at least on paper. These benefits include increased energy security and the potential for creating new jobs, such as green jobs—provided there are enough skilled workers to fill them. However, the outcomes for the next 25 years will ultimately depend on the decisions and circumstances that unfold in the short term.

Therefore, policymakers must strategically balance short-term impacts with long-term economic and environmental benefits through detailed planning. Effectively managing fiscal sustainability, debt, and tax revenues is crucial to ensuring a smooth energy transition that supports Indonesia's economic and environmental goals.

5

# Regional Variations and Potential Socioeconomic Impacts

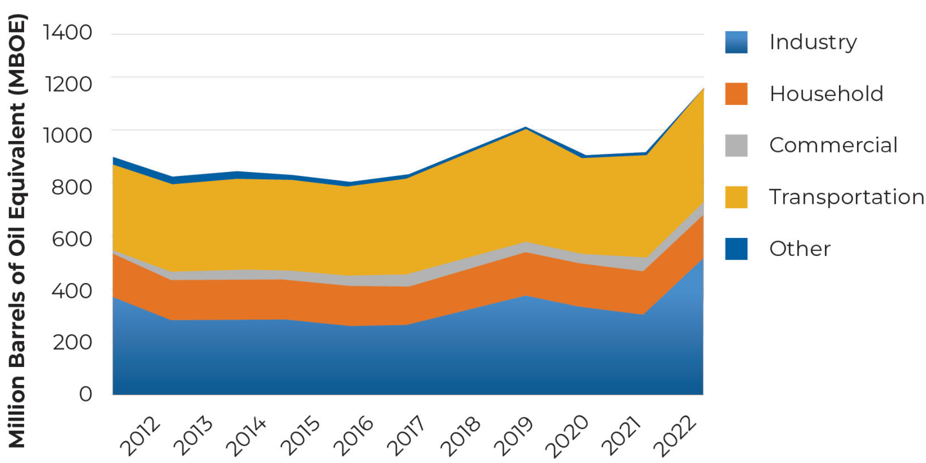
Martin D. Siyaranamual

## Introduction

Indonesia, one of the world's largest coal producers and the top natural gas supplier in Southeast Asia, ranked 9th globally in primary energy production in 2022. That year, coal accounted for 42.4% of total energy production, followed by oil (31.4%), gas (13.9%), and new and renewable energy (NRE) at 12.3%. By 2025, the country's primary energy production is expected to reach 16 quadrillion British thermal units (Btu), reinforcing its crucial role in the global energy market.

Since 2022, there has been a shift in energy consumption patterns in Indonesia. For the past decade, the transportation sector was the largest energy consumer, but it has now been overtaken by the industrial sector, which accounts for 45% of total energy demand. Meanwhile, the transportation sector consumes 37%. Together, these two sectors (industry and transportation) comprise 82% of Indonesia's total energy consumption. Meanwhile, households, commercial activities, and other sectors, such as mining, construction, and agriculture, use the remaining energy.

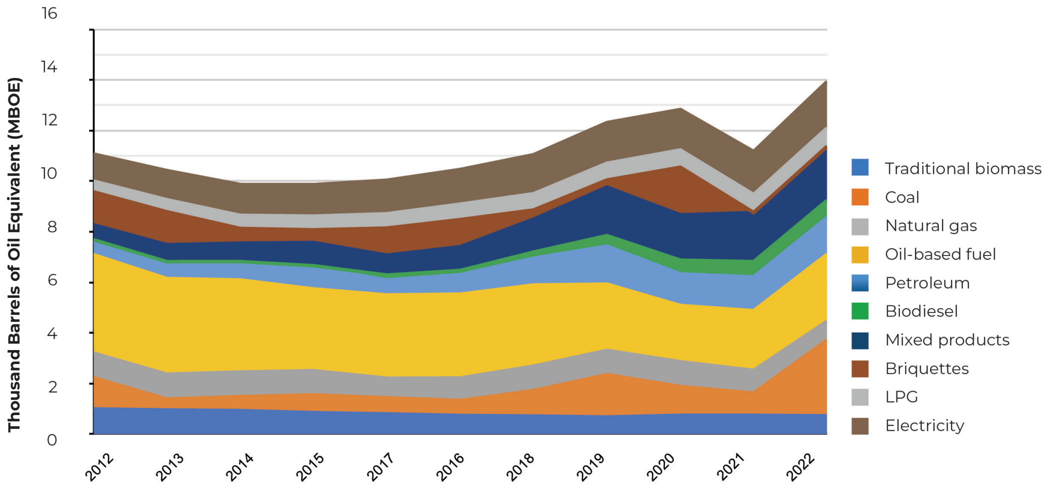
Figure 1.1 Energy Consumption by Sector




*Source: Ministry of Energy and Mineral Resources (2022)*

Based on energy type, coal dominated Indonesia's final energy consumption in 2022, reaching nearly 42 million tons of oil equivalent (TOE), followed by fuel oil at 37 million TOE. Biodiesel accounted for around 30 million TOE, while electricity stood at approximately 26 million TOE. As seen in the data, the country's final energy supply relies heavily on two primary non-renewable resources (coal and fuel oil), which collectively comprise 87% of total energy consumption.

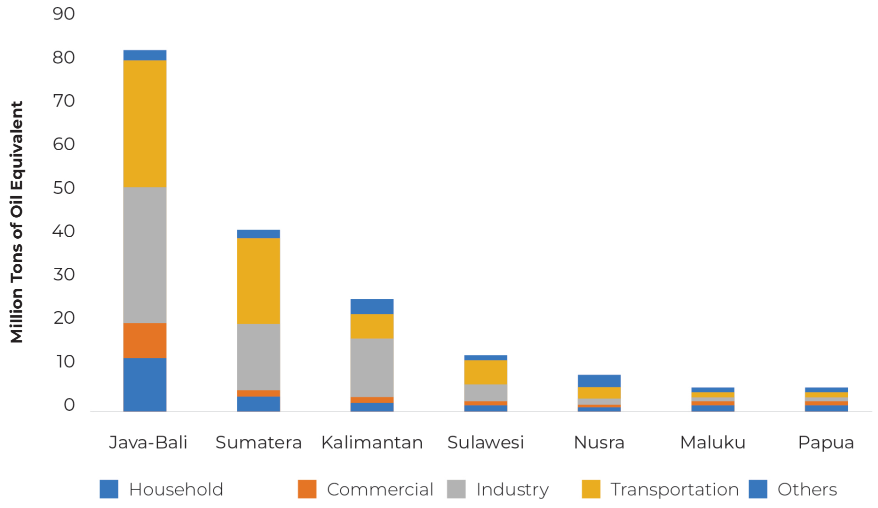
Figure 1.2 Energy Consumption by Energy Type




*Source: National Energy Council (2023)*

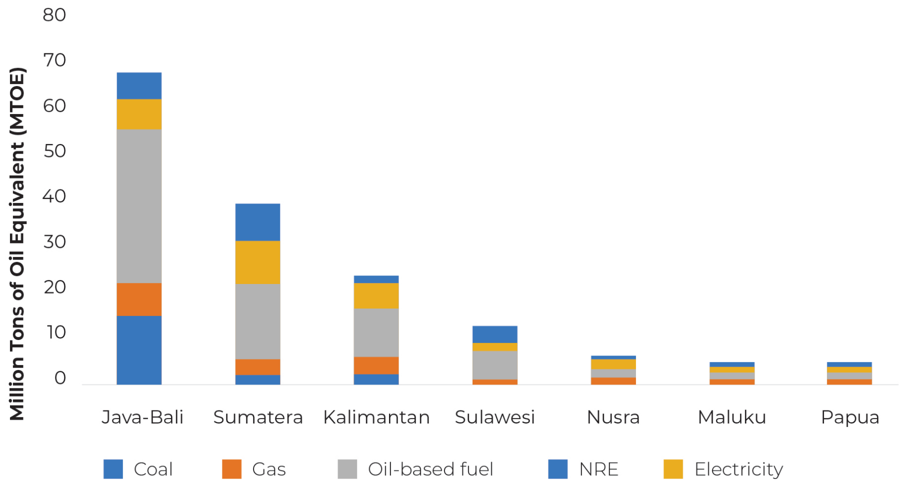
Reflecting Indonesia's population distribution, Java-Bali remained the largest final energy consumer in 2022, accounting for 54% of the total. This was followed by Sumatra (23%), Kalimantan (14%), Sulawesi (6%), and the remaining 4% spread across Nusa Tenggara, Maluku, and Papua. Once again, this highlights a significant imbalance in energy distribution, with 77% of total consumption concentrated in Java, Bali, and Sumatra. Interestingly, while energy use in Java-Bali, Kalimantan, and Maluku is primarily driven by the industrial sector, in Sumatra, Sulawesi, Nusa Tenggara, and Papua, consumption is dominated by the transportation sector.

Figure 1.3 Energy Consumption by Sector in Various Regions




*Source: National Energy Council (2023)*

Figure 1.4 Energy Consumption by Type in Various Regions

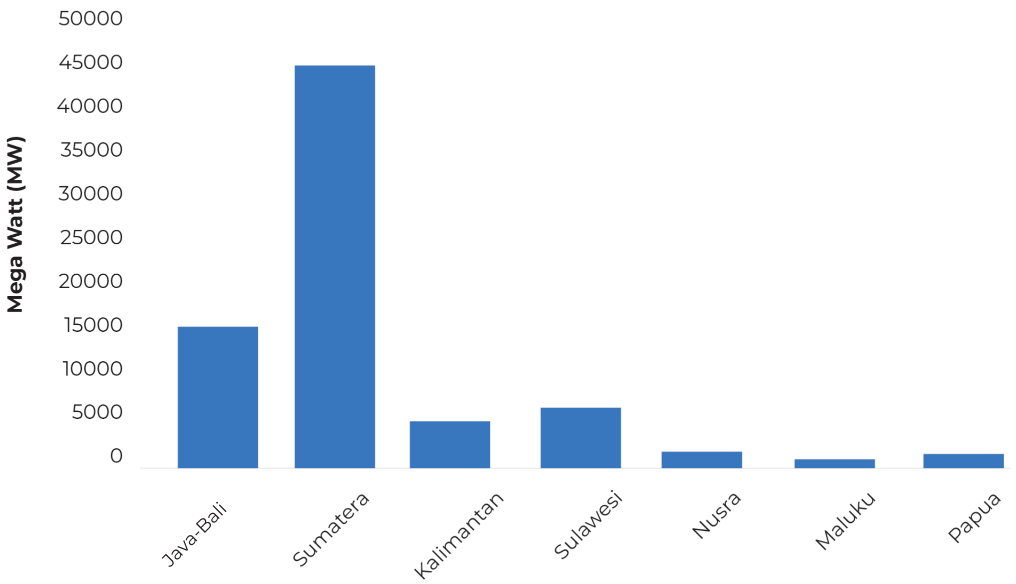



*Source: National Energy Council (2023)*

By energy source, approximately 58% of Indonesia's total energy supply is generated in the Java-Bali region, primarily from coal and oil-based fuel. The primary energy supply in Sumatra accounts for about 20% of the national total, mainly sourced from oil-based fuels. This highlights another imbalance, with 78% of the energy supply concentrated in Java, Bali, and Sumatra.

Regional disparities in electricity supply are also evident. In 2022, about 62% of the total power generation capacity was built in the Java-Bali region, while Sumatra accounted for 19%. Beyond these two islands, the remaining 19% of power generation capacity was distributed in Kalimantan, accounting for 7%, Sulawesi 10%, and Nusa Tenggara, Maluku, and Papua, collectively contributing just 2%.

Figure 1.5 Installed Capacity of National Power Plants by Province




*Source: Directorate General of Electricity (2023)*

## Landscape of Inequality in Access to Quality Energy

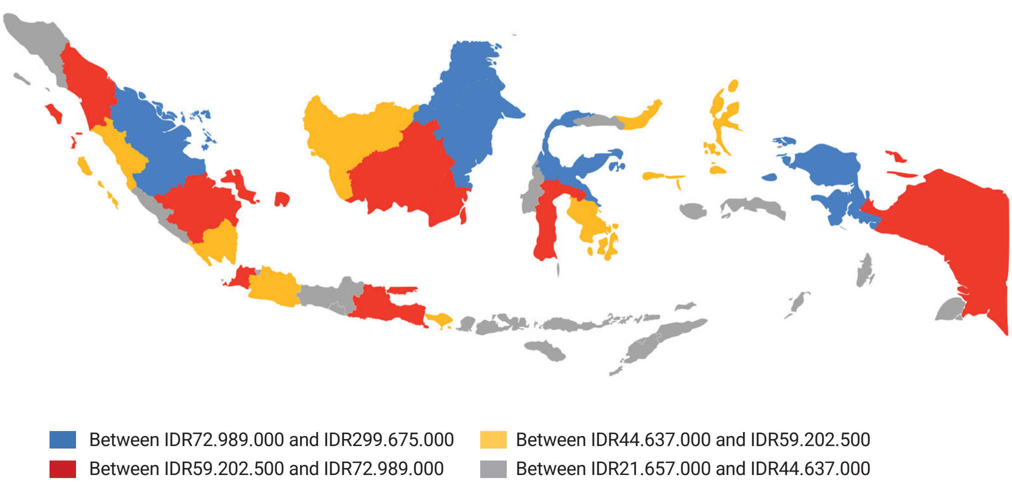
Data from the National Socio-Economic Survey (Susenas) from 2019 to 2023 highlights disparities in household energy consumption. This energy inequality is examined through three key household perspectives, namely income class, geographic location (especially on Java-Bali), and regional characteristics (rural vs. urban areas).

## Inequality Between Economic Classes

Figure 2.1 illustrates the Gross Regional Domestic Product (GRDP) per capita distribution across 34 provinces in Indonesia in 2022, categorized into four income groups. Different colors on the map represent these groups. Blue is for the highest income level, red is for the second highest, yellow is for the third, and white is for the lowest GRDP per capita.

The figure reveals that provinces with the highest GRDP are not concentrated in a single region but are distributed across nearly all major islands in Indonesia, except for Java Island. This highlights significant economic diversity across regions, with areas outside Java also making substantial financial contributions.

Figure 2.1 GRDP Per Capita Distribution Across 34 Provinces

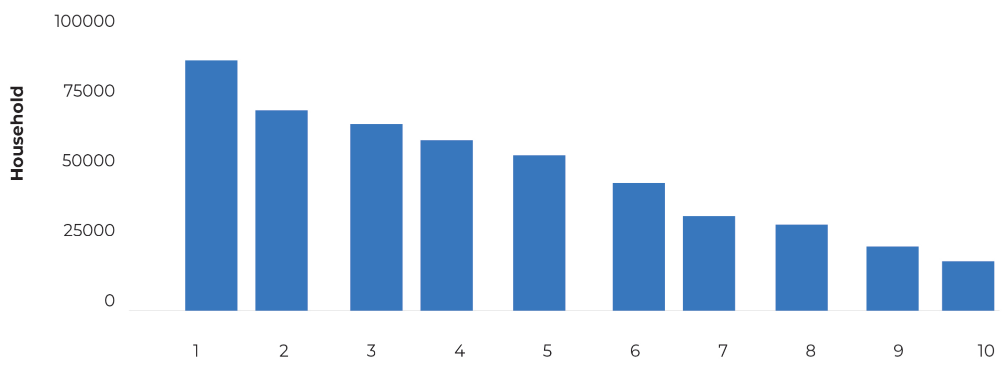



*Source: Statistics Indonesia*

From an income class perspective, households are divided into 10 subgroups or deciles. Decile 1 represents the lowest-income households (poor), while decile 10 represents the highest-income households (wealthy).

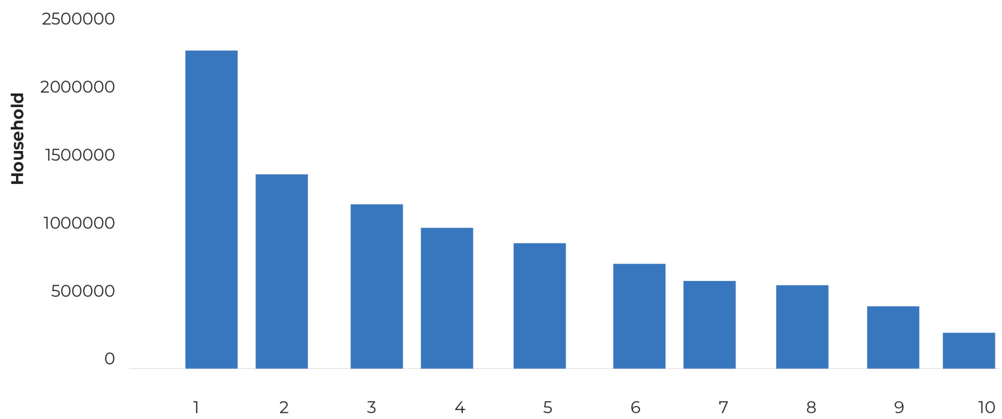
Susenas data provides a factual picture that the poorest households (decile 1) have the highest percentage of non-electricity users. Interestingly, in 2019, many households in the relatively wealthy subgroups (deciles 7, 8, and 9) also lacked electricity access, even more so than some lower-income groups. This highlights a notable inequality in energy access and utilization across different income groups in Indonesian households.

Figure 2.2 Non-Electricity Households by Income Decile




*Source: Author's analysis based on Susenas (2023) data*

Figure 2.3 Household Use of Traditional Cooking Energy by Income Decile

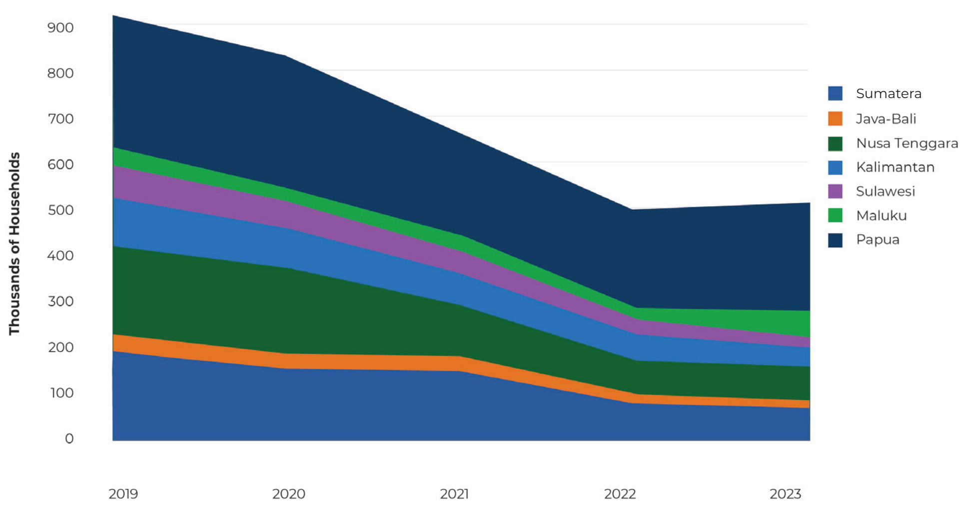



*Source: Author's analysis based on Susenas (2023) data*

## Disparity Between Java-Bali and Non-Java-Bali

Data from the 2019-2023 Susenas survey highlights a significant disparity in electricity access between Java-Bali and the rest of Indonesia. Households on the Java-Bali Islands generally have better access to electricity, while Papua has the highest number of households without it. According to the Susenas data in March 2023, inequality in electricity access reached 96%. This means 441,000 households lacked electricity outside Java and Bali, compared to just 15,000 households. The disparity was nearly 97%.

Figure 2.4 Comparison of Non-Electricity Households by Region




*Source: Author's analysis based on Susenas (2019–2023) data*

Despite the disparity in the number of households without access to electricity between Java-Bali and non-Java-Bali regions, data shows that average monthly electricity consumption per capita (Kwh) across different areas in Indonesia does not vary significantly. Regions like Java-Bali, Sumatra, Kalimantan, and Papua have relatively balanced electricity consumption levels per capita. However, areas like Maluku and Nusa Tenggara still show much lower electricity usage.

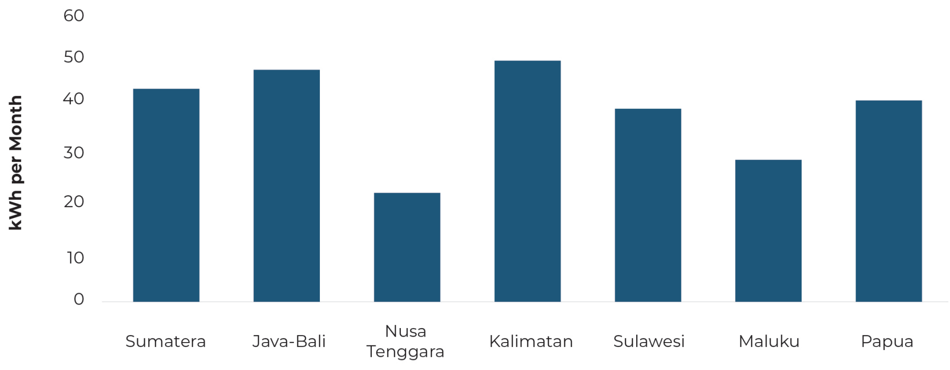
The low electricity consumption in these areas is often driven by lower purchasing power, which limits households' ability to afford and use electricity optimally. In

Maluku and Nusa Tenggara, low purchasing power is likely linked to the region's low per capita income. This is further supported by Figure 2.1, which shows that Maluku and Nusa Tenggara are among the provinces with the lowest per capita GRDP levels.

This phenomenon highlights the connection between low per capita income and limited purchasing power, emphasizing the economic challenges faced by these areas. Although physical access to electricity may be available, economic factors—particularly purchasing power—remain a significant barrier to increased electricity use. To boost electricity consumption and improve living standards in these regions, strategic measures are needed to enhance people's purchasing power.

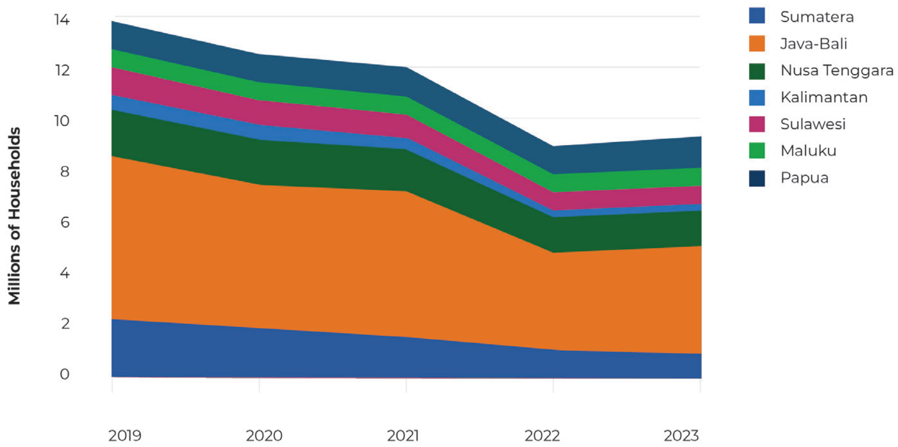
The gap between Java-Bali and non-Java-Bali regarding using dirty energy for cooking is tiny. In proportion to its population, Java-Bali has the highest number of households (in absolute terms) using dirty energy for cooking. Non-Java-Bali households use dirty energy for cooking, totalling 5.22 million, while in Java-Bali, the number is 4.13 million. This Susenas data highlights the need to ensure equal access to clean cooking energy across Indonesia.

Figure 2.5 Per Capita Electricity Consumption by Region




*Source: Author's analysis based on 2019-2023 National Socio-Economic Survey*

Figure 2.6 Comparison of Households Using Traditional Cooking Energy by Region




*Source: Author's analysis based on 2019-2023 National Socio-Economic Survey*

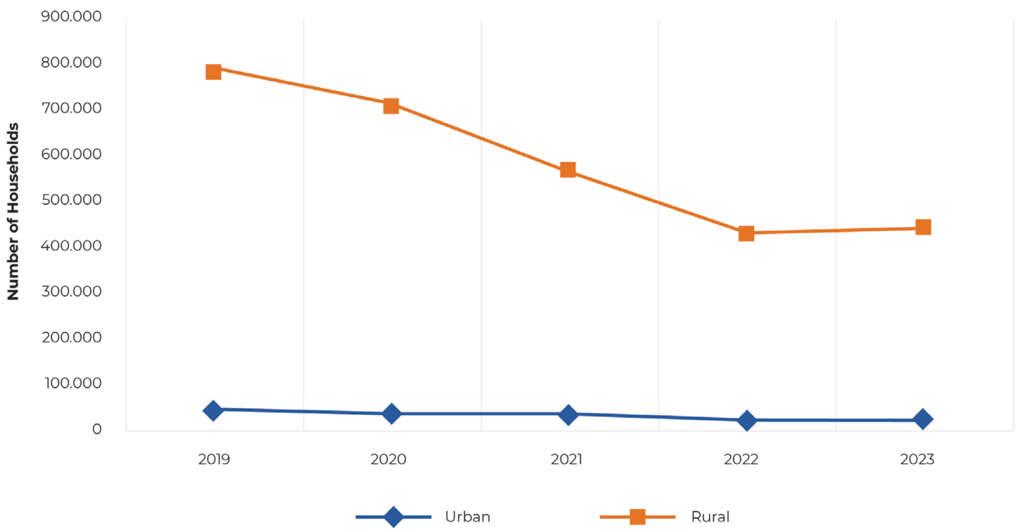
## Disparity Between Rural and Urban

Data analysis in 2023 shows that urban areas accounted for 62% of household electricity consumption based on the differences in rural and urban locations. That year, approximately 437,000 rural households lacked access to electricity, compared to nearly 20,000 in urban areas. Thus, the disparity is 95%.

The disparity is also evident in the use of dirty energy for cooking. Nearly 6.5 million rural households rely on dirty energy, compared to about 2.9 million in urban areas—a gap of 35%. This highlights significant inequality in access to electricity and clean cooking energy between rural and urban areas.

Significant disparities exist across multiple dimensions, including household income levels, regional differences (Java-Bali versus other parts of Indonesia), and location characteristics (urban versus rural). Many households in Indonesia still experience energy shortages, particularly in rural areas. Those in the economically vulnerable group (income deciles 1 to 3) are also more likely to face energy poverty.

Figure 2.7 Comparison of Households Without Electricity in Rural and Urban Areas




*Source: Author's analysis based on 2019-2023 National Socio-Economic Survey*

## Government Initiatives to Address Energy Transition Inequality

The key challenge for Indonesia's energy policy is developing a public policy framework that can balance growing energy demand and ensure the achievement of sustainable development.

To tackle these challenges, the government has introduced four key initiatives: The first one promotes the use of renewable energy, the second improves energy efficiency, the third expands energy access to rural communities, and the fourth strengthens energy security. These four initiatives aim to make energy more accessible, affordable, and sustainable for all Indonesians.

## Promoting Renewable Energy

Historically, Indonesia has heavily relied on fossil fuels for electricity generation and transportation. However, as the public awareness of renewable energy's benefits in addressing environmental issues and mitigating the impacts of climate change increases, the demand for a transition to cleaner, more sustainable energy sources also grows (Ministry of Energy and Mineral Resources, 2019).

Several key initiatives can accelerate renewable energy adoption in Indonesia, including feed-in tariffs, tax incentives, regulatory reforms, renewable energy auctions, and ambitious renewable energy targets. Feed-in tariffs guarantee renewable energy producers a guaranteed price for the electricity they generate, encouraging investment in renewable energy projects. Tax incentives help lower financial barriers by offering exemptions or reductions on corporate income tax, VAT, and import duties for renewable energy equipment and materials.

Regulatory reforms aim to streamline the licensing process, simplify requirements, and create a more attractive investment environment for renewable energy developers. Renewable energy auctions use competitive bidding to allocate capacity and drive investment in renewable energy projects. Ambitious renewable energy targets signal the government's strong commitment to investors and developers and encourage investment in the respective industry. Given the IMF's significant influence on preparing Indonesia's energy bills during the 1998 monetary crisis, it is crucial to implement homegrown reforms by conducting a comprehensive review of existing laws and regulations.

Implementing feed-in tariffs, tax incentives, regulatory reforms, renewable energy auctions, and ambitious targets will help Indonesia attract investment in renewable energy projects and reduce greenhouse gas emissions. Overcoming challenges and seizing opportunities requires collaboration among stakeholders and policy alignment. Successful collaboration and aligned policies can accelerate the transition to a low-carbon economy and support global efforts to combat climate change. However, it is also essential to assess the net impact of these tariffs on the State Budget and consumer purchasing power.

## Improving Energy Efficiency

Alongside promoting renewable energy, Indonesia actively tries to enhance energy efficiency and conservation. Initiatives in this sector include implementing energy efficiency standards and device labeling programs, promoting energy-efficient technologies, and investing in energy management systems (World Bank, 2017).

However, it is essential to recognize that standardization often comes with economic costs that ultimately fall on consumers. It is also closely tied to dependence on technology providers. The Ministry of Energy and Mineral Resources has established minimum energy performance standards for various household appliances, including refrigerators, air conditioners, lighting products, and industrial machines. The 2014 Energy Conservation Act provides a legal framework for energy efficiency standards and labeling, giving the government the authority to regulate high-energy consumption products and promote the adoption of energy-saving technologies.

Indonesia must take a more thorough and systematic approach to promoting energy audits and management systems to enhance energy efficiency in industries, commercial buildings, and public facilities. The Energy Conservation Law mandates regular energy audits for large energy consumers to identify savings opportunities and implement efficiency measures. Additionally, the government encourages the adoption of energy management systems, such as ISO 50001, to help organizations track, monitor, and optimize energy use effectively.

Indonesia currently provides various financial incentives and support mechanisms to provide incentives in energy efficiency. These incentives include tax exemptions, grants, subsidies, and preferential loans for energy-efficient projects and technologies. For example, the government provides tax incentives for companies investing in energy-efficient equipment and technologies by lowering corporate income tax liabilities. Additionally, government-backed funding schemes and programs offer affordable loans and credit facilities to help businesses and households implement energy efficiency measures. However, comprehensive cost-benefit analyses of these initiatives have yet to be fully developed.

Renewable energy (NRE) infrastructure in rural areas often faces long-term sustainability challenges due to maintenance difficulties (Derks & Romijn, 2019). While these initiatives can initially improve access to sustainable electricity and energy, there are concerns that villages may lack the funds and expertise needed to keep the infrastructure running. Although governments are responsible for providing support, they often face fiscal constraints that limit their ability to ensure ongoing maintenance.

Without proper maintenance and support strategies, investments in NRE for rural areas may not reach their full potential. Local training and education play a crucial role in ensuring the long-term sustainability of NRE infrastructure in rural areas. Developing a comprehensive and relevant training curriculum covering solar panel, battery management, and energy management systems is essential. Additionally, hands-on training through workshops, simulations, internships, and certifications can encourage periodic skill enhancement and knowledge updates.

Capacity-building and training programs are essential for raising awareness of energy efficiency and enhancing skills among stakeholders. In collaboration with industry associations, educational institutions, and international partners, the government organizes training workshops, seminars, and certifications on energy management, conservation practices, and energy-saving technologies. These programs, designed for policymakers, energy managers, engineers, technicians, and consumers, empower them to adopt energy-efficient practices and technologies in their daily operations and lives.

Finally, public awareness and education campaigns are crucial in promoting a culture of energy efficiency and conservation. Through mass media, social media, and community outreach programs, the government raises awareness about energy efficiency's importance, highlights energy conservation's benefits, and provides practical tips for adopting energy-saving behaviors. These campaigns aim to engage the public, encourage behavioral change, and promote sustainable lifestyles.

Indonesia’s energy efficiency policy and regulatory framework offer a comprehensive strategy to optimize energy use, reduce consumption, and minimize environmental impact. By implementing homegrown energy efficiency standards tailored to Indonesia’s socioeconomic and cultural context, promoting energy audits and management systems, providing financial incentives, building capacity, and raising public awareness, the country can move toward a more sustainable and resilient energy future. However, continuous monitoring, evaluation, and refinement of these policies and programs are crucial to ensuring their effectiveness and maximizing energy savings.

In addition to the aspects mentioned earlier, it is essential to consider the methods and approaches for planning, financing, and implementing energy efficiency projects. Energy efficiency initiatives in the industrial sector, such as replacing outdated chillers and boilers with more efficient technologies, have not received sufficient financial support. Funding models like retrofitting, which modernizes existing systems and technologies through innovative financing schemes, such as low-interest loans, performance-based financing, or public-private partnerships, can be an alternative. This approach is especially relevant in industries and rural areas, where energy infrastructure is often limited and inefficient.

## Expanding Energy Access

Indonesia strongly emphasizes rural electrification as part of its effort to expand access to quality energy, particularly in remote and underserved areas. The 2009 Electricity Law, reinforced by an amendment in 2017, mandates the government to ensure universal access to electricity, driving initiatives to extend the electricity grid to even the most isolated communities. The government allocates funds for infrastructure development, equipment procurement, and system installation through targeted rural electrification programs, ensuring that remote and isolated areas are not left without power.

Off-grid renewable energy systems have become a lifeline for communities outside the reach of the centralized electricity grid. Backed by the 2007 Renewable Energy Law, which was amended in 2020, Indonesia encourages investment in decentralized solutions like solar PV systems, micro-hydro power plants, and mini-grids. This legislative framework streamlines permitting, licensing, and implementation, paving the way for private sector involvement and community-driven initiatives that provide sustainable energy access.

The Sustainable Energy Access for All Program demonstrates Indonesia's commitment to equitable energy access. Led by the Ministry of Energy and Mineral Resources, the initiative aims to electrify 12,000 villages by 2025, primarily through off-grid renewable energy systems. By leveraging government funding, international cooperation, and public-private partnerships, the Sustainable Energy Access for All Program reflects Indonesia's determination to provide everyone with sustainable and inclusive energy access, leaving no one in the dark.

Public-private partnerships (PPPs) are the cornerstone of Indonesia's rural electrification efforts. By collaborating with private sector entities, NGOs, and community-based organizations, the government taps into expertise, resources, and networks to implement electrification projects more effectively. Established under the 2014 Energy Law, these partnerships foster innovation, enhance efficiency, and ensure the sustainability of off-grid energy solutions, helping to create a brighter future for rural communities across Indonesia.

Community engagement and empowerment are central to Indonesia's rural electrification efforts. Following a participatory approach outlined in the 2014 Community Empowerment Law, the government actively involves local communities in decision-making and implementation. By fostering a sense of ownership and building capacity, Indonesia ensures that electrification initiatives remain sustainable, resilient, and socially accepted, empowering communities to shape their energy future.

Indonesia's commitment to rural electrification underscores its dedication to achieving universal electricity access and fostering inclusive development. Through government subsidies, off-grid renewable energy systems, rural electrification programs, and public-private partnerships, Indonesia is narrowing the energy gap between urban and rural areas, bringing light to rural communities. However, sustaining this progress requires ongoing investment, policy support, and stakeholder collaboration.

## Strengthening Energy Security

The last key government initiative implemented is actively reinforcing energy security to navigate global uncertainties and safeguard domestic interests. Indonesia's energy security strategy, anchored in the 2009 Energy Law, focuses on diversification, renewable energy promotion, infrastructure expansion, and international cooperation. By enhancing energy infrastructure and fostering regional partnerships, Indonesia seeks to reduce its vulnerability to external disruptions and build a more resilient energy ecosystem.

The 2007 Renewable Energy Law and its recent amendments reaffirm Indonesia's commitment to renewable energy as a cornerstone of energy security. The country promotes energy-efficient practices and enhances overall resilience through initiatives such as energy audits and management systems. Additionally, investments in critical energy infrastructure, including power plants and transmission networks, bolster Indonesia's ability to manage disruptions and ensure an uninterrupted energy supply.

Indonesia's proactive approach to energy diplomacy strengthens its resilience on the global stage. The country promotes energy trade, resource sharing, and technology transfer, as well as strengthens regional stability and cooperation through bilateral agreements, regional forums, and multilateral initiatives. By prioritizing sustainable energy security, Indonesia is paving the way for a stable, sustainable, and resilient energy future.

## Optimizing Energy Policy for a Just Transition

Indonesia's initiatives to achieve a just energy transition are crucial for sustainable development and climate resilience. However, several challenges hinder effective and equitable implementation.

One major challenge is the stark regional disparity in energy infrastructure and development. While urban centers, particularly in Java and Bali, enjoy better access to renewable energy and advanced grid systems, many rural and remote areas remain underserved. This urban-rural divide leads to unequal access to reliable energy. Rural communities often depend on traditional biomass or diesel generators, which are inefficient and pose risks to both health and the environment (Asian Development Bank, 2020a).

Financial and technical barriers also pose significant challenges to the transition. While renewable energy technologies are becoming more cost-effective, they still require substantial upfront investments—often beyond the reach of local communities and small businesses. Many groups lack access to affordable financing options needed to adopt clean energy solutions (International Energy Agency/IEA, 2022). Additionally, there is a significant shortage of technical expertise and capacity-building initiatives, which enable local stakeholders to actively participate in and benefit from the energy transition (International Renewable Energy Agency, 2021b).

Policy and regulatory frameworks also present significant challenges. While several policies have been introduced to promote renewable energy, inconsistencies and bureaucratic obstacles often impede effective implementation. Frequent changes in regulations and unclear policy directives create uncertainty for investors and developers, slowing the progress of renewable energy projects (World Bank, 2021). Additionally, current policies often fail to fully address social equity concerns, which are crucial for ensuring that the benefits of the energy transition are shared justly across all segments of society (UNDP, 2020b, 2020a).

These gaps significantly affect expanding access to quality energy for all Indonesians. The unequal distribution of infrastructure and resources deepens energy poverty in underserved areas, worsening existing social inequalities. If financial and technical barriers are not addressed, the energy transition could become a privilege for the wealthy, leaving marginalized communities even further behind. Furthermore, inconsistencies in policies and regulations hinder the overall progress of renewable energy adoption, limiting its potential to reduce greenhouse gas emissions and promote sustainable development.

Addressing this gap requires Indonesia to adopt a more inclusive and comprehensive approach to its energy transition. Increasing regional cooperation and investment in infrastructure, particularly in underserved areas, is crucial. This includes developing off-grid and mini-grid solutions to provide reliable and sustainable energy to remote communities (Asian Development Bank, 2020b). Additionally, offering targeted financial and technical support to vulnerable groups can help them adopt renewable energy technologies. Such support could include subsidies, low-interest loans, or grant programs to ease initial investments' financial burden (International Renewable Energy Agency, 2021a).

Simplifying policies to create a stable and supportive environment for renewable energy development is also essential. This includes ensuring regulatory consistency, providing clear and long-term policy direction, and incorporating social equity considerations into energy policies. These steps can enhance investor confidence, speed up project implementation, and ensure that the benefits of the energy transition are shared fairly (World Bank, 2021).

Several laws and regulations need to be updated or introduced to support a just energy transition. The Energy Law Number 30 Year 2007 should be revised to include clear targets for renewable energy adoption and emissions reductions. The law should also mandate the gradual removal of fossil fuel subsidies, redirecting these funds to renewable energy projects. Additionally, it should require integrating social equity considerations in energy policies, ensuring that the benefits are distributed fairly across regions and demographics.

Law Number 21 Year 2014 on Geothermal governs geothermal energy development, which holds great potential in Indonesia. To speed up the approval process, licensing procedures must be simplified, and bureaucratic obstacles must be removed. Introducing incentives, such as tax holidays, reduced royalties, and government-backed guarantees, is crucial to attracting private investment. Additionally, ensuring community involvement and establishing benefit-sharing mechanisms to support local development are essential.

Presidential Regulation Number 22 Year 2017 on the National Energy General Plan outlines Indonesia's long-term energy strategy. This regulation should be updated to align renewable energy targets with international commitments and speed up the transition. Clear implementation timelines, accountability mechanisms for each target, and priority to off-grid and mini-grid solutions for rural and remote areas must be established to ensure equitable access to energy.

Regulation of Minister of Energy and Mineral Resources Number 50 Year 2017 on the Utilization of Renewable Energy for Electricity Supply aims to promote renewable energy in the electricity sector. The regulation should be revised to include more attractive feed-in tariffs, which are regularly updated to reflect market conditions, a transparent and simplified approval process for renewable energy projects, and a mandate for utilities to purchase a certain percentage of their power from renewable sources.

Environmental regulations also play a crucial role in the energy transition. Law Number 32 Year 2009 on Environmental Protection and Management should be revised to strengthen enforcement mechanisms that ensure compliance with environmental standards in energy projects. Incentives for adopting clean energy technologies should be introduced, while penalties for pollution from fossil fuels should be increased. Integrating climate adaptation and resilience measures into energy planning is also essential for long-term sustainability.

Additionally, new regulations are needed to address specific aspects of energy transition. Law related to renewable energy is crucial to attract and facilitate investment in renewable energy, provide comprehensive incentives, establish one-stop services for investors, and offer guarantees against political and regulatory risks. The green finance regulation should establish a green financing facility, encourage banks to include renewable energy in their lending portfolios, and support innovative financing models, such as public-private partnerships.

Building local capacity in renewable energy technologies and project management requires a technical capacity-building regulation. This regulation should mandate the inclusion of renewable energy and sustainability topics in educational curricula, provide funding for technical training programs and internships, and establish partnerships with international institutions for knowledge transfer. An inclusive energy planning regulation is needed to ensure public consultation and participatory planning processes for all significant energy projects, implement benefit-sharing mechanisms, and establish community energy programs.

By revising existing laws and introducing new regulations, Indonesia can establish a framework that supports a just energy transition. These legal and regulatory changes will help accelerate the adoption of renewable energy, ensure equitable access to quality energy, and promote sustainable economic growth. Addressing these areas comprehensively will enable Indonesia to harness its renewable energy potential and achieve a fair and inclusive energy transition.

## Conclusion

This chapter highlights the challenges of energy inequality in Indonesia, particularly the limited access to electricity in remote areas. Java and Bali dominate energy consumption and have better infrastructure than other regions.

Thus far, the government has launched a series of initiatives, such as promoting renewable energy, improving energy efficiency, and advancing rural electrification. However, there are many challenges on the ground, both financial and technical, as well as hurdles in implementing various policies. In this context, it is crucial to emphasize the importance of an integrated approach, sustainable investment, and policy reforms to ensure that the energy transition fosters fair and equitable energy consumption, production, and access across Indonesia.

# 6

# Weighing the Impact of Transitioning Toward New and Renewable Energy for Industries

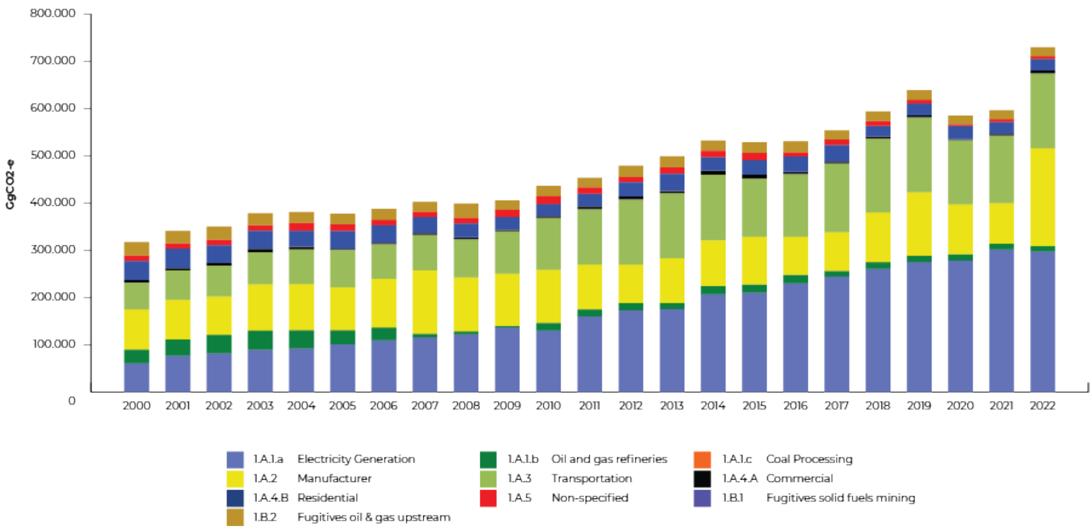
Martin D. Siyaranamual

## Introduction

Indonesia is at a pivotal point in its energy policy, driven by the need to cut greenhouse gas emissions, enhance energy security, and align with global sustainability standards. These shifts impact the manufacturing sector, a cornerstone of the country's economy. Additionally, the transition to new and renewable energy (NRE) and clean technology in this sector is shaped by multiple factors, including government policies, technological advancements, economic incentives, and social and environmental considerations.

Adopting renewable energy and clean technology in Indonesia's manufacturing sector is crucial for several reasons. First, manufacturing is among the most significant contributors to greenhouse gas (GHG) emissions and environmental pollution. According to national GHG data from the Ministry of Environment and Forestry, the manufacturing subsector is the second-largest emitter within the energy sector, following the energy industry. Between 2000 and 2022, its emission share consistently exceeded 15%, primarily due to fuel combustion in production processes and transforming raw materials into finished products (Ministry of Environment and Forestry, 2024). Within the energy sector, emissions stem largely from fuel used for power generation, heating, and oil refining (42.3%), followed by manufacturing (28.6%), transportation (21.9%), residential use (3.8%), fugitive emissions from oil and gas (2.1%), unspecified sources (0.5%), fugitive emissions from coal mining (0.4%), and the commercial sector (0.3%).

Figure 1 GHG Emission Levels in the Energy Sector by Source Subsector in 2000–2022




*Source: Ministry of Environment and Forestry (2024)*

Integrating NRE sources, such as solar, wind, and biomass, is crucial for reducing the sector's carbon footprint, combating climate change, and enhancing environmental sustainability (Amri, 2019).

The second is energy security. Indonesia's reliance on fossil fuels, particularly coal, makes the country vulnerable to fluctuations in the energy market and geopolitical risks. Transitioning to NRE will create a more stable energy supply from local sources, strengthening national energy security (Aslani et al., 2014).

Third, NRE sources can lead to significant long-term cost savings for manufacturers. By reducing reliance on imported fossil fuels and minimizing energy price volatility, manufacturers can achieve more stable and lower energy costs, ultimately enhancing their global competitiveness (Baker & Sovacool, 2017).

Fourth, it provides health benefits. Reducing fossil fuel use directly decreases air and water pollution. Cleaner energy sources improve air quality and public health outcomes, lowering healthcare costs and enhancing overall community well-being (Koplitz et al., 2017).

Lastly, compliance with global standards is crucial. The international market is increasingly demanding environmentally friendly products. Indonesian manufacturers that adopt clean technology will be better positioned to meet international environmental standards and sustainability certifications, unlocking new markets and investment opportunities (Murray & Skene, 2021).

The Indonesian government has established comprehensive policies and regulatory frameworks to drive the energy transition. The National Energy Policy and the National Energy General Plan set ambitious targets, such as achieving 23% of total energy consumption by 2025 (Ministry of Energy and Mineral Resources of Indonesia, 2017). These policies are supported by various incentives, such as tax exemptions, import duty waivers for renewable energy equipment, and feed-in tariffs for renewable energy projects (Investment Coordinating Board, 2022).

Transitioning to NRE and clean technology in Indonesia's manufacturing sector is not easy. The process is complex and challenging, but it is essential for creating a greener and more sustainable future.

Despite the challenges, this transition is crucial as it brings significant economic, environmental, and social benefits. Indonesia can accelerate its industrial transformation toward a greener and more prosperous future by continuously investing in renewable energy, embracing technological innovations, and improving the regulatory framework.

## Energy Consumption and Clean Technology Adoption in the Manufacturing Industry

The manufacturing sector in Indonesia relies heavily on fossil fuels, particularly coal, natural gas, and oil. These energy sources are widely used across various manufacturing processes, ranging from heavy industries like steel and cement to textiles and food processing sectors.

For example, coal, the primary energy source in Indonesia's manufacturing sector, is widely available and inexpensive. It has long been the preferred choice for energy-intensive industries. According to data from the International Energy Agency (IEA) in 2020, coal accounted for nearly 50% of total energy consumption in the manufacturing sector. Industries, such as cement, steel, and ceramics, rely heavily on coal due to its high energy density and cost efficiency.

Natural gas, the second-largest energy source, contributes about 30% of the manufacturing sector's energy mix (IEA, 2020). It is favored for its cleaner-burning properties compared to coal and oil, making it a better option for industries like chemicals, glass, and ceramics. Additionally, natural gas can co-generate heat and power, enhancing the energy efficiency of industrial processes.

Meanwhile, oil, particularly diesel and fuel oil, accounts for around 15% of the manufacturing sector's energy consumption (British Petroleum, 2021). It is primarily used in transportation, machinery, and backup power generation. However, the industry is increasingly looking for alternative energy sources due to its high cost and environmental impact.

Renewable energy currently plays a minor role in manufacturing, making up only about 5% of total energy consumption (Ministry of Energy and Mineral Resources of Indonesia, 2021). The primary renewable sources include biomass, biogas, and small-scale hydropower, which are primarily used in agro-industrial operations and by small and medium-sized enterprises (SMEs).).

Table 1 Energy Consumption by Source in the Manufacturing Sector in 2020

| Energy Source | Energy Consumption (Mtoe) | Percentage (%) |
|---|---|---|
| Coal | 15.0 | 50 |
| Natural Gas | 9.0 | 30 |
| Oil | 4.5 | 15 |
| NRE | 1.5 | 5 |
| Total | 30.0 | 100 |

*Source: Statistics Indonesia (2022)*

In addition to relying on fossil-based energy, the manufacturing sector also uses NRE sources through electricity consumption. However, coal remains the primary source of energy. According to data from the 2022 International Energy Agency, around 60% of electricity in Indonesia is generated from coal-fired power plants.

Table 2 Power Generation Mix in 2022

| Energy Source | Percentage (%) |
|---|---|
| Coal | 60% |
| Natural Gas | 22% |
| Oil | 3% |
| Hydropower | 6% |
| Hydrothermal power | 5% |
| Solar and wind power | 1% |
| Biomass | 3% |

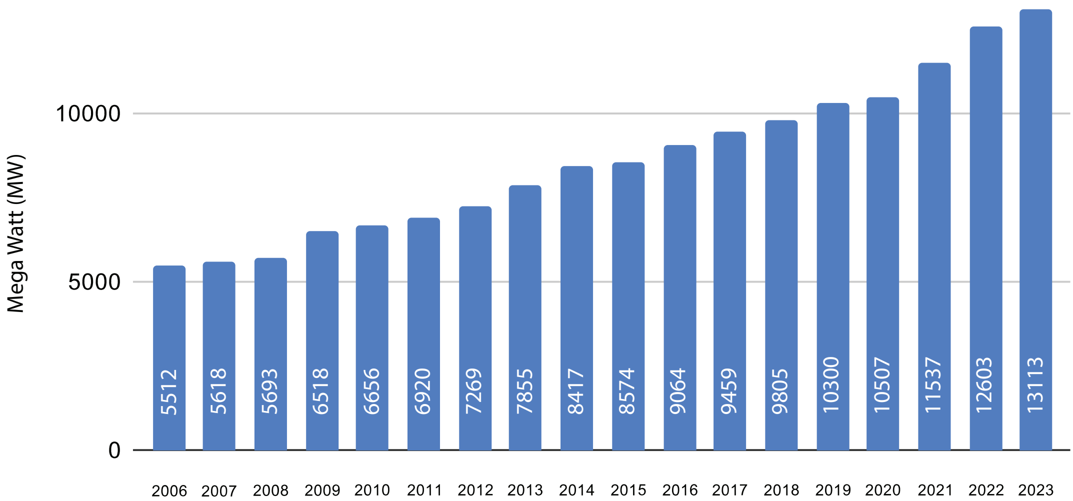
*Source: Statistics Indonesia (2022)*

In addition, oil plays a crucial role, particularly in the transportation sector and as an industrial fuel. Although Indonesia is one of the significant oil producers, rising domestic consumption has turned the country into a net importer (British Petroleum, 2022). Similarly, natural gas is used for power generation and as a direct fuel in manufacturing. NRE sources, such as hydropower, geothermal, solar, and wind, contribute less than 15% of the electricity supply, highlighting the manufacturing sector's heavy dependence on fossil fuels (IRENA, 2022).

Nevertheless, Indonesia's adoption of NRE has steadily increased over the past decade. New regulations are being introduced to further support this growing trend, although widespread use of renewable energy is still limited. These efforts ensure that producers are motivated by economic incentives and compliance with International Energy Agency regulations (IEA, 2020).

Currently, solar energy is gaining traction, with many manufacturing facilities installing solar panels to reduce their dependence on grid electricity (Hapsari, 2023). Solar power primarily benefits industries with large roof spaces, offering a

Figure 2 New and Renewable Energy Capacity in Indonesia



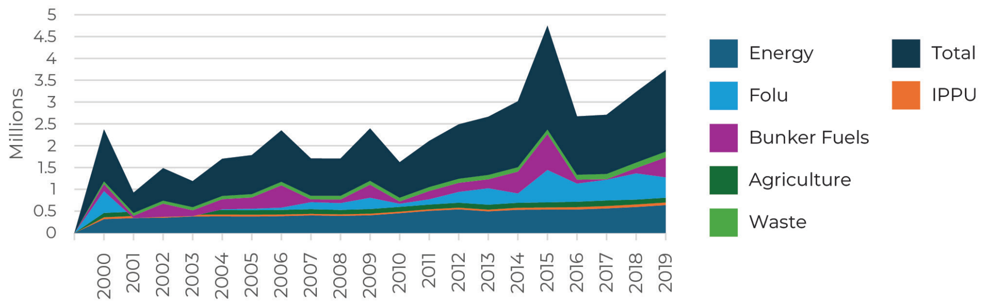

*Source: IRENA (2020)*

sustainable and cost-effective energy solution (ASEAN Centre for Energy/ACE, 2019). Biomass and biogas are also becoming more popular, particularly in agriculture. For instance, palm oil mills use waste to produce biogas, creating a closed-loop system that boosts sustainability (Indonesian Palm Oil Association, 2022). Additionally, some manufacturing facilities are exploring small-scale hydropower and wind energy, especially in areas with favorable geographic conditions (ASEAN Centre for Energy/ACE, 2021).

The manufacturing sector's reliance on fossil fuels not only poses significant challenges to transitioning to renewable energy and adopting clean technologies, but also has severe environmental impacts, including air pollution and greenhouse gas emissions (World Bank, 2022).

Technological innovation is crucial to the energy transition toward NRE sources in Indonesia's manufacturing sector. Energy-efficient technologies, such as advanced machinery, LED lighting, and modern HVAC systems, have been adopted to reduce overall energy consumption (IRENA, 2019). The integration

Figure 3 $CO_2$ Emissions by Sector in Indonesia (2000–2019)




*Source: Statistics Indonesia (2022)*

of innovative manufacturing technologies, including the Internet of Things (IoT) and artificial intelligence (AI), further optimizes energy use and enhances process efficiency (Ministry of Industry of Indonesia, 2020).

In this sector, electric and hybrid vehicles are becoming more common for logistics and transportation, helping to reduce reliance on fossil fuels and support broader sustainability goals (IEVA, 2020). Additionally, waste-to-energy technology converts industrial waste into energy, addressing waste disposal issues while generating renewable energy (Indonesian Low Carbon Development, 2020).

Several case studies highlight successful transitions in Indonesia's manufacturing sector. For example, PT Pertamina (Persero), the state-owned oil and gas company, has invested in solar energy projects and biofuel production, setting an example for other major industry players (Pertamina, 2020). Additionally, Unilever Indonesia has implemented various energy efficiency measures and used biomass boilers in its production processes, showing that integrating renewable energy into daily operations is achievable (Unilever Indonesia, 2020). Cargill Indonesia also employs waste-to-energy technology at its palm oil processing plant, significantly reducing waste while generating renewable energy (Cargill Indonesia, 2020).

Several significant challenges could arise if Indonesia's manufacturing sector refuses to switch to renewable sources. One major issue is the rising cost of energy. Fossil fuel prices are highly influenced by global market fluctuations, resulting in unpredictable and often increasing energy costs. Dependence on imported oil worsens this problem, making energy prices unstable and difficult for producers to manage (British Petroleum, 2022). Furthermore, Indonesia's fossil fuel reserves are limited. This can be seen as domestic supplies decrease and extraction costs rise, leading to rising energy prices from time to time. This scenario could force producers to pay more for their energy needs, reducing their profit margins (IEA, 2021).

Another challenge is the implementation of stricter environmental regulations and penalties. With growing international and domestic pressure to tackle climate change, more stringent environmental regulations, such as carbon taxes, emission limits, and other measures, are likely to be introduced to reduce greenhouse gas emissions. Complying with these regulations can be costly and operationally challenging for producers who still rely on fossil fuels (World Bank, 2022). Besides that, failing to meet environmental standards could result in penalties, fines, and even operational restrictions, significantly increasing operational costs and eventually affecting financial stability (PwC Indonesia, 2022).

Reputational risks and market competitiveness also present significant threats. There is a growing demand for sustainable products in international markets, especially Europe and North America, which increasingly favor products with a low carbon footprint. Manufacturers not transitioning to renewable energy may face reduced market access and decreased competitiveness (IEA, 2021). Moreover, companies are increasingly judged by their environmental impact. Failing to adopt renewable energy could harm a company's brand image and consumer trust, negatively affecting sales and market position (PwC Indonesia, 2022).

Another potential challenge is the risk of relying on outdated technology. Renewable energy technologies are evolving quickly, becoming more efficient and cost-effective. Producers who fail to adopt these technologies may fall behind and struggle to compete with more innovative and efficient competitors (IEA, 2021b). Continued reliance on outdated fossil fuel-based technologies can lead to operational inefficiencies, resulting in higher production costs, lower productivity, and a decline in global competitiveness (World Bank, 2022).

Supply chain disruptions also pose a significant risk to manufacturers. Supply chain disruptions may arise from resource scarcity, geopolitical tensions, or other global events. These disruptions can lead to production delays and higher costs, affecting the reliability and profitability of manufacturing operations (British Petroleum, 2022). Moreover, Indonesia's status as a net oil importer and the growing natural gas consumption increase the risk of supply chain vulnerabilities. Dependence on international energy markets exposes manufacturers to risks beyond their control, which can undermine the stability of their operations (IEA, 2021).

## Government Initiatives Versus International Practices

The transition to NRE and clean technology in Indonesia's manufacturing sector is supported by a comprehensive set of government policies, regulations, and incentives, as outlined in the following points.

### National Energy Policy and National Energy General Plan

The National Energy Policy forms the foundation of Indonesia's energy transition strategy. Enacted in 2014, this policy outlines the country's long-term energy goals, including the ambitious target of achieving 23% renewable energy in the total primary energy supply by 2025. This policy is supported by the National Energy General Plan, which provides a detailed roadmap for reaching this target. The plan outlines strategies to increase the share of renewable energy, improve energy efficiency, and promote technological innovation in energy production and consumption (Ministry of Energy and Mineral Resources, 2014; President of the Republic of Indonesia, 2017).

Like Indonesia, many countries have developed national energy policies and plans to guide their energy transitions. For example, the European Union (EU) has established a renewable energy directive, which sets binding targets for renewable energy use across member states, aiming for at least 32% renewable energy by 2030 (European Commission, 2020). The United States, under various administrations, has also implemented comprehensive energy plans, such as the Clean Power Plan, despite ongoing political challenges and changes (United States Environmental

Protection Agency/US EPA, 2015). With clear targets and detailed implementation plans, Indonesia's approach aligns with international practices, although its targets are more modest than those of the EU.

## Feed-In Tariff and Incentives

To encourage investment in NRE, the Indonesian government has introduced a feed-in tariff (FiT) that guarantees a fixed price for NRE producers. This tariff provides long-term financial security for investors in renewable energy projects, including those supplying electricity to manufacturing facilities. Additionally, the government offers tax incentives and exemptions for renewable energy investments, such as income tax deductions, value-added tax exemptions, and exemptions from import duties on renewable energy equipment (IEA, 2021a).

FiT's have been widely adopted worldwide as an effective tool for promoting renewable energy investment. Germany's Energiewende, a policy framework for transitioning to renewable energy, successfully leveraged FiTs to become a global leader in the sector (BMWi, 2021). Similarly, countries like China and India have implemented FiTs to expand their renewable energy capacity (IRENA, 2020a). While Indonesia's FiT system is comparable to these international models, the financial incentives and regulatory certainty could be further enhanced to match the success of these leading countries.

## Presidential Regulation Number 22 Year 2017

Presidential Regulation Number 22 Year 2017 on National Energy Policy mandates the promotion of new and renewable energy (NRE) and energy conservation. This regulation outlines specific actions for government agencies, local governments, and the private sector to accelerate the adoption of renewable energy. It also supports the manufacturing sector by encouraging renewable energy use and providing a regulatory framework for energy conservation practices (President of the Republic of Indonesia, 2017).

Some examples of regulatory mandates to implement NRE worldwide are Japan's Renewable Energy Act—which provides a legal framework to promote renewable energy—and the UK's Climate Change Act, which mandates significant reductions in greenhouse gas emissions and supports the transition to renewables (METI, 2018; UK Parliament, 2008). Indonesia's regulatory approach aligns with these international practices, though its enforcement mechanisms and incentives for compliance could be further strengthened.

## Green Industry Standards

The Indonesian Ministry of Industry has introduced Green Industry Standards to promote sustainable practices in the manufacturing sector. These standards provide guidelines on energy efficiency, waste management, and the use of renewable energy. Compliance with these standards is incentivized through recognition programs and potential access to government support and funding (Ministry of Industry, 2021).

Green Industry Standards are integral parts of promoting sustainability in manufacturing worldwide. The European Union's Eco-Management and Audit Scheme (EMAS) helps companies assess, report, and improve their environmental performance (European Commission, 2020). The Leadership in Energy and Environmental Design (LEED) certification in the United States encourages sustainable building and industrial practices (USGBC, 2021). Indonesia's Green Industry Standards share similar objectives but could further benefit from stricter enforcement and broader industry participation.

## Fiscal Policies and Subsidies

The Indonesian government has introduced various comprehensive fiscal policies and subsidies to reduce financial barriers to NRE adoption. These initiatives include subsidies for research and development in renewable energy technologies, financial support for pilot projects, and incentives to encourage private sector investment in green technologies. Lowering initial investment costs encourages producers to shift to cleaner energy sources (PwC Indonesia, 2022).

Fiscal policies and subsidies are standard tools worldwide to promote NRE. The United States implements these measures by providing tax credits for renewable energy production and investment, while European Union countries offer substantial subsidies to renewable energy projects (IRENA, 2020b). Indonesia's fiscal policies align with these international practices, but expanding the scale and reach of subsidies could further stimulate investment in renewable energy.

## Energy Conservation Programs

Energy conservation is a crucial part of Indonesia's energy policy. The government has implemented several initiatives to promote energy efficiency in the manufacturing sector. These initiatives include mandatory energy audits, implementation of energy management systems, and promotion of best practices in energy use. These programs aim to reduce energy consumption while improving the overall performance of manufacturing operations (Ministry of Energy and Mineral Resources, 2017).

Energy conservation programs are a global priority. Directive No. 2012/27/EU on Energy Efficiency established binding measures to help achieve a 20% energy efficiency target by 2020 (European Commission, 2012). Likewise, Japan's Top Runner Program sets strict energy efficiency standards across various products and industries, driving significant improvements in energy performance (METI, 2023). While Indonesia has similar programs, the country can benefit from stricter targets and more proper monitoring mechanisms to enhance compliance.

## International Partnerships and Cooperation

Indonesia actively engages in international partnerships to support its energy transition. Collaborations with global organizations like the International Energy Agency (IEA), the World Bank, and the Asian Development Bank (ADB) provide technical assistance, funding, and knowledge exchange. These partnerships help transfer advanced technologies and best practices, enabling the manufacturing sector to accelerate its shift toward renewable energy (IEA, 2021b).

International cooperation plays a crucial role in accelerating NRE adoption, as is the case with the European Union (EU), which extensively collaborates through initiatives with global partners like the International Renewable Energy Agency (IRENA, 2020c). At the same time, the United States (US) participates in the Clean Energy Ministerial to promote renewable energy and energy efficiency worldwide (CEM, 2020). Indonesia's international partnerships follow a similar approach and could be expanded to leverage global expertise and access global funding.

### Local Government Initiatives

Local governments in Indonesia play a vital role in driving the energy transition. Regional energy plans and policies tailored to local needs are developed to support national targets. These local initiatives include the development of renewable energy projects, energy conservation campaigns, and green industrial zone promotion that prioritizes sustainability and the use of renewable energy (World Bank, 2022).

Local government initiatives are vital components of national energy strategies worldwide. States like California have set ambitious NRE targets in the US and its own aggressive programs (California Energy Commission, 2020). Similarly, Germany's federal system enables states to develop and enforce specific energy policies that align with national goals (BMWi, 2021). Indonesia's local government initiatives are commendable and could be further empowered with more resources and autonomy to encourage regional renewable energy projects.

The Indonesian government has implemented various comprehensive initiatives and regulations to promote the transition to renewable energy and clean technologies in the manufacturing sector. These measures, which include national policies, financial incentives, regulatory frameworks, and international partnerships, align with global best practices. However, to unlock the full potential of these initiatives, Indonesia could enhance enforcement mechanisms, scale up financial incentives, and foster stronger local and international cooperation. By doing so, Indonesia can more effectively pave the way toward a sustainable and resilient energy future.

## Additional Strategies to Accelerate the Energy Transition

The transition to green energy in the manufacturing sector is essential for achieving the targets of greenhouse gas emission reduction and promoting sustainable development. While various initiatives and regulations are already in place, additional strategies are needed to accelerate the adoption of NREs and clean technologies. These key strategies can be implemented and compared with international best practices to provide a more comprehensive perspective.

## Innovation and Technology Ecosystem Development

Setting up renewable energy innovation centers across Indonesia can be a strategic move. These centers would serve as incubators for start-ups and technology companies specializing in clean energy solutions. Besides that, they would also provide research and development (R&D) facilities supported by the government and private sector. A successful example of this approach is Germany's Fraunhofer Institutes, which focus on R&D in renewable energy technologies (Fraunhofer-Gesellschaft, 2021).

Strengthening partnerships among industries, universities, and research institutions for joint research and the development of clean energy technologies can accelerate innovation. The government can provide grants and incentives for R&D projects on renewable energy and energy efficiency. South Korea has successfully adopted this model, with universities and industries frequently collaborating on renewable energy projects, making it a valuable example to follow (KETEP, 2020).

## Human Resource Development

Investing in specialized education and training for NRE and clean technologies is crucial. The government and industry can collaborate to develop relevant vocational and university curricula. Additionally, certification programs can enhance workforce skills in renewable energy technologies. Denmark, for example, has implemented extensive training programs to equip workers for careers in the renewable energy sector (Danish Energy Agency, 2019).

Educational campaigns that increase awareness among industry stakeholders on the importance of energy transition can encourage the adoption of clean energy practices. These campaigns can include seminars, workshops, and conferences that showcase NRE's economic and environmental benefits. Japan, for example, has implemented a comprehensive energy awareness campaign as part of its national energy strategy (METI, 2018).

## Optimizing Local Renewable Energy Sources

Indonesia has vast potential for solar and wind energy. Optimizing these resources through large-scale projects and microgrids can provide a stable and sustainable energy supply for the manufacturing industry. The government can support this development with incentives and regulatory policies. India is a strong example, having successfully developed large-scale solar projects like the Bhadla Solar Park (IEA, 2021).

Indonesia has abundant biomass resources, including agricultural residues and industrial waste. Technological development to convert biomass into NRE can offer a sustainable alternative energy source for manufacturing. For example, Sweden successfully utilizes biomass to meet a significant portion of its energy needs (IEA Bioenergy, 2020).

Biofuels offer several advantages as a sustainable energy source for Indonesia. Their renewable nature can enhance energy security and reduce geopolitical risks by ensuring a more equitable energy supply across the country. Biofuel production can also boost the agricultural and social sectors, driving economic growth in rural areas. Environmentally, biofuels can cut greenhouse gas emissions by over 80%, hydrocarbon emissions by nearly 70%, and dust particles by up to 50%, leading to cleaner air and helping the fight against global warming (Nisa, 2023).

While there are challenges related to land use, pesticide use, and the potential rise in food prices, these can be addressed through balanced planning and sustainable practices (Usmani, 2023). Additionally, advancements in nanotechnology and genetic engineering can enhance the efficiency and effectiveness of biofuel production, making biofuels a viable and environmentally friendly alternative to fossil fuels (Edwin et al., 2023).

## Promoting a Circular Economy

Encouraging manufacturing industries to embrace circular economy practices can be an effective measure in reducing reliance on fossil fuels. In this model, industrial waste is repurposed as a source of energy or raw materials, helping to reduce waste and improve resource efficiency.

To promote the adoption of a circular economy, the government can offer incentives for projects that incorporate these principles into industrial processes. Finland is one of the successful examples of implementing circular economy principles in its industrial sector (Sitra, 2019).

Investing in efficient recycling and energy recovery technologies can help reduce energy consumption and emissions. Governments can support these innovations by providing research and development funding and tax incentives for adopting green technologies. The Netherlands, for example, has a highly efficient waste management program incorporating advanced recycling technologies (Dutch Ministry of Infrastructure and Water Management, 2020).

## Adopting New Business Models

Adopting an Energy-as-a-Service (EaaS) business model, manufacturers can purchase renewable energy from third-party service providers and accelerate the transition without substantial upfront investments. This model offers companies access to clean energy with lower operating costs and greater flexibility. A successful example of EaaS implementation can be seen in the United States (Navigant Research, 2019).

Developing greener products and services and energy efficiency can add value to manufacturing companies. Not only does it enhance the company's image, but it also meets the growing demand from consumers who are increasingly concerned about the environment. Companies like Apple and Google are examples of businesses that have successfully adopted this strategy with environmentally friendly products and operations (Apple, 2020; Google, 2021).

## Strengthening Policies and Regulatory Frameworks

Implementing carbon pricing policies, such as carbon taxes or emissions trading schemes, can provide substantial economic incentives for companies to reduce their emissions and transition to NRE. A transparent and fair carbon pricing system can help steer investment toward clean energy. The European Union, for example, has successfully implemented an effective emissions trading scheme (European Commission, 2020).

Ensuring that regional and national spatial planning supports NRE development can help accelerate the transition to green energy. This includes allocating land for NRE projects and building supporting infrastructure, such as electricity grids and energy storage facilities. Germany has effectively implemented this approach through its spatial planning policy (BMWi, 2021).

Implementing a cap-and-trade emissions trading scheme can be an effective market mechanism for reducing emissions. This system allows companies to buy and sell emissions permits, providing an economic incentive to cut emissions most cost-effectively. The European Union's Emissions Trading System (ETS) is the largest emissions trading scheme in the world (European Commission, 2020).

Energy efficiency standards for industrial equipment and machinery in Indonesia must be updated and strengthened to ensure that the technology used in the manufacturing sector meets high energy efficiency benchmarks. Japan's Top Runner program sets the highest energy efficiency standards globally and fosters technological innovation (METI, 2020). Indonesia could adopt a similar approach to encourage the use of more efficient technologies.

Encouraging green certification in the manufacturing industry can strengthen commitment to sustainability. Certifications like ISO 50001 for energy management systems help companies manage energy consumption and improve efficiency. The government can incentivize businesses that achieve green certification.

### Strengthening Fiscal and Non-Fiscal Incentive Policies

Currently, tax incentives for renewable energy and energy efficiency investments in Indonesia remain limited. Revisions are needed to expand their scope and enhance their appeal. Thailand, for example, offers substantial tax incentives for renewable energy projects through its Board of Investment (BOI) (Thailand BOI, 2021). Indonesia can adopt a similar approach by introducing more competitive and transparent tax incentives to drive green energy investment.

The government can expand subsidy and grant allocations for renewable energy projects, particularly for research and development (R&D) and pilot initiatives. Germany sets a excellent sexample with its subsidy and grant programs, managed through the KfW Development Bank, to support renewable energy and energy efficiency projects (KfW, 2021).

Carbon taxation can be a powerful economic incentive for companies to lower emissions and transition to renewable energy. Carbon taxes should be designed progressively and transparently to ensure fairness and effectiveness. Sweden, for example, has successfully reduced emissions through a high carbon tax (World Bank, 2019).

### NRE Infrastructure Development

Regulations supporting NRE infrastructure development, such as electricity grids, energy storage facilities, and solar and wind power plants, are essential. The government should streamline bureaucratic processes and simplify permits to accelerate renewable energy projects. An example of international practices is the UK policy that allows fast-track permitting for renewable energy projects (UK Department for Business, Energy & Industrial Strategy, 2020).

Governments should incentivize companies to integrate renewable energy into the national grid. This includes competitive feed-in tariffs and net metering policies, which allow renewable energy producers to sell surplus power back to the grid. China implements a feed-in tariff policy to support the growth of renewable energy (IRENA, 2020b).

### Strengthening Spatial and Environmental Policies

Spatial planning should incorporate the need for renewable energy development. This includes allocating land for NRE projects and ensuring spatial policies to actively support their expansion. Germany, for example, implements a spatial policy that promotes renewable energy through special zoning arrangements for solar and wind energy projects (BMWi, 2021).

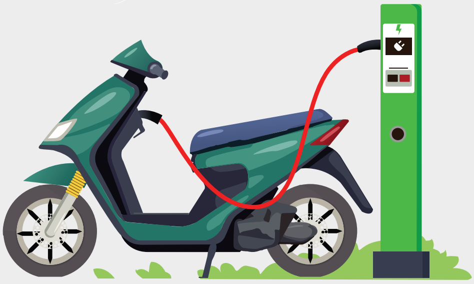
Strict environmental regulations are essential to ensure that renewable energy projects do not harm ecosystems or the environment. This includes the analysis of a comprehensive Environmental Impact Assessment (EIA) before granting project permits. Canada, for example, implements rigorous environmental standards for renewable energy projects (Canadian Environmental Assessment Agency, 2019).

To accelerate the energy transition in Indonesia's manufacturing sector, additional strategies are needed, including regulatory revisions and enhancements that support technological innovation, human resource development, optimization of local energy sources, circular economy practices, adoption of new business models, and enhancement of policy and regulation frameworks. By integrating these strategies, Indonesia can more effectively achieve its energy transition and sustainability goals while enhancing the global competitiveness of its manufacturing sector. Adopting cleaner and more efficient energy sources can also reduce long-term operational costs. Additionally, lowering emissions and carbon footprints will strengthen the reputation of Indonesia's manufacturing industry among global consumers and investors, who increasingly value environmental commitment.

## Conclusion

This chapter highlights the urgent need for an energy transition in Indonesia's manufacturing sector to reduce GHG emissions and boost economic competitiveness. Relying fossil fuels presents significant challenges, including sustainability concerns and energy price volatility. Adopting NRE sources, such as biomass and solar power, along with energy-efficient technologies, is crucial to address these issues. Beyond environmental benefits, this transition supports public health, enhances cost efficiency, and helps meet global sustainability standards.

Comprehensive policy reforms and formulations have introduced various new policies and programs. However, they also need to review existing laws and regulations, including their derivative laws and regulations. Strategic investment is also crucial. Only through these efforts can the energy transition strengthen energy security and accelerate the transformation of industries toward a greener, more competitive future.



# 7

# The Indonesian Way for Energy Transition

Fadli Rahman

## Introduction

Indonesia's energy sector is at a crossroads. To realize true energy independence, the energy transition must be undertaken based on an approach that aligns with Indonesia's characteristics and needs. Therefore, transition programs implemented in other countries cannot be simply replicated.

Policy priorities must be tailored to Indonesia's unique conditions, considering economic challenges, infrastructure development, demographic distribution, and resource potential. Changes must be implemented swiftly and strategically to optimize the energy sector's performance. Therefore, the energy transition not only supports national energy security, but also drives long-term sustainable economic growth. Changes must be implemented quickly so that Indonesia can ensure that the energy sector reaches its optimal level.

## Indonesia's Energy Transition Falls Short of Initial Expectations

The progress of Indonesia's energy transition has not met initial projections. A key example is the low share of new and renewable energy (NRE) in the energy mix, which was initially targeted to reach 23% by 2025, as outlined in Government Regulation Number 79 Year 2014.[7] However, given the trajectory of the past four years, this target is unlikely to be met. In 2021,[8] the NRE share stood at just 12.32% and over the next two years, it increased by only 0.8 p.p. (percentage point). As a result, the 2025 target has been revised to a more modest range of 17–19%.[9]

However, some achievements have exceeded initial expectations, such as the target of greenhouse gas (GHG) emission reductions. The government initially aimed to cut emissions by 29–41%[10] by 2030. However, due to progress in recent years, the target was revised to 31.9–43.2%,[11] as outlined in the Enhanced Nationally Determined Contribution (ENDC) released by the Ministry of Environment and Forestry (MoEF) in 2022. This adjustment was driven by Indonesia's GHG reduction performance from 2019 to 2022, which exceeded projections—achieving 91.5 million tons compared to the initial target of 91.0 million tons.[12] This progress was mainly due to various emission reduction efforts, particularly in the forestry and energy sectors. However, more ambitious and cross-sectoral measures will be necessary to meet the newly established targets.

Indonesia has made significant strides in promoting biofuels in the transportation sector through the Mandatory Biodiesel Program, which has been in place since 2008[13]. The biodiesel blend started at 2.5% in 2008 and gradually increased over the years—7.5% in 2010, 10–15% between 2011 and 2015, 20% (B20) in 2016, and 30% (B30) in 2020—before reaching 35% (B35) on February 1, 2023. With the implementation of B35, Indonesia has become the world's third-largest biofuel producer, following the United States and Brazil. In 2022, Indonesia produced 174,000 barrels of oil equivalent per day (BOEPD). The B35 program is also projected to cut GHG emissions by 34.9 million tons of $CO_2e$ and save up to USD10.75 billion[14] in foreign exchange. The use of biofuels can not only reduce dependence on imported fossil fuels, which erode the current account and burden the fiscal, but also provide a more environmentally friendly fuel alternative.

However, several energy transition programs, including electric vehicle incentives and carbon trading, face challenges. The electric motorcycle incentive program, aimed at absorbing 200,000 units in 2023, has only achieved 7.5%[15] of its target. This is despite the rise of the motorcycle conversion incentive from IDR7 million to IDR10 million per unit[16] and changes in the eligibility criteria from low-income individuals to the general public. Meanwhile, carbon trading, which was launched in September 2023, needs time to develop. Based on IDX Carbon data, as of June 2024[17], total transactions recorded IDR36.8 billion, equivalent to 609,000 tons of $CO_2e$, reflecting a 32% increase from the initial transaction volume at launch. However, 68.8% of the available carbon credits remain untapped in the carbon market.

Some programs, such as the early phase-out for 13 coal-fired power plants (CFPPs) and the ban on new CFPP development as outlined in Presidential Regulation (Perpres) Number 112 Year 2022 on accelerating renewable energy development for electricity supply, have stalled. To this day, the implementation progress of regulation has been minimal and allows loopholes to permit new CFPP developments. Identification, roadmap preparation, foundation of a special secretariat under a dedicated funding program, and plans for pilot projects have been undertaken, but no concrete action has been taken so far. Some issues, such as taxonomy, compensation mechanisms, legal uncertainties, and potential negative economic impacts, become primary obstacles in the implementation. Those challenges in implementing the energy transition highlight fundamental problems and challenges in Indonesia's energy and economic sectors.

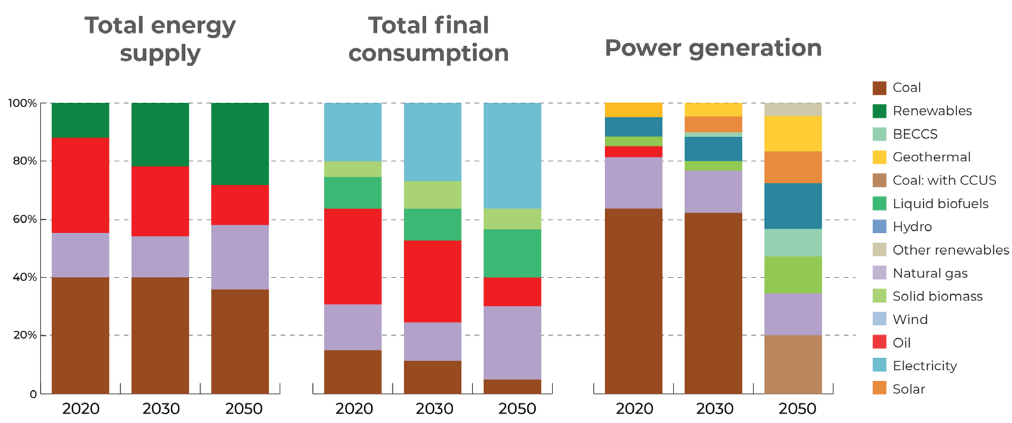
## Indonesia's Energy Transition Issue is Not Different from Other Countries

The lessons from the past five years have been critical for informing Indonesia's future energy transition. The lessons touch on all aspects, notably conservative energy market consumers, economic dynamics, sectoral anxiety, limited funding, and regulations, which are still in the early stages of development.

Most business and retail consumers in Indonesia’s energy market are pretty conservative. They usually want short-term economic benefits from their energy consumption and ignore its long-term risks (such as adverse health impacts). They will adopt greener energy only when it is cheaper. For example, they demand that the cost of solar panels must be lower than that of the primary electricity grid. Indeed, this is hard to get because, in fact, the grid still has a mixture of fossil fuels and is subsidized by the government. Furthermore, green, technology is still developing and expensive, especially in a relatively small market.

Another major challenge is sectoral anxiety due to potential business disruptions. For example, there has been a fear that the introduction of electric vehicles (EVs) and the early phase-out of coal-fired power plants will significantly and quickly impact the fossil energy sector. This misperception stems from a misunderstanding of the energy transition. Many still think the energy transition will eliminate fossil energy, which is still crucial for the Indonesian economy. The energy mix projection prepared by the National Energy Council shows that fossil fuels will still contribute around 69% to the total energy supply in Indonesia in 2050.[18] However, based on the International Energy Agency's (IEA) report entitled *An Energy Sector Roadmap to Net Zero Emissions* in Indonesia, the demand for fossil fuels will inevitably decline over time. The following is a projection of Indonesia's energy supply and demand by 2050.

Figure 1 Projected Energy Supply and Demand in Indonesia Through 2050




Source: An Energy Sector Roadmap to Net Zero Emissions in Indonesia (International Energy Agency)[19]

On the other hand, the energy transition must not come at the expense of Indonesia's economic growth. The financial resources needed to fund this transition are estimated at approximately USD281 billion from 2023 to 2030, more than double that amount to reach the net-zero emissions target by 2060.[20] This is a massive and costly figure. The funding required by 2030 alone is nearly 10 times the IDR466 trillion allocated for developing Indonesia's new capital city. Meanwhile, access to competitive financing with minimal conditions remains limited. Moreover, unlike countries like the United States and China, Indonesia lacks substantial and easily accessible government funding for this transition. While some foreign countries and international institutions try to offer financial support for energy transition programs in Indonesia, it turns out that the stringent and complex requirements make it challenging to fulfill, resulting in low absorption.

Regulations are also in their early stages and continue to evolve. There are ongoing shifts in policy, such as the New and Renewable Energy (NRE) Law, which has yet to be finalized, and the National Energy Policy, which still needs to be drafted and ratified. Additionally, several government regulations related to energy and the environment remain incomplete. While this is understandable given that Indonesia's energy transition is still in its early phases, it is crucial to establish proper regulatory frameworks to foster a more favorable investment climate and ensure smoother execution in the future.

## Lessons from Other Countries

These challenges are not unique to Indonesia. Developing and developed nations face similar obstacles in their energy transitions. According to a 2021 report from the International Energy Agency, developing countries are working to scale up investment in clean energy but struggle with limited funding sources, currency instability, weak local banking systems, and inadequate supporting infrastructure that make attracting investment even more challenging. Therefore, a concerted international effort is essential. Collaborating with global institutions like the World Bank and the World Economic Forum can help build a sustainable and resilient economic future for developing nations.

In fact, similar challenges are encountered worldwide, including in the United States, China, Norway, and Brazil, though the severity varies by country. According to the World Energy Council's 2023 Energy Pulse survey, the biggest hurdles for most nations include funding constraints, infrastructure investment, and the development of new technologies. Meanwhile, other emerging factors are a global framework to drive the energy transition, gaps in trust and collaboration, and energy access for sustainable development.

The solutions that other countries adopt to tackle these challenges can offer valuable lessons for Indonesia. Each nation navigates its energy transition differently, some successfully, some less so, and often not exactly as planned. However, some programs and strategies can serve as references for Indonesia.

The United States implement two key policies, namely the Bipartisan Infrastructure Law (BIL) and the Inflation Reduction Act (IRA), to accelerate the energy transition. Both of which emphasize funding. Passed in late 2021, BIL is an infrastructure and jobs investment law that allocates USD150 billion (approximately IDR2,400 trillion) for energy transition-related infrastructure development. The fund allocation includes USD75 billion for upgrading electricity transmission and grids, USD50 billion for strengthening natural and physical infrastructure resilience, USD7.5 billion for expanding the national EV charging network, USD4.7 billion for reducing methane emissions from abandoned oil and gas wells, and over USD20 billion for the foundation of Office of Clean Energy Demonstrations (OCED), which is dedicated to supporting research and development of clean hydrogen, carbon capture, utilization, and storage (CCUS), and others.

A year after passing the BIL, the U.S. government introduced the IRA in August 2022, aiming to promote clean energy and cut emissions. In August 2022, the U.S. Congress passed the Inflation Reduction Act (IRA), which combines the goals of lowering domestic inflation, mainly driven by the global energy crisis, with addressing climate change. Meanwhile, one of its primary goals is to reduce carbon emissions by approximately 40% by 2030.[21] The IRA provides a combination of grants, loans, tax incentives, and other measures to accelerate the transition to environmentally friendly energy, electric vehicles, buildings, and manufacturing. It supports investments in clean energy deployment, grid expansion, domestic green technology production, incentives for EV adoption, methane emission reductions, enhanced building efficiency, climate resilience in communities, and other sectors.

The total allocation for the energy transition is USD400 billion or around IDR6,200 trillion. This funding is distributed across tax incentives for businesses and consumers, grants, loans, and government operations related to clean electricity infrastructure and transportation, including electric vehicles. It can be seen that the U.S. government is prioritizing significant public funding as both a foundation and a catalyst to speed up the country's energy transition. This policy has the potential to position the U.S. as a global leader in developing environmentally friendly energy technologies and innovations in the future, although it still lags behind China.[22]

As one of the largest producers and consumers of energy and emissions, China has aggressively approached the energy transition. One indicator is its installation of solar power plants (SPPs) capacity in 2023, exceeding the total number of SPP installations in the U.S. throughout history. Additionally, Build Your Dream (BYD), the world's largest Chinese electric car manufacturer, has surpassed Tesla in the U.S. Unlike the U.S., which primarily focuses on funding infrastructure and boosting production, China's policies emphasize funding and expanding production and consumption. In 2021, China invested over USD380 billion (around IDR6,000 trillion). In addition, it became one of the first countries to issue the Green Bond Project Catalogue, develop its green bond principles, and collaborate with the European Union to establish the Common Ground Taxonomy.

China is actively driving large-scale NRE development and has gradually shifted its heating system from coal to gas, focusing on ensuring more sustainable gas usage. Moreover, in June 2022, China unveiled its 14th Five-Year Plan (FYP) for Renewable Energy Development (2021-2025), aiming for a 50% increase in NRE production (from 2.2 trillion kWh in 2020 to 3.3 trillion kWh in 2025). The plan sets a target for renewable electricity consumption to make up 33% by 2025 and strives for 50% of China's electricity and overall energy consumption to come from NRE during this development period. Support for electric vehicles (EVs) is also no joke. Currently, EVs make up over 30% of the total vehicle population in the country.[23]

Norway has pioneered the transition to sustainable energy, focusing on reducing greenhouse gas emissions and increasing its use of renewable energy. The country has invested in NRE sources like hydropower, wind, and solar energy. For decades, hydropower has been Norway's primary source of electricity. Meanwhile, wind and solar power generation projects are being developed. Today, nearly 100% of Norway's electricity comes from renewables, with hydropower accounting for 91% and wind power contributing 7%.

Norway is a global leader in electric vehicle adoption, with EVs making up 87% of new car sales each year, far ahead of countries like the U.S., where the figure is just 7%. This widespread adoption is driven by policies such as tax incentives, toll exemptions, and financial support for EV purchases. The shift to electric vehicles has significantly reduced emissions from the transportation sector, thanks to Norway's clean electricity supply. Moreover, Norway is at the forefront of clean hydrogen development and carbon capture and storage (CCS). Norway is one of the leading nations in Europe's energy transition.

India, known for its ambitious approach to energy transition, is taking a unique path by focusing on clean electricity and transportation. In 2022, the country introduced the Energy Conservation (Amendment) Bill, which focuses on developing domestic carbon markets and mandating the use of NRE by large energy consumers.

To support its transition, India has also launched several policies, including the National Solar Mission, the National Wind Mission, and the National Biofuel Policy. Additionally, the Indian government launched the Green Energy Corridor project to facilitate the integration of renewable energy into the electricity grid. Through the Energy Transitions Commission (ETC), India is confident that the country can achieve 45% non-fossil fuel electricity generation by 2030 and double its electricity supply. At the G20, India promoted several climate policy initiatives, including the International Biofuel Alliance and the Mission Lifestyle for Environment (Mission LiFE), which advocates a circular economy and the green hydrogen standard. Other Indian targetted policies to mitigate climate change include increasing the share of natural gas in the energy mix to 15% and subsidizing electric vehicle sales through the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme.[24]

Brazil has undertaken an energy transition by focusing on NRE and biofuels. The significant rise of this transition is the country's renewable energy usage in its electricity mix from hydropower. In recent years, investments in wind and solar power have also increased, making Brazil's electricity sector one of the lowest in carbon emissions worldwide. Since 2004, Brazil has encouraged NRE energy installation through a competitive auction system under the Renewable Energy Support program. In July 2021, the Brazilian government auctioned 420 MW of wind power and 270 MW of solar, biomass, and hydropower capacity.

Additionally, Brazil implements several policies and programs, such as incentives for alternative energy sources to promote the foundation of local manufacturing for wind turbines and their components, an energy compensation system to promote the distribution of solar energy, and land use regulations such as the Forest Code. Brazil also continues to advance its national biofuel policies like RenovaBio, as outlined in the Brazilian National Biofuels Policy (Law No. 13,576/2017). This program promotes using biofuels, such as ethanol, biodiesel, biomethane, and aviation biokerosene, to contribute to energy security, market stability, and greenhouse gas emission reductions in the fuel sector. This program aims to reduce carbon intensity in Brazilian transportation by encouraging biofuel production and consumption, eventually making Brazil the world's second-largest biofuel producer after the United States.[25]

Southeast Asian countries are also making aggressive energy transitions. Vietnam, for example, has rapidly expanded its solar energy sector over the past two years, increasing installed solar energy capacity from just 100 MW (0.1 GW) to 5 GW. This achievement has been driven by strong government support, including Feed-in Tariffs (FiT) and the involvement of environmental organizations like the Green Innovation and Development Center (GreenID), which was established to promote renewable energy development. In this matter, the FiT program provides incentives for various solar energy projects, including solar farms, floating solar, and rooftop solar installations. Vietnam conveniently allows investors to access diverse funding sources, including foreign financing, and offers a 14-year land lease exemption until project completion and various tax benefits.

The Philippines has been seen to be firmly committed to advancing clean and low-carbon energy initiatives. The Philippines participates in the Energy Transition Partnership (ETP), which supports the Electricity Market Corporation of the Philippines in building a more competitive and transparent energy market. This initiative aims to lower investment risks in energy storage systems, modernize the electricity grid, and enable the Philippines to unlock its renewable energy potential while meeting its climate goals.

The Green Energy Option Program (GEOP), launched by the Independent Electricity Market Operator of the Philippines, allows consumers to choose renewable energy, supporting the country's transition to a low-carbon future. Additionally, a proposed Energy Transition Bill aims to phase out fossil fuel power plants and internal combustion engines. Meanwhile, renewable energy companies in the Philippines are introducing innovations to secure funding for green energy projects, including utilizing real estate investment trust (REIT) structures and facilitating the early phase-out of privately financed coal-fired power plants.

Malaysia has also taken concrete steps to tackle energy challenges and make the transition to a more sustainable energy mix, aiming for 70% renewable energy by 2050. Malaysia implements the National Energy Transition Roadmap (NETR), the flagship projects and initiatives of Phase 1 of NETR, which outlines ten flagship catalytic projects and initiatives focused on the transition to a low-carbon country. In addition, Malaysia has announced several renewable energy programs and initiatives, including ASEAN's largest large-scale solar (LSS) program and a new category of floating solar power. Financing for the energy transition will come from a mix of grants, loans, rebates, incentives, and other investments to support the national approach to achieve net-zero emissions by 2050. Malaysia has committed USD159 billion to increase NRE capacity, improve infrastructure, and enhance energy efficiency. Critical commitments pledged include the decision not to build new coal-fired power plants. The country is also actively engaged in cross-border renewable energy trade, primarily through an electricity exchange system that helps meet ASEAN's regional power demands. Additionally, Malaysia is reforming its electricity sector by introducing third-party access (TPA) to supply fuel sources and expand smart grids and other electricity network infrastructure. However, Malaysia faces challenges in its energy transition, including declining domestic gas reserves and the need for more explicit policies on financing and expanding the electricity grid to accommodate more renewable energy. The country is also exploring alternatives, such as nuclear energy, to ensure a just, sustainable, and secure transition.[26]

The key takeaway from these countries' experiences is that there is no one-size-fits-all approach to developing and implementing energy transition. Each nation follows its path, in which its plan and policies are shaped by its unique circumstances, including the potential and challenges the country faces.

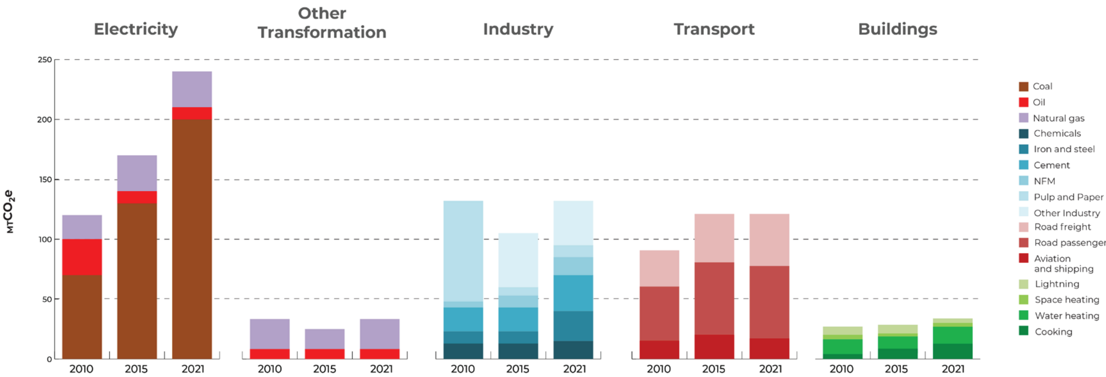
## Indonesia's Potential for Energy Transition

Indonesia is unique in terms of geography, demographics, and geological features. Its potential lies in its capacity to generate clean energy while absorbing substantial carbon.

Regarding clean energy, Indonesia has diverse NRE resources. This potential is expected to support reducing GHG emissions in various energy sectors to realize Indonesia's net zero emission by 2060 or sooner.

Figure 2

$CO_2$ Emissions from Fuel Combustion by Sector and Sub-Sector (2010–2021)




*Source: An Energy Sector Roadmap to Net Zero Emission in Indonesia (International Energy Agency)*[28]

Based on the 2010-2021 emissions data, the electricity sector through coal-fired power plants is the largest contributor to $CO_2$ emissions, followed by the industrial sector, which was driven by fuel combustion in heavy industries—such as chemicals, steel, and cement—and the transportation sector through land transportation, which contributed almost 90% of the total emissions in the transportation sector. Therefore, maximizing NRE energy potential is essential to accelerating the energy transition and reducing GHG emissions.

According to the Directorate General of New, Renewable Energy, and Energy Conservation's data at the Ministry of Energy and Mineral Resources in 2022, Indonesia only utilized around 0.3% of its total NRE potential, which was a relatively low figure. Several challenges contributed to this, including less favorable environmental conditions than in other countries. For example, Indonesia receives only 4–6 hours of solar radiation per day, lower than in countries like Australia, Bangladesh, or India in East Asia. Similarly, Indonesia's average wind and ocean currents strength is not as strong as that of countries like Australia, Vietnam, and many other European countries. Geothermal energy, which holds great promise as a key pillar of Indonesia's NRE, also requires new site development and exploration, which takes time, and access to supporting infrastructure that must be built. These potentials can still be optimized with careful and strategic planning.

Table 1 Renewable Energy Potential and Utilization

| Types of Energy | Potential (GW) | Utilization (GW) | Utilization (% ) |
|---|---|---|---|
| Solar | 3,295 | 0.31 | 0.01 |
| Hydro | 95 | 6.69 | 7.0 |
| Bioenergy | 57 | 3.13 | 5.4 |
| Wood | 155 | 0.15 | 0.1 |
| Geothermal | 23 | 2.36 | 10.2 |
| Ocean | 60 | 0 | 0 |
| **Total** | **3,686** | **12.64** | **0.3%** |

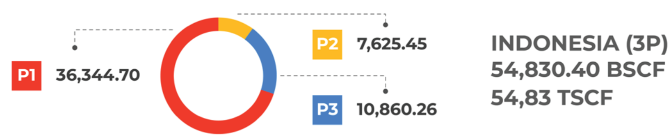
Note: Nuclear potential consists of 89,483 tons of uranium and 143,234 tons of thorium.

Source: Directorate General of New, Renewable Energy,and Energy Conservation (2022)[29]

The energy transition is not solely about shifting from fossil fuels to renewable energy. Other ways include a decarbonization program that uses low-emission fuels like natural gas and biofuels. Indonesia has giant and widespread natural gas reserves, with the largest concentrations in eastern Indonesia. In the past two years, discoveries of several enormous natural gas reserves have attracted global attention and are recorded as giant discoveries. One is in the Geng North deepwater, called the North Ganal block, in East Kalimantan, which holds an estimated 5 trillion cubic feet of gas and 400 million barrels of condensate. Another large find is in Layaran, North Sumatra, within the South Andaman block, with potential reserves exceeding 6 trillion cubic feet. According to Wood Mackenzie, Rystad Energy, and S&P Global, these are among the five largest gas discoveries in the world in 2023.[29] The Ministry of Energy and Mineral Resources' data shows that Indonesia's total natural gas reserves are 41.62 trillion cubic feet, with current usage accounting for around 23% of the national energy mix. With such potential and substantial optimization of Indonesian oil and gas, the use of natural gas is expected to increase to at least 30–35%. However, despite these large reserves, Indonesia still imports natural gas due to infrastructure limitations.

| Figure 3 | Distribution of Natural Gas Reserves in Indonesia |
|---|---|


| | | | |
|---|---|---|---|
| ACEH | P1 293.01 | P2 87.02 | P3 98.23 |
| NORTH SUMATRA | P1 103.14 | P2 97.39 | P3 168.31 |
| CENTRAL SUMATRA | P1 488.39 | P2 379.77 | P3 369.12 |
| NATUNA | P1 809.68 | P2 345.04 | P3 549.06 |
| SOUTHERN SUMATRA | P1 4,200.06 | P2 951.28 | P3 1,409.84 |
| WEST JAVA | P1 1,168.09 | P2 291.11 | P3 231.48 |
| EAST JAVA | P1 3,175.69 | P1 608.99 | P1 547.59 |
| KALIMANTAN | P1 3,035.42 | P2 1,319.32 | P3 1,192.44 |
| SULAWESI | P1 3,130.43 | P2 1,097.36 | P3 841.46 |
| MALUKU | P1 10,134.66 | P2 4,554.42 | P3 1,094.58 |
| PAPUA | P1 9,806.14 | P2 1,097.36 | P3 1,123.25 |




*Source: Oil and Gas Statistics: First Half of 2022*[31]

Indonesia's geographical conditions present the potential for developing biofuel production through the agricultural sector. As the world's third-largest biofuel producer, Indonesia currently focuses on utilizing palm oil as the primary FAME production in biodiesel. Nevertheless, other agricultural commodities, such as sugarcane, molasses, corn, and cassava, can be developed into bioethanol, thereby supporting the growing demand for oil-based fuel in the transportation sector, which continues to increase annually.

In addition to cleaner energy generation, Indonesia has a unique potential for high carbon absorption capacity. This carbon absorption can be implemented in the forestry, marine, oil, and gas sectors.

Table 2 Various Conversion Processes for Different Biofuel Types

| Conversion Process | Feedstock | Resulting Fuel | Generation | Mixing Barrier |
|---|---|---|---|---|
| Biodiesel/Fatty Acid Methyl Esters (FAME) | palm oil, used cooking oil/ UCO, coconut, soybean, castor oil, animal fat | biodiesel | first | 5%–10% in most countries; higher in Indonesia |
| Hydroprocessing | palm oil, used cooking oil/ UCO, coconut, soybean, castor oil, animal fat | drop-in fuels, such as Hydrotreated Vegetable Oil (HVO) or renewable diesel and Hydroprocessed Esters and Fatty Acids (HEFA) | first | none |
| Conventional Bioethanol | sugar cane, molasses, sweet sorghum, cassava, corn | Ethanol | first | 5%-15% |
| Cellulosic Ethanol | palm oil residue, rice straw, corn cob, sugarcane bagasse, cassava stalks, organic fraction of municipal solid waste (OFMSW), wood chunks | Ethanol | second | 5%-15% |
| Gasification and Fischer-Tropsch Synthesis | natural gas, coal, petroleum coke, and biomass resources typically processed for cellulosic ethanol | drop-in fuels, such as Hydrotreated Vegetable Oil (HVO) or renewable diesel and jet fuel, gasoline | second | none |
| Anaerobic Digestion | palm oil mill effluent (POME), degradable waste, livestock manure, grass residues, agricultural residues, food waste | Biogas, which can be combusted for electricity generation or purified and compressed to produce methane | first | none |

*Source: International Council on Clean Transportation (2021)* [32]

Indonesia's vast forest resources present an opportunity to implement nature-based solutions (NBS) to capture atmospheric carbon dioxide. According to data from the Ministry of Environment and Forestry, Indonesia's forests cover approximately 125.79 million hectares, equivalent to 62.97% of the country's total land area. The forestry sector is crucial in achieving GHG emission reduction targets, with a projected carbon absorption potential of around 140 million tons of $CO_2e$ by 2030. Another climate benefit is the preservation of biodiversity within forests.

Indonesia's marine ecosystems also offer opportunities for reducing emissions by conserving and restoring mangrove and seagrass habitats. According to the Ministry of Environment and Forestry data in 2021, Indonesia has the largest mangrove forest in the world, covering approximately 3.3 million hectares, along with 293,465 hectares of seagrass meadows. These ecosystems are estimated to store up to 3.3 gigatons of carbon, with mangroves' capability of sequestering 4 to 8 times more carbon per hectare than tropical rainforests. These ecosystems are critical to protecting coastlines from storms and erosion, serving as nurseries for fish populations, supporting food security and livelihoods, and offering opportunities for ecotourism in coastal communities. As the country with the world's most diverse marine ecosystems, Indonesia is committed to rehabilitating 600,000 hectares of mangroves by 2024 through collaboration with the World Economic Forum (WEF).

Indonesia has demonstrated its commitment to mangrove rehabilitation since 2017 by considering global agreements, setting targets, and formulating strategies. These commitments were internalized in the National Development Plan and outlined in the 2021–2030 National Roadmap for Mangrove Rehabilitation. In addition, Indonesia established a dedicated institution called the Peatland and Mangrove Restoration Agency through a presidential regulation to rehabilitate mangroves. The agency has a specific mandate to accelerate rehabilitation. This program has contributed to the community's better economy and ecological and social resilience. Under this labor-intensive program, the total mangrove areas were 17,000 hectares in 34 provinces in 2020 and expanded to 83,000 hectares in 2021.

Building on this progress, the Government of Indonesia, in collaboration with the World Bank, launched the Mangroves for Coastal Resilience (M4CR) Program. This program takes a comprehensive approach from policy development to on-the-ground rehabilitation. The program is supported through a combination of grants, estimated at USD19 million, and loans of approximately USD400 million, currently in the disbursement process.[32]

Unfortunately, despite the significant carbon absorption potential of mangrove and seagrass ecosystems, their contribution has not yet been included in Indonesia's official emission reduction targets outlined in the Nationally Determined Contribution (NDC) and the Long-Term Strategy for Low Carbon and Climate Resilience (LTS-LCCR). However, ongoing efforts are being made to recognize and incorporate these ecosystems under the blue carbon category, referring to carbon stored in coastal and marine ecosystems, including mangroves, seagrass beds, and coral reefs, within the adaptation scenario of Indonesia's Second Nationally Determined Contribution (SNDC).

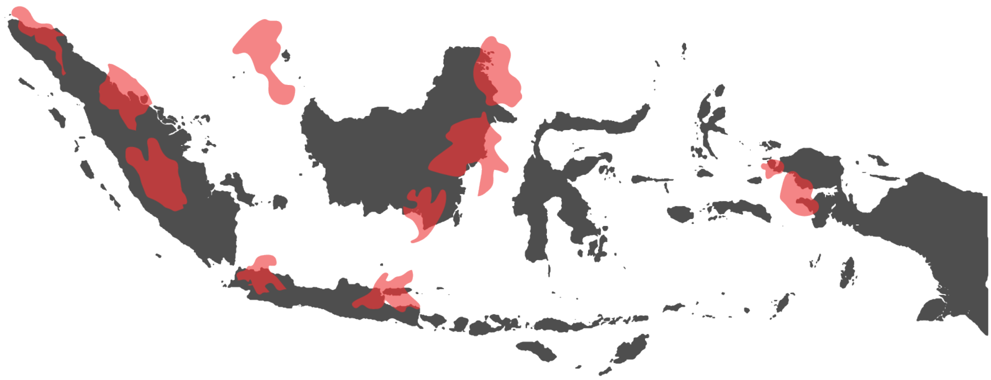
Lastly, there is potential for carbon absorption in the oil and gas sector through implementing CCS/CCUS programs. According to studies conducted by various institutions, Indonesia is estimated to have underground storage potential of up to 400 billion tons of carbon, which is equivalent to absorbing Indonesia's annual emissions for more than 200 years. With this massive capacity, Indonesia can position itself as Southeast Asia's regional carbon storage hub. Currently, there are 15 planned CCS/CCUS projects in Indonesia, with eight targeted to begin operations before 2030. However, similar to mangrove and seagrass ecosystems, the carbon absorption potential from CCS/CCUS is yet to be fully accounted for in Indonesia's SNDC. Therefore, collaborative monitoring will be crucial to ensure these initiatives are implemented effectively for optimal emission reduction efforts to support the achievement of ambitious national climate targets.

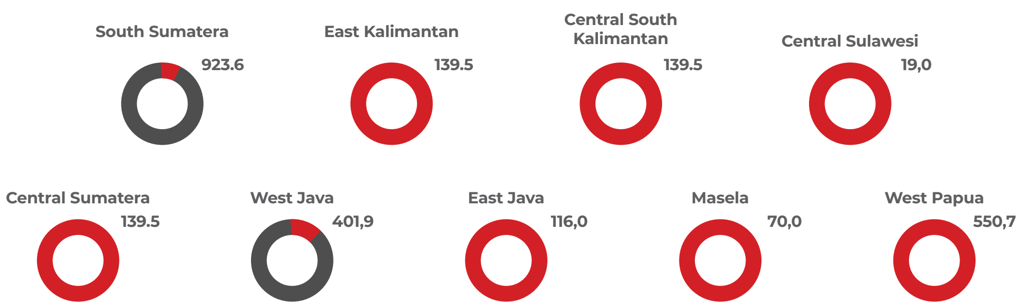
The potential above represents a unique combination of resources rarely found in other countries. Therefore, Indonesia needs to develop a program tailored to its potential to implement the transition more optimally.

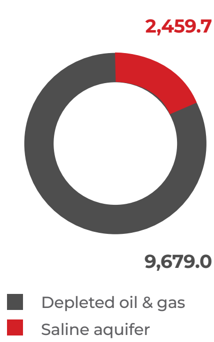
Figure 4 Map of Mangrove Potential in Indonesia


*Source: 2013-2019 One National Mangrove Map*[34]

Figure 5 CCS/CCUS Potential Map in Indonesia






**Total $CO_2$ Storage Potential**

**12,2 bilion tonne $CO_2$**

- Depleted Oil & Gas: 2,5 bilion tonne $CO_2$
- Saline Aquifers: 9,7 bilion tonne $CO_2$

**Study from International Institution:**

- Exxon Mobil: 80 Giga tonne $CO_2$ in saline aquifers
- Rystad Energy: >400 Giga tonne $CO_2$ Oil & Gas reservoir and saline aquifers

*Source: LEMIGAS Study (2009), LEMIGAS and ADB Study (2012), LEMIGAS and World Bank Study (2015)*[35]

Figure 6 CCS/CCUS Implementation Plan in Indonesia


*Source: Directorate General of Oil and Gas (2022)*[36]

Table 3 Estimated $CO_2$ Storage Potential in Indonesia's Subsurface

| No | Project | Expected CO2 Storage | Expected on Stream |
|---|---|---|---|
| 1 | CCS ARUN, Carbon Aceh and PEMA | Huge, under detail assesment | 2028 |
| 2 | Gemah CO2 EOR (CCUS), PetroChina International Jabung | Significant, under detail assesment | 2028 |
| 3 | Ramba CO2 EOR (CCUS) | Significant, under detail assesment | 2030 |
| 4 | Central Sumatera Basin CCS-CCUS, Pertamina & Mitsui | Huge, under detail assesment | 2028 |
| 5 | Sakakemang CCS, Repsol Sakakemang | 2 million ton per year and 30 million ton in total | 2028 |
| 6 | Jatibarang CO2 EOR (CCUS), Pertamina and JOGMEC | 14.6 thousand tons/year | 2031 |
| 7 | Gundih CO2 EGR (CCUS), Pertamina, J Power, Janus, CoE CCS | 3 million tons for 10 years | 2027 |
| 8 | Sukowati CO2 EOR (CCUS), Pertamina, Lemigas, Japex | 7 to 14 million tons for 15 years | 2027 pilot 2030 commercial |
| 9 | Sunda Asri Basin, Pertamina, and ExxonMobil | 6-10G tons in saline aquaifer | 2029 |
| 10 | Kutai Basin CCS-CCUS Hub, Pertamina | Huge, under detail assesment | 2028 |
| 11 | CCU to Methanol, Pertamina Refinery Balikpapan, Pertamina, Air Liquide | Significant, under detail assesment | 2028 |
| 12 | East Kalimantan CCS/CCUS, Kaltim Parna Industry | 10 million tons for 10 years | 2028 |
| 13 | Blue Ammonia CCS, Panca Amara Utama, JOGMEC, Mitsubishi, Pertamina | 19 million tons for 20 years | 2028 |
| 14 | Tangguh CO2 EGR (CCUS), BP Tangguh | 25-33 million tons for 10-15 years | 2026/2027 |
| 15 | Abadi CCS/CCUS, Inpex Masela, Ltd. | 70 million tons by 2055 | 2029 |

*Source: Directorate General of Oil and Gas (2022)*[37]

## "The Indonesian Way" Through Eight Strategic Action Paths

Indonesia's energy transition requires concurrently implementing eight strategic actions with clear short-term, medium-term, and long-term priorities.[37] These eight actions are designed based on the potential, current conditions, and the goal of realizing Golden Indonesia. These actions aim to achieve energy independence while driving economic growth. Therefore, all eight actions must be pursued with equal focus and implemented collaboratively across all stakeholders.

The first action is to increase public awareness and engagement in the importance of energy transition. Widespread information campaigns on energy transition to the public can effectively raise their awareness about the importance of the energy transition. This effort can help strengthen public understanding of energy efficiency, clean energy consumption, and sustainable daily lifestyle practices. Simple actions can start at the individual level, such as using energy-efficient appliances, adopting environmentally friendly building designs, and turning off electrical devices when not in use. In the medium term, integrating renewable energy education into early education curricula at schools can help build a shared understanding of the importance of energy transition to future generations.

The second action is limiting cross-sector emissions. Indonesia's current NDC needs to be translated into detailed concrete actions to reduce emissions, particularly in key subsectors that contribute the most, such as energy, industry, and transportation. Emission limits for these subsectors should be gradually implemented as part of the NDC's follow-up programs, accompanied by clear consequences for non-compliance. Therefore, each sector will focus more on planning mitigation efforts to meet its carbon reduction targets. This will, in turn, send a strong signal to the public and business stakeholders about Indonesia's commitment to environmental sustainability. It is also expected to drive the adoption of low-emission technologies, promote energy efficiency, and support emission offsetting through carbon credits.

The third one is decarbonizing the transportation sector. Reducing emissions through transportation decarbonization can be achieved by accelerating the adoption of biofuels and increasing the electrification of vehicles. In addition to expanding the use of biodiesel, bioethanol presents a promising opportunity to support Indonesia's energy transition. The government could consider implementing a mandatory bioethanol program similar to the current B35 biodiesel mandate. This program not only helps reduce emissions and oil-based fuel imports, but also creates room to gradually increase the mandate from B35 to B40 or higher, depending on vehicle specifications. In the long term, the target of the use of biofuels needs to be set to support energy independence.

Additionally, vehicle electrification is a crucial aspect of transportation decarbonization. Expanding the use of electric vehicles can go hand in hand with biofuel use, with both approaches complementing each other in reducing emissions. However, ensuring that the electricity powering EVs comes from renewable energy sources is vital. This requires a growing share of NRE in the power system, so EVs can effectively reduce local emissions and contribute to broader carbon reduction efforts.

The fourth is implementing targeted subsidies. Indonesia's current subsidy system remains ineffective because it is not well-targeted to those who genuinely need it. This situation poses challenges for implementing and progressing Indonesia's energy transition. The existing subsidies tend to make non-fossil-based energy products less competitive, while being cleaner and positively impacting the environment. The government needs to review and restructure oil-based fuel and electricity subsidies to manage energy more fairly and sustainably. Those energy subsidies should be shifted to direct financial assistance to low-income households. This approach would maintain economic stability while more effectively supporting renewable energy development rather than abruptly removing subsidies.

The fifth action is revitalizing and improving the domestic gas infrastructure. Optimizing the use of natural gas is a key step in reducing carbon emissions, especially given Indonesia's substantial untapped gas potential. While natural gas still produces emissions, its carbon intensity is significantly lower than other fossil fuels, making it a widely accepted transitional energy source. However, it is understandable that a gap exists between upstream gas production and downstream consumption, highlighting the need to expand liquefaction and regasification capacity across various regions. Strengthening this capacity will have positive impacts on both upstream and downstream sectors and support efficient gas usage. Additionally, investing in revitalizing gas hubs will boost investors' confidence in the upstream industry. This, in turn, will accelerate the overall domestic gas development and production.

The sixth one is accelerating the development of Indonesia's carbon sector. The potential, spanning the forestry, marine, and oil and gas sectors, positions carbon as a key milestone in Indonesia's energy transition. Leveraging this carbon potential can help offset fossil fuel use, such as oil and coal, to support economic growth. The forestry and marine sectors, which serve as natural carbon sinks, can generate tradable carbon credits and provide financial incentives for environmental preservation. In parallel, a carbon tax on the oil and gas sector, based on emissions produced, encourages companies to reduce their carbon footprint. Carbon trading and taxation are acting as incentives and disincentives for the market to cut GHG emissions and facilitate the transition towards a cleaner, more sustainable energy system. Furthermore, in the oil and gas sector, carbon storage in Indonesia can now be potentially used through various initiatives focusing on enhancing natural carbon absorption. CCS and CCUS technology can be applied in the oil and gas sector to capture and store carbon emissions from industrial processes. Harnessing this carbon storage potential not only contributes to emission reduction targets, but also strengthens Indonesia's green and blue carbon economy. The development of carbon-related projects has the potential to generate new economic value through carbon trading, creating new revenue streams that support sustainable economic growth.

The seventh is decarbonizing the electricity and industrial sectors. These sectors are the first and third largest sources of Indonesia's carbon emissions, making them critical drivers in accelerating the country's energy transition. However, decarbonizing these sectors is a long-term process. Key technologies, such as carbon capture and energy conservation, are crucial in reducing carbon footprint. While energy conservation initiatives have already been implemented, their scale and effectiveness must be significantly expanded to achieve a more optimal impact. Additionally, the development of co-firing technology and the implementation of direct electricity purchase agreements offer promising medium to long-term pathways to support decarbonization efforts and accelerate energy transition.

The eighth action is future energy development. Clean hydrogen and nuclear energy represent Indonesia's potential resources that can be optimized as part of its future energy strategy. Several countries, including Saudi Arabia, Morocco, Australia, and India, are aggressively developing hydrogen technology. Indonesia also has an opportunity to use this potential with the available renewable resources. Meanwhile, the development of nuclear energy requires careful consideration, particularly in terms of technological readiness and environmental safety. Suitable nuclear technology is expected to be ready in 2030, enabling Indonesia to effectively and safely use nuclear energy in the long run.

## Conclusion

It is expected that Indonesia's energy transition will run faster, more effectively, and sustainably through the implementation of these eight "Indonesian Way" actions.

The energy transition should not be seen as a burden, but rather as an opportunity for Indonesia to accelerate growth and development across all sectors, from the economy, industry, environment, resilience, education, and health.

8

# Can Banks Finance The Energy Transition?

Andreas N. Tjendro

## Introduction

This chapter explores whether the commercial banking sector in Indonesia can meet the investment needs of Indonesia's energy transition, particularly in the electricity sector and renewable power plants. The analysis is based on simulations using three scenarios, each projecting annual loan balances from 2023 to 2050. To gauge the banking system's capacity to absorb the financing needs of the energy transition, this chapter refers to macroprudential credit limits as a benchmark for credit demand.

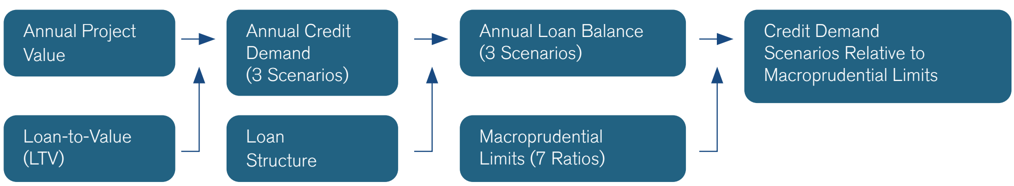
As explained in Chapter 3, the annual investment needs for Indonesia's energy sector range from USD12 billion (JETP, 2023) to USD90 billion (IEA, 2022), depending on the scope of investment considered. These estimates fall into two categories: investments covering the entire energy sector and those focused more narrowly on the electricity subsector. This chapter focuses on the narrower scope, primarily involving investment in developing new renewable power plants.

Four institutions, namely the International Renewable Energy Agency (IRENA), the Just Energy Transition Partnership (JETP), the Climate Policy Initiative (CPI), and Indonesia's Ministry of Energy and Mineral Resources (MEMR), have projected the investment needs for renewable energy projects. These estimates range from USD16.1 billion per year (CPI, 2023) to USD28.5 billion per year, according to the MEMR. This chapter only uses CPI's projection as the reference as it is the only institution that provides detailed data to simulate credit demand for this analysis.

## Methodology

This chapter estimates the banking sector's capacity to finance renewable power plants using a three-step approach. The first step is calculating the annual investment needed for renewable energy (RE) projects to achieve the net zero emissions (NZE) target and a loan-to-value (LTV) ratio possible for commercial bank financing. Based on these two factors, the analysis generates three scenarios to project annual credit demand.

Figure 1 Methodology for Estimating Banks' Capacity to Finance Renewable Power Plants




*Source: Author*

The second step is to convert the projected annual credit demand into a loan balance. This is done by combining the credit demand with the typical loan structures used to finance RE projects. The simulation includes three loan structures based on the types of RE projects.

The third step is to compare the annual loan balance from the three credit demand scenarios against seven macroprudential limits simulated through 2050. This comparison will produce several scenarios, from scenarios where financing remains 'within the limit' to those where it is projected to 'exceed the macroprudential limit' during the simulation period.

## Historical Renewable Power Plant Financing Realization

CPI has tracked detailed data on committed financing for RE projects between 2015 and 2021. This includes a breakdown by financing source, such as debt versus equity and commercial versus non-commercial loans, and by technology type, including solar, hydro, and others. In addition, CPI provides projections of investment needs of future RE projects based on technology type.

CPI reports that financing commitments for RE projects averaged USD2.9 billion annually between 2015 and 2021, totaling USD20.6 billion over the seven years. However, this only meets 18% of the projected investment needs, meaning that RE investment must increase 5.6 times to stay on track to achieve NZE.

Historically, investments in the electricity sector, both renewable and fossil-based, have been financed through debts (78%), equity (18%), and market support or grants (4%). Of the 78% of debt, nearly half or around 38% of the USD2.9 billion annually, came from Commercial Financial Institutions (CFIs), primarily commercial banks. The remaining 40% of the annual financing came from Development Financial Institutions (DFIs).

DFIs have pioneered financing renewable power plants in Indonesia. However, to achieve the required 5.6-fold increase in total investment, future growth must come from equity investors and commercial bank lending. These sources have larger pools of capital but are also more risk-sensitive and driven by profit considerations due to their commercial nature.

For example, the 145 MW floating solar power project at the Cirata Reservoir in West Java was financed in 2021 through a 16-year project financing facility worth USD112 million provided by three CFIs, without support from DFIs, export credit agencies (ECAs), or government guarantees. This project marked the first purely commercial financing for an Independent Power Producer (IPP) in Indonesia rather than a state-owned electricity company.

Meanwhile, based on project types, RE investments have historically been categorized into hydropower, geothermal, solar, wind, bioenergy, multi-technology, and supporting infrastructure. Between 2015 and 2021, hydropower accounted for the largest share of financing commitments at 42%, followed by geothermal at 25%. However, the largest share of future RE investment is expected to shift towards wind power, which is projected to reach 35%, and solar power at 29%.

## Future Scenarios of Bank Lending for RE Projects

To meet the NZE target, investment in RE projects will need to grow 5.6 times, from the current USD2.9 billion to around USD16.1 billion per year. Meanwhile, the share of financing provided by commercial banks, which currently stands at 38%, could potentially increase 1.8 folds to 70%, while DFIs would still cover the remaining 10%.

Using these two variables, this chapter simulates three scenarios (in addition to the baseline).

Table 1 Scenario Matrix and the Assumptions

| Project Value \ Bank Loan | LTV = 38% (Current Level, DFI as Major Contributor) | LTV = 70% (Current Level, Reduced DFI Contribution) |
|---|---|---|
| USD2.9 billion (Current Level ➛ NZE will not be achieved) | Baseline USD1.1 billion (1.0x) | #1 Bank-driven USD2,0 billion (1.8x) |
| USD16.1 billion (Aspirational Target ➛ NZE will be achieved) | #2 Market-Driven USD6.1 billion (5.6x) | #3 Best case USD11,2 billion (10.2x) |

*Source: Author*

## Bank-Driven Financing Scenario

In this scenario, the value of RE projects remains at USD2.9 billion per year as the market cannot grow without government support and improvements in project economics. On the other hand, commercial banks increased their share of average financing quantum from 38% to 70%, as they participate in more RE projects with higher loan-to-value (LTV) ratios. This is possible because banks build capacity and are more willing to lend to RE projects. As a result, commercial bank lending grows 1.8 times to USD2.0 billion per year. However, this scenario falls short of achieving NZE by 2060 because the total project investment remains capped at USD2.9 billion per year.

## Market-Driven Financing Scenario

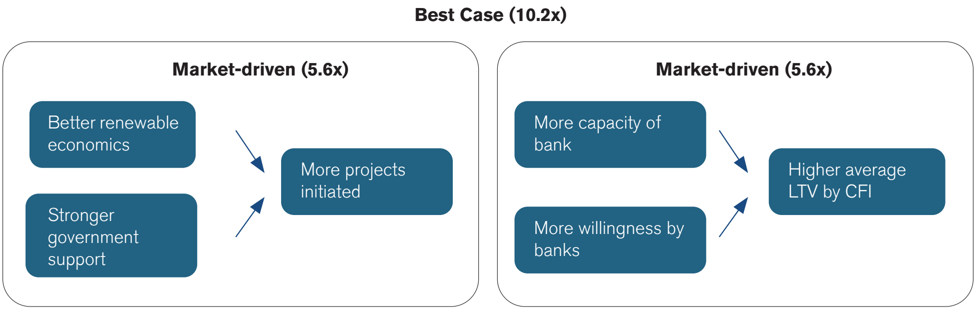
In this scenario, the value of RE projects grows 5.6 times, from USD2.9 billion to USD16.1 billion per year. The RE project owners, recognizing a profitable opportunity, drive this increase. Strong government support for the RE projects and improved economic conditions as RE technology advances also make this possible.

On the other hand, commercial banks maintained their contribution at 38%, but with loan sizes 5.6 times larger, reaching USD6.1 billion — a level they can support. However, the LTV ratio remains low due to banks' limited capacity and appetite to manage financing for renewable energy projects. To realize the full USD16.1 billion project value, DFIs will need to remain the primary source of funding for renewable energy, as commercial banks are not yet stepping up to play a bigger role.

### Best-Case Financing Scenario

In this scenario, both the value of RE projects and the LTV ratio increase together as the market capitalizes RE opportunities and commercial banks take an active role in financing. Commercial lending grows significantly, rising 10.2 times to reach USD11.2 billion annually. Like the market-driven scenario, this best-case scenario supports Indonesia's pathway to achieving NZE by 2060.

Figure 2 Three Main Scenarios and Their Forming Factors




*Source: Author*

## Bank Loan Structure Assumptions by Renewable Energy Type

CPI outlines the annual investment needs for renewable energy, totaling USD16.1 billion per year, with a breakdown by RE type, as summarized in Table 2.

Table 2 Annual RE Investment Needs Based on RE Group

| RE Type | Annual RE Investment Needs (USD Billion) | Composition | Composition | RE Group |
|---|---|---|---|---|
| Solar | 4.7 | 29% | 64% | VRE |
| Wind | 5.7 | 35% | | |
| Hydro | 2.6 | 16% | 28% | DRE (ex-Bio) |
| Geothermal | 1.9 | 12% | | |
| Bio-based | 1.2 | 7% | 7% | Biomass |
| **Total** | **16.1** | **100%** | **100%** | **Total** |

*Source: CPI/MEMR*

Across all scenarios, this paper assumes a consistent composition of RE types. This assumption is essential to simulate the annual loan balances through 2050 under each of the three scenarios.

The five RE types mentioned above can be regrouped into two to three broader RE categories. The first is Variable Renewable Energy (VRE), which refers to technologies that rely on natural conditions like weather and time of day. These conditions cannot be controlled continuously without external storage because, for example, solar power depends on sunlight during the day and wind power depends on wind speeds varying from hour to hour.

The second category is Dispatchable Renewable Energy (DRE). This RE type can be turned on, off, or adjusted to match electricity demand at any time. Examples include hydropower with reservoirs that can store and release water as needed; geothermal energy, which relies on a stable supply of underground heat; and biomass energy with fuel sources that can be stored and used when required.

Table 3 Loan Structure by RE Group

| RE Group | Composition | Credit Disbursement During Construction | Credit Repayment During Operation |
|---|---|---|---|
| **DRE: Geo Hydro** | 28% | 3-year grace period with annual disbursements | 25-year fully amortizing loan with flat principal repayments |
| **VRE: Wind, Solar** | 64% | 2-year grace period with annual disbursements | 20-year fully amortizing loan with flat principal repayments |
| **Biomass** | 7% | 2-year grace period with annual disbursements | 15-year fully amortizing loan with flat principal repayments |

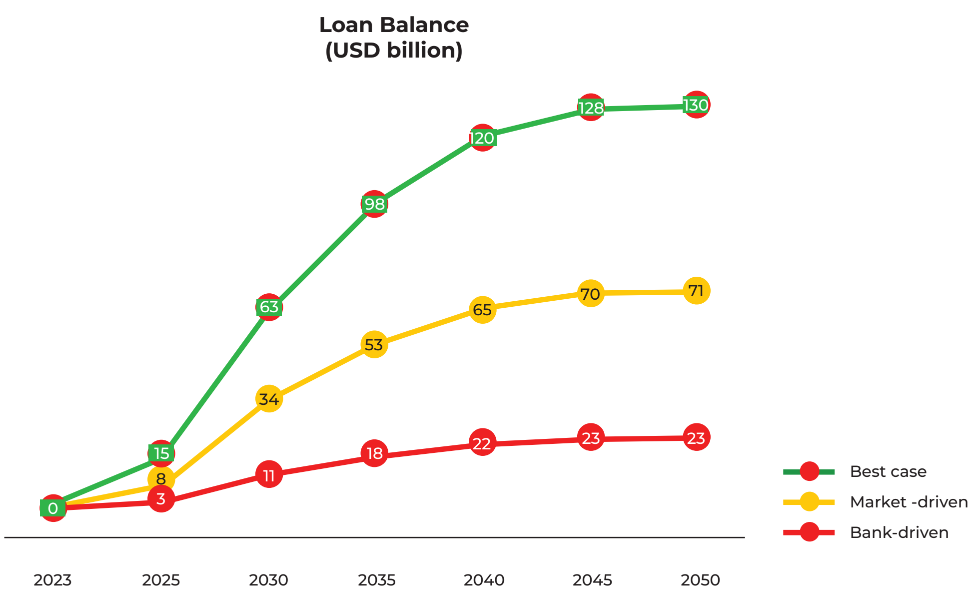
*Source: Author*

This categorization affects the loan structure and enables a more realistic simulation of the loan balance through 2050. DRE, except biomass, has a more extended grace period and tenor than VRE, given that DRE requires a higher upfront capital expenditure. Biomass, while technically part of DRE, is treated as a separate category because it requires lower capital expenditure, resulting in a shorter grace period and tenor. All three scenarios apply these loan structure and project composition assumptions to simulate the loan balance trajectory until 2050.

## Estimated Future Bank Loan Balance for Renewable Energy

In both the best-case and market-driven scenarios, loans grow exponentially starting in 2024 before levelling off around 2040 as loan repayments are offset by new disbursements. In the best-case scenario, loans stabilize at approximately USD120 billion. In the market-driven scenario, the loans level off at around USD70 billion,

Figure 3 Estimated Bank Loan Balance by Scenario




*Source: Author*

roughly half the size of the best case. Meanwhile, loan growth is much slower in the bank-driven scenario, with the balance plateauing around USD20 billion.

The next step is to examine the key drivers behind these scenarios, particularly the banking sector's capacity to increase loan supply in response to loan demand. This lending capacity will depend on macroprudential regulations set by the regulator, namely the Financial Services Authority (OJK).

Other drivers include banks' willingness, which is shaped by regulatory pressure on the banking sector, and the attractiveness of a project's risk and return profile. However, these aspects are beyond the scope of this chapter. Similarly, this chapter does not cover drivers from the project owners' side, such as RE economics or government policies, as these have been extensively discussed in the literature.

## Scope of Banking Categories Reviewed

In Indonesia, banks are classified into four categories based on the size of their core capital. This classification system is called Kelompok Bank berdasarkan Modal Inti or KBMI (Bank Group Based on Core Capital).

Table 4 Core Capital and Loans by Bank Category

| KBMI | Core Capital | Total Bank | Loan (Billion USD) |
|---|---|---|---|
| 1 | up to IDR6 trillion (USD390 million) | 66 | 49 |
| 2 | up to IDR14 trillion (USD909 million) | 22 | 56 |
| 3 | up to IDR70 trillion (USD4.5 billion) | 13 | 121 |
| 4 | above IDR70 trillion (USD4.5 billion) | 4 | 241 |
| **Total** | | **105** | **467** |

Note: USD/IDR at 15,400

*Source: Financial Services Authority (OJK). Note: USD/IDR at 15,400*

As of December 2023, 105 commercial banks were operating in Indonesia, with total loans of USD467 billion. However, only four banks were in KBMI 4, yet they provided more than half, or 52%, of the total loans. Meanwhile, KBMI 3, with 13 banks, provided around 26% of total loans. The remaining 88 banks in KBMI 1 and KBMI 2 collectively accounted for just 23% of total loans.

By applying the 80/20 rule, which focuses on the top 20% of banks that accounted for around 80% of total loans, this chapter narrows the analysis to 17 banks in KBMI 3 and 4.

Table 5 Capital Profile of Banks in KBMI 3 and 4

| NO | BANK (EXCL. SUBSIDIARIES) | KBMI | HEAD OFFICE | 25% Capital (Million USD) | 10% Capital (Million USD) |
|---|---|---|---|---|---|
| **1** | Bank Rakyat Indonesia (BRI) | 4 | Indonesia | 3,879 | 1,552 |
| **2** | Bank Central Asia (BCA) | 4 | Indonesia | 3,534 | 1,414 |
| **3** | Bank Mandiri | 4 | Indonesia | 3,405 | 1,362 |
| **4** | Bank Negara Indonesia (BNI) | 4 | Indonesia | 2,126 | 850 |
| **5** | Bank Permata | 3 | Thailand | 774 | 310 |
| **6** | Bank Pan Indonesia | 3 | Indonesia | 678 | 271 |
| **7** | Bank CIMB Niaga | 3 | Malaysia | 703 | 281 |
| **8** | Bank BTPN (now SMBC) | 3 | Japan | 504 | 201 |
| **9** | Bank Syariah Indonesia (BSI) | 3 | Indonesia | 586 | 234 |
| **10** | Bank OCBC NISP | 3 | Singapore | 573 | 229 |
| **11** | Bank Danamon | 3 | Japan | 554 | 222 |
| **12** | Bank Maybank Indonesia | 3 | Malaysia | 386 | 154 |
| **13** | Bank Tabungan Negara (BTN) | 3 | Indonesia | 441 | 176 |
| **14** | Bank Mega | 3 | Indonesia | 341 | 136 |
| **15** | Bank HSBC Indonesia | 3 | UK | 298 | 119 |
| **16** | Bank UOB Indonesia | 3 | Singapore | 254 | 102 |
| **17** | Bank Mayapada International | 3 | Indonesia | 190 | 76 |

*Source: Annual Report of Each Bank (2023)*

Mayapada, the smallest bank, has a *Batas Maksimum Pemberian Kredit* or BMPK (legal lending limit) of USD190 million, equivalent to 25% of its core capital. However, given that RE project financing is considered high-risk, it will be more prudent to cap the loan at 10% of core capital or around USD76 million. Adjusting for an LTV ratio of 70% means this smallest bank can realistically finance an RE project worth approximately USD100 million. Following this analysis, this chapter compares these results with the distribution of RE project values.

Table 6 Distribution of RE Projects by Value

| Estimated RE Project Value | Number of Projects (%) | Project Value (%) |
|---|---|---|
| ≤ USD10 million | 24 | 1 |
| > USD10 million and ≤ USD100 million | 37 | 9 |
| > USD100 million | 39 | 90 |
| **Total** | 100 | 100 |

*Source: CPI/MEMR, JETP Comprehensive Investment and Policy Plan (CIPP) 2023*

Although projects valued at USD100 million or more accounted for only 39% of the total RE projects, they represent nearly 90% of the total project value. This indicates that the 17 banks in KBMI 3 and 4 are well-positioned to finance around 90% of the RE project value, although their level of participation vary based on each bank's core capital. These 17 banks can finance smaller RE projects valued below USD100 million.

On the other hand, the 88 banks in KBMI 1 and 2 generally lack the core capital needed to finance larger-scale RE projects. Beyond that, they also face limitations in managing project financing structures, credit risk, liquidity risk, and risk-return requirements. Many of these constraints are inherent to their smaller scale and are difficult to overcome unless they significantly increase their capital and move up to KBMI 3 or 4. For this reason, these banks are excluded from the simulation and this chapter focuses solely on banks in KBMI 3 and 4.

In addition to the 17 banks in KBMI 3 and 4, seven foreign bank branches operating in Indonesia, namely Bank of America, Bank of China, Citibank, Deutsche Bank, JPMorgan Chase, MUFG Bank, and Standard Chartered, have access to capital support from their parent companies. Therefore, they have the capacity to finance large-scale RE projects. Furthermore, five of these banks, excluding Bank of China and JPMorgan Chase, along with HSBC and SMBC, are members of the Glasgow Financial Alliance for Net Zero (GFANZ) Working Group, which contributed to Indonesia's USD20 billion Just Energy Transition Partnership (JETP) financing package.

The next section of this chapter reviews banks' macroprudential capacity. The analysis focuses on the 17 banks in KBMI 3 and 4, using data from their quarterly and annual reports and loan statistics published by OJK. While the seven foreign bank branches can also support energy transition financing, the availability of data on them is more limited. Therefore, they are not included in this analysis.

## Bank's Macroprudential Capacity

OJK implements macroprudential policies to safeguard the stability of the overall financial system and prevent disruptions to essential financial services. Financial system instability can arise when banks operate with high leverage, rely heavily on short-term funding, or have complex and non-transparent connections. Macroprudential policies are, therefore, designed to mitigate these vulnerabilities and strengthen banks' resilience to external shocks.

The massive demand for RE project financing will significantly pressure Indonesian banks' macroprudential capacity. Large loan sizes, US dollars, long tenors, and the fixed-rate structure typical of RE project financing will affect Indonesian banks' capital adequacy ratios (CAR), credit risk concentration, and asset and liability management (ALM).

Table 7 List of Banking Macroprudential Ratios Reviewed

| Macroprudential Ratio | Limitation | DEC 2023 | Compliance | Source |
|---|---|---|---|---|
| **Capital Adequacy Ratios (CAR)** | Min. 8% | 25% | Yes | OJK Statistics |
| **Name Concentration** | Max. 25% | Null | Yes | Annual Report |
| **Sector Concentration** | Max. 10% | 2.9% | Yes | OJK Statistics |
| **Loan-Deposit Ratio (LDR)** | Max. 92% | 84% | Yes | OJK Statistics |
| **Net Stable Funding Ratio (NSFR)** | Min. 100% | 134% | Yes | Annual Report |
| **Net Open Position (NOP)** | Max. 20% | 1.1% | Yes | Annual Report |
| **Delta NII** | N/A | 9.8% | Yes | Annual Report |

*Source: Author*

This chapter relies on several assumptions, summarized in Table 8, to simulate capacity projections through 2050. It is important to note that not all indicators are available in the OJK Statistics. As a result, this chapter uses data from individual bank reports. Additionally, the KBMI classification in OJK Statistics only began in 2021, providing just two years of data for KBMI 3 and 4 banks. Therefore, this chapter uses the 10-year compound annual growth rate (CAGR) of all commercial banks (KBMI 1 to 4).

Table 8 List of Assumptions in the Macroprudential Analysis

| Indicator (in USD) | YOY | Source |
|---|---|---|
| USD/IDR Depreciation | 2.5% | OJK Statistics (10-year CAGR, 2014–2023) |
| Total Capital | 8.5% | |
| Risk-Weighted Asset (RWA) | 3.9% | |
| Third-Party Loan (TPL) | 5.5% | |
| Third-Party Fund (TPF) | 6.2% | |
| Net Interest Income (NII) | 5.6% | |
| Available Stable Fund (ASF) | Flat | Banks' Annual Report and NSFR Report (2023) |
| Required Stable Fund (RSF) | Flat | |
| Net Open Position (NOP) | Flat | |
| Delta NII | Flat | |

*Source: Author*

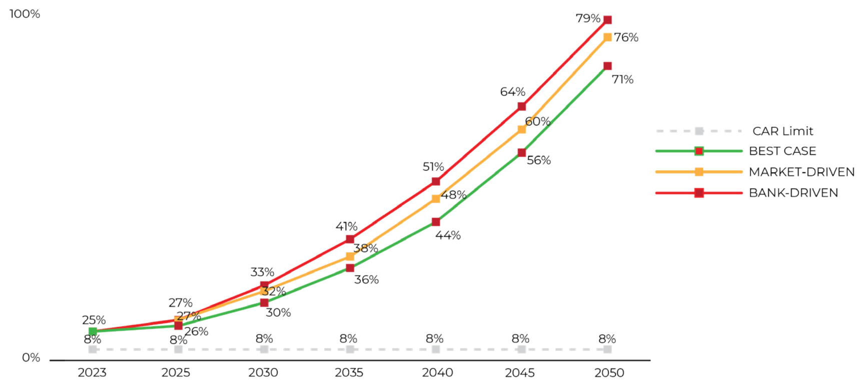
## Capital Adequacy Factor

The capital adequacy ratio (CAR) measures a bank's ability to absorb potential losses from economic downturns, credit risks, and other financial shocks. In Indonesia, OJK has required banks to maintain a relatively high CAR, well above the regulatory minimum of 8% plus additional capital buffers.

RE loans will increase a bank's risk-weighted assets (RWA) and, all else being equal, reduce its CAR. For simplicity, this chapter assumes a fixed risk weight of 100% for every dollar of outstanding loans. Although in practice, the applicable risk weight can vary between 20% and 150%.

The top seventeen banks have an aggregate CAR of 25%, which is high. Moreover, total bank capital has grown faster than RWA, at 8.5% and 3.9% per year in US dollar terms, respectively. This indicates that banks have room to support higher loan growth without reducing their CAR.

Figure 4 Projected Banking Capital Adequacy Ratio (CAR) by Scenario




*Source: Author*

CAR continues to increase across all three scenarios despite rising loan demand from RE projects. This suggests that Indonesian banks, particularly the largest ones (KBMI 3 and 4), have substantial capital buffers. This resilience is shown by quicker accumulated capital than their risk-taking.

However, not all capital growth comes from organic banking activities. Part of the increase has been driven by capital injections from foreign banks acquiring Indonesian banks and upgrades of banks from KBMI 2 to KBMI 3 categories, in which these factors are unlikely to repeat in the future. Therefore, this chapter excludes these sources of capital growth from the analysis.

## Credit Concentration Risk Factors

### 1. Name Concentration Risk Factors

Name concentration risk occurs when a significant portion of a bank's loan portfolio is concentrated among a small number of borrowers or related groups. This makes the bank vulnerable to potential financial distress from any of these significant borrowers.

There are several metrics commonly used to measure name concentration risk. In Indonesia, banks generally rely on the legal lending limit, which caps lending to a single borrower or group of related borrowers at 25% of the bank's core capital. Some banks, such as CIMB Niaga, go further by monitoring all borrowers with exposures between 10% and 25% of core capital, categorizing them as 'big names.' Given that project finance typically involves higher-risk lending structures, this chapter applies a threshold of 10% of core capital rather than the standard 25%.

This chapter attempts to match larger RE projects with the largest banks to assess whether the top 17 banks have sufficient capacity to absorb name concentration risk. The size distribution of RE projects is simulated based on the 2023 JETP CIPP.

To simplify the matching process, this chapter groups projects and banks into five size categories. For example, top-tier banks, referring to the top three largest banks, are considered capable of financing large loans of over USD300 million.

For example, a 375 MW wind project valued at around USD1.2 billion and financed under the JETP framework would require approximately USD800 million in loans, assuming a 70% LTV ratio. An RE project of this scale would need to be financed by one of the top three banks, given their sufficient core capital to support it.

Meanwhile, a 1MW mini-hydro project, such as Biak Mini Hydropower Plant II in Sulawesi, is worth around USD1.4 million and requires a loan of approximately USD1 million at a 70% LTV ratio. Any of the top 17 banks could finance this RE project.

This chapter applies certain assumptions to simplify the simulation. First, it assumes no loan syndication. Each bank is deemed to finance all RE project loans on its own without sharing the exposure with other banks. Second, it supposes there are no borrowers affiliated with any of the 17 banks since loans to related parties are subject to a lower legal lending limit of 10% of total capital. Third, it assumes no affiliation between borrowers themselves as loans to related borrowers must be consolidated for legal lending limits and name concentration risk.

Table 9 Estimated Loan Distribution by Scenario, Loan Size, and Bank Size

| Size | Loan (MUSD) | Bank | Bank Driven | Market Driven | Best Case |
|---|---|---|---|---|---|
| **Top Tier** | >300 | Top 3 | 1# \| 837 USD mn | 3# \| 837 USD mn | 8# \| 4,646 USD mn |
| **Large** | 200-300 | Top 5 | 2# \| 420 USD mn | 2# \| 476 USD mn | 10# \| 2,329 USD mn |
| **Medium** | 100-200 | Top 11 | 4# \| 516 USD mn | 13# \| 1,764 USD mn | 20# \| 2,862 USD mn |
| **Small** | 10-100 | Top 16 | 6# \| 229 USD mn | 45# \| 2,116 USD mn | 36# \| 1,274 USD mn |
| **Micro** | <=10 | Top 17 | 7# \| 28 USD mn | 47# \| 158 USD mn | 36# \| 158 USD mn |
| **Total** | | | 20# \| 2.0 USD bn | 111# \| 6.1 USD bn | 111# \| 11.2 USD bn |

*Note: # = loan amount; USD mn = million USD; USD bn = billion USD*

*Source: Author*

In the bank-driven scenario, investment demand remains steady at USD2.9 billion. However, commercial banks increase their participation from 38% LTV or USD1.1 billion in loans to 70% LTV or USD2.1 billion. This is achievable if the top 17 banks originate 20 new loans totaling USD2.0 billion each year, an average of just 1.2 loans per bank, which is actually relatively modest.

To keep loan exposures below 10% of core capital, this chapter simulates the optimal distribution of new loan issuance based on bank size. First, the top three banks would need to issue one top-tier loan worth USD837 million collectively. Second, the top five banks would need to issue two large loans totaling USD420 million. Third, the top eleven banks would need to issue four medium-sized loans totaling USD516 million. Finally, the top 17 banks would need to issue 13 small or microloans totaling USD28 million. Overall, this distribution remains well within the lending capacity of the top 17 banks.

In the market-driven scenario, investment demand rises from USD2.9 billion to USD16.1 billion, with banks increasing their lending accordingly while maintaining the LTV ratio at 38%. The simulation shows that the top 17 banks would need to book 111 new loans each year, totaling USD6.1 billion. This translates to an average of 6.5 loans per bank, a significant step up from current levels and a fairly ambitious target.

Looking at the distribution as shown in Table 9, the majority of new loans, 92 out of 111, are small or microloans. While the top 17 banks can absorb these loans, the large volume will require stronger credit risk management and more efficient end-to-end credit processes.

Meanwhile, for loans of USD100 million or more, the top banks have sufficient capacity to manage both name concentration risk and credit processes because the size of these loans remains manageable relative to the number of banks involved.

In the best-case scenario, loan sizes nearly double as LTV ratios rise from 38% to 70%, pushing many loans beyond the capacity of smaller banks.

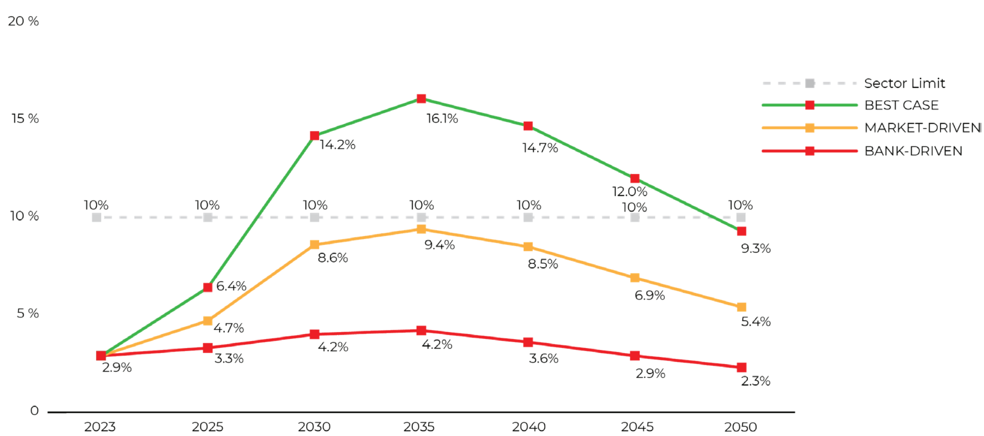
Looking at the distribution, each of the top three banks would need to book two to three top-tier loans, two large loans, and two medium-sized loans per year. In total, a bank in the top three would need to book six to seven large loans, over USD100 million, along with around four small loans annually.

In this scenario, large banks are required to handle more loans because loan sizes are significantly larger than in the other two scenarios. While name concentration risk remains manageable, the real challenge lies in the number of new loans that need to be booked.

## 2. Sector Concentration Risk Factors

Banks need to manage concentration risk within specific sectors, typically limited to 10% of total third-party loans, excluding interbank lending. As of December 2023, the top 17 banks had 2.9% of their loan portfolios allocated to the utility sector, which is where most RE loans are concentrated. This chapter simulates the share of utility sector loans through 2050 under three different scenarios.

Figure 5 Projected Percentage of Loans to the Utilities Sector by Scenario




*Sumber: Author*

In both the bank-driven and market-driven scenarios, lending to the utility sector is expected to stay below 10% of total third-party lending through 2050. However, in the best-case scenario, utility sector lending exceeds the 10% threshold between 2025 and 2030, peaking at 16% in 2035.

This suggests that, in the best-case scenario, RE loan demand outpaces total third-party lending growth of 5.5% by a sizable margin. As a result, sector concentration risk could emerge for the top 17 banks.

OJK needs to balance its role as the financial sector regulator with its responsibility to support the national agenda of promoting bank financing for the energy transition. For instance, to safeguard financial system stability, OJK could impose higher capital requirements on banks with elevated concentration risk. On the other hand, it may also choose not to do so in order to support the energy transition agenda.

Banks may charge higher interest rates on new loans that exceed the 10% sector concentration limit to compensate for the increased risk and maintain an appropriate risk-return balance within their loan portfolios.

## Asset Liability Management

### 1. Liquidity Risk Factors

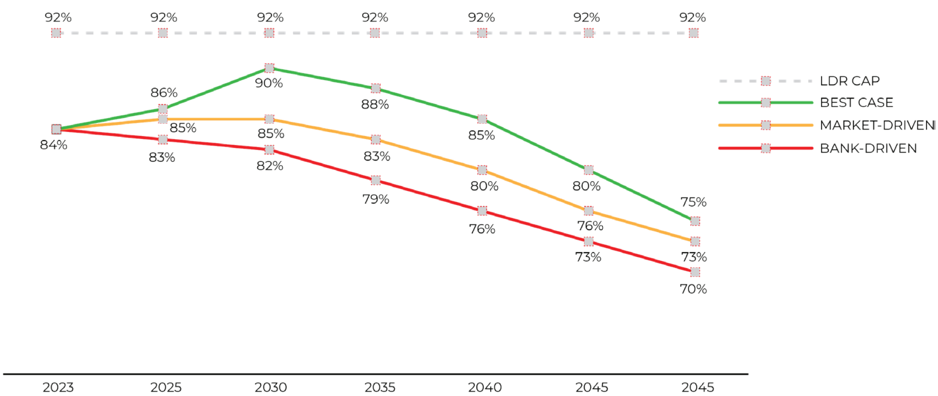
The Liquidity Coverage Ratio (LCR) is an indicator used to ensure adequate High-Quality Liquid Assets (HQLA) that can be quickly converted into cash to cover its net cash outflows over a 30-day stress period.

Since project finance loans typically follow a predetermined disbursement schedule, they are unlikely to generate unexpected or significant short-term cash outflows. Therefore, this chapter does not consider liquidity risk as a limiting factor in the supply of loans to RE projects.

### 2. Funding Risk Factors

The loan-to-deposit ratio (LDR) is a commonly used metric to assess a bank's funding structure, primarily available customer deposits to support lending activities. A higher LDR may indicate a greater reliance on wholesale funding, which tends to be more volatile than stable customer deposits, thereby increasing funding risk. As of December 2023, the top 17 banks recorded an average LDR of 84%, comfortably below the regulatory limit of 92%.

Figure 6 Projected Loan-to-Deposit Ratio (LDR) for Banks by Scenario




*Source: Author*

In the best-case scenario, the LDR rises to 90% by 2030 before declining as the RE loan balance stabilizes. In other scenarios, however, the LDR shows little to no increase and even declines sharply. This is mainly driven by faster growth in the Third-Party Fund (TPF) compared to loan growth, likely reflecting the slowdown in lending activity during the COVID-19 period.

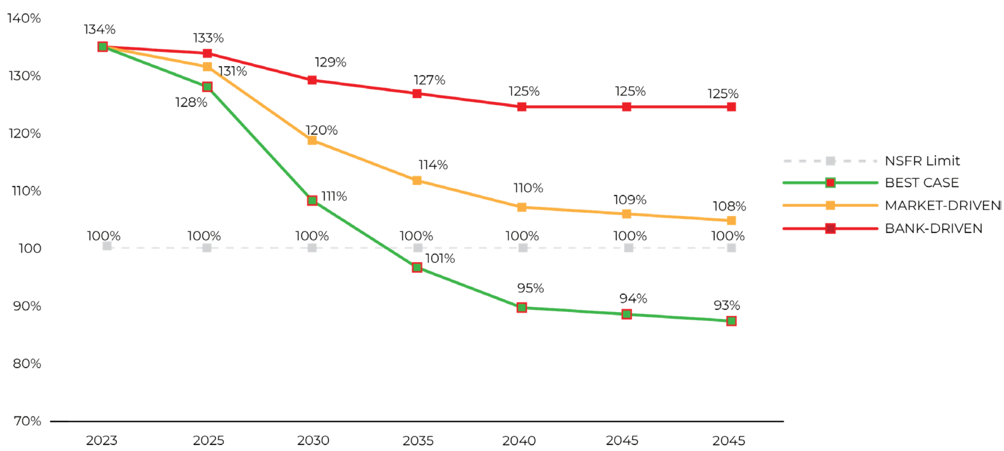
Another relevant metric is the Net Stable Funding Ratio (NSFR), a more recent and comprehensive regulatory measure introduced under Basel III. The NSFR is designed to ensure that banks maintain a stable funding structure over a one-year horizon by considering not only loans and deposits, but also all assets and liabilities. In addition, it accounts for the stability of funding sources and asset liquidity.

The NSFR requires a bank's Available Stable Funding (ASF) to be at least equal to its Required Stable Funding (RSF). Project financing tends to increase a bank's RSF, so it needs more additional stable funding (ASF), such as customer deposits, long-term debt with maturities aligned to the project financing, or equity capital.

Since NSFR reporting began in 2018, this chapter has approximately six years of historical data available to project future NSFR developments. However, as OJK does not publish aggregate data on ASF, RSF, or NSFR, this analysis relies on individual bank disclosures. Due to time constraints, this chapter only uses NSFR data as of December 2023 and assumes the NSFR will remain stable through 2050.

KBMI Banks 3 and 4 (excluding BSI, which does not disclose NSFR data) currently have an average NSFR of 134%, providing approximately USD101 billion in additional RSF capacity before reaching the regulatory minimum of 100%. Since project financing carries a 100% RSF weight, the projected loan balances from the previous section can be directly translated into RSF projections, allowing for the calculation of future NSFR levels.

Figure 7 Projected Net Stable Funding Ratio (NSFR) for Banks by Scenario




*Source: Author*

The NSFR remains above 100% in both the market-driven and bank-driven scenarios throughout the simulation period. However, in the best-case scenario, the NSFR falls below 100% after 2035, indicating insufficient ASF to support the demand for RE loans. This finding contrasts with the results of the previous LDR simulations.

This difference can be attributed to the differing assumptions used in the base case or no-RE scenario for the LDR analysis. In this case, this chapter assumes growth in third-party loans (TPL) and third-party funds (TPF) provide a buffer for more lending. In contrast, the NSFR projection assumes a fixed ratio due to the lack of direct access to detailed available NSFR data. Based on the current simulation, the ASF appears insufficient to support the best-case scenario.

The most organic way to increase ASF through the bank's retail base is to utilize funds from the retail segment, which tends to be sticky and carries a higher weight in the ASF calculation. However, only a few of the 17 banks analyzed have a strong retail base. Moreover, these banks are typically involved in a wide range of project financing activities, including long-tenor loans such as mortgages, which share similar characteristics to project financing in terms of long tenor.

Banks without a strong retail funding base may need to rely more on the wholesale market to support their NSFR. They can tap into the emerging green bond market to finance RE loans with appropriate tenors, provided that Indonesia's green bond market develops as planned and there is sufficient investor demand.

Raising capital is another alternative, although it is generally reserved for more pressing contingencies as it would dilute shareholders' returns.

## 3. Foreign Currency Risk Factors in Banking Books

RE project financing is typically denominated in US dollars or other foreign currencies rather than in Rupiah. This is mainly because much of the equipment used in these projects is still imported and electricity tariffs are often linked to the US dollar. Providing loans in Rupiah would expose banks to unnecessary credit risk as borrowers' ability to repay could be affected by exchange rate fluctuations between the US dollar and Rupiah. In addition, US dollar loans generally offer lower interest rates compared to Rupiah loans, making them a more attractive option for both project owners and banks.

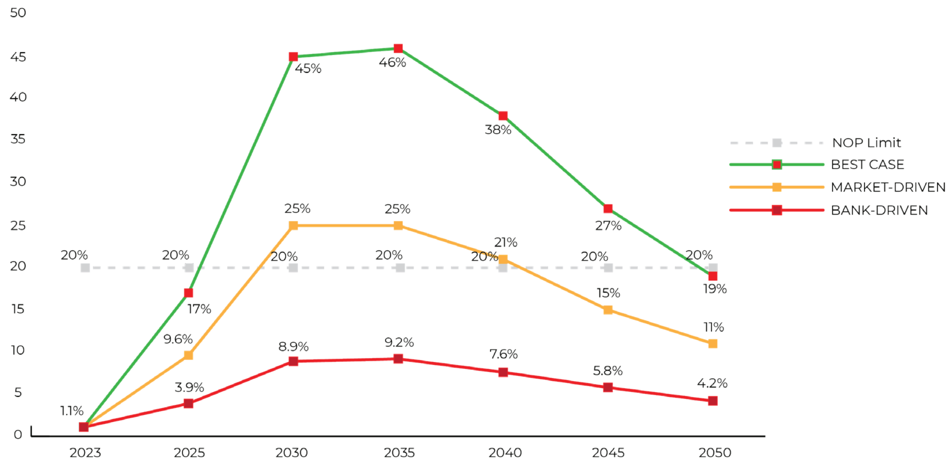
However, lending in US dollars exposes banks to foreign exchange risk through a Net Open Position (NOP), which is the difference between a bank's foreign currency assets and liabilities. This risk arises unless the bank can fully fund the loan with US dollar liabilities or hedge the exposure in the market. The same principle applies to loans in other foreign currencies. To avoid increasing the NOP, corresponding liabilities must be denominated in the same foreign currency as the loan. The higher the NOP, the more sensitive the bank's financial position, including its income and capital, becomes to movements in exchange rates.

OJK limits banks' NOP to a maximum of 20% of total capital. In practice, however, all 17 of Indonesia's top banks maintain their NOP under 5%, and many even below 1%. As of December 2023, these 17 top banks had an average NOP of just 1.1% or about USD15.4 billion in headroom before reaching the 20% regulatory cap.

This chapter projects the NOP percentage to remain flat from 2023 to 2050, implying that both NOP and total capital will grow in tandem over time. The key variable in this projection is the increase in US dollar borrowing across the three scenarios, based on the assumption that it is funded by Rupiah liabilities left unhedged (i.e., and left unhedged (or not squared in the market).

Under the best-case and market-driven scenarios, NOP is projected to exceed the 20% regulatory threshold sometime between 2025 and 2030. However, this projection assumes that banks do not increase their US dollar liabilities through natural hedging or square their US dollar assets in the market. In reality, banks are likely to manage their US dollar exposure to avoid breaching the 20% NOP limit.

Figure 8 Projected Banking Net Open Position (NOP) by Scenario




Source: Author

This chapter does not examine whether sufficient US dollar liquidity is available in Indonesia to meet the rising demand for stable US dollar funding or explore the potential impact of this demand on the US dollar/Rupiah exchange rate. These issues are beyond the scope of this study but may be worth exploring in future research. If banks are able to access foreign investors through the green bond market with tenors aligned to the needs of RE projects, the potential impact can be mitigated.

## 4. Foreign Exchange Risks as Drivers of Liquidity Risk

In addition to foreign exchange translation risk, sharp currency movements can also create liquidity risk for banks. The last major currency crisis that led to widespread bank failures in Indonesia happened in 1998 when the Rupiah depreciated by 85% against the US dollar within about a year, plunging from USD/IDR2,400 to USD/IDR16,000.

Such extreme foreign exchange movements often trigger capital outflows. Depositors and counterparties may rush to withdraw their short-term US dollar funds from banks. In contrast, banks' long-term US dollar assets are typically illiquid and cannot be sold quickly to meet these demands, especially if their NSFR (Net Stable Funding Ratio) is weak. As a result, banks may be forced to purchase US dollars at elevated prices to meet their liquidity needs, potentially incurring losses.

Keeping NOP below 20% of total capital helps mitigate the impact on banks to some extent. However, in a currency crisis, the effects on assets and liabilities tend to play out separately. The larger a bank's gross foreign currency exposure, the more significant the potential impact. In this context, NOP — while useful as a macroprudential limit — has its limitations since it offsets a bank's assets and liabilities.

## 5. Interest Rate Risk in the Banking Book (IRRBB)

Interest Rate Risk in the Banking Book (IRRBB) arises when there is a mismatch between the interest rate characteristics, such as fixed versus floating rates, and the maturity of a bank's assets and liabilities. This risk is typically measured using two key metrics. The first is the Economic Value of Equity (EVE), which captures changes in a bank's equity driven by shifts in the present value of future cash flows from assets and liabilities. The second is Earnings-at-Risk (EaR), which measures changes in a bank's Net Interest Income (NII) resulting from fluctuations in interest income on assets and interest expenses on liabilities.

Long tenors in RE project financing increase the bank's duration or the sensitivity of asset prices to interest rate changes, resulting in greater volatility in the bank's EVE. In addition, if RE project financing is provided with a fixed interest rate or a floating interest rate that is rarely adjusted compared to liabilities, this also increases the volatility of the bank's EVE and NII. For example, in a rising interest rate environment, the interest expense of floating rate liabilities increases. In contrast, the interest income from fixed-rate RE loans remains unchanged, leading to compression in the bank's net interest margin (NIM).

OJK has set six interest rate shock scenarios for measuring EVE, two of which also apply to NII. Banks are required to use the worst-case impact from these scenarios to calculate delta EVE and delta NII. For delta EVE, OJK imposes a regulatory limit of 15% of core capital, while there is currently no regulatory limit for delta NII.

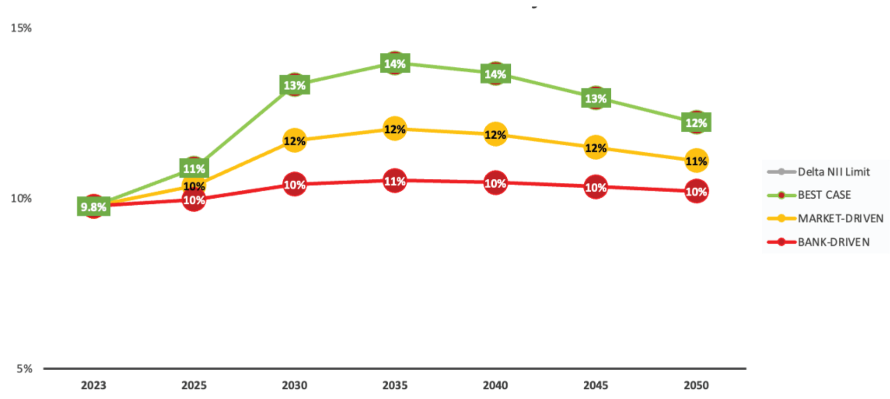
Table 10 List of Shock Scenarios for the Economic Value of Equity

| Scenario | Description | USD interest rate changes | Metric |
|---|---|---|---|
| **Parallel Up** | All interest rates increase across the yield curve. | +200bps | EVE, NII |
| **Parallel Down** | All interest rates decrease across the yield curve. | -200 bps | EVE, NII |
| **Steepener** | Short-term rates fall, long-term rates rise. | S-300 bps<br>L+150 bps | EVE |
| **Flattener** | Short-term rates rise, long-term rates fall. | S+300 bps<br>L-150 bps | EVE |
| **Short Up** | Only short-term interest rates increase. | +300 bps | EVE |
| **Short Down** | Only short-term interest rates decrease. | -300 bps | EVE |

*Source: Author*

Due to the complexity involved, this chapter does not conduct an EVE simulation. The NII simulation applies a simplified assumption of a 200 basis point (bps) decline in NIM, regardless of the direction of interest rate movements. As of December 2023, the top 17 banks, excluding BSI and Mayapada, recorded a delta NII of 9.8%.

Figure 9 Estimated Banking Net Interest Income (NII) by Scenario




*Source: G20 Principles to Scale up Blended Finance in Developing Countries (G20, 2022)*

At its peak, the best-case scenario results in a 14% decline in NII in 2035. As noted earlier, OJK does not impose a regulatory limit on the delta NII. However, from a business perspective, this impact appears manageable. This suggests that IRRBB from providing fixed-rate financing for RE projects is unlikely to have a material effect on bank earnings.

## Macroprudential Simulation Summary

Under both the bank-driven and market-driven scenarios, the top 17 banks appear to have the macroprudential capacity to absorb loan demand. However, in the best-case scenario, stable long-term US dollar funding is insufficient. The green bond market could offer banks a potential source of long-term US dollar financing.

Table 11 Summary and Insights of Macroprudential Analysis Under Three Scenarios

| Macroprudential Ratio | Best Case | Market Driven | Bank Driven | Commentary |
|---|---|---|---|---|
| Capital Adequacy Ratio (CAR) | ✓ | ✓ | ✓ | There is a substantial capital adequacy buffer in place. However, the projected capital growth is based on historical trends that were not entirely organic and, therefore, may not be sustainable. |
| Name Concentration | ✓ | ✓ | ✓ | Strengthening credit risk management and enhancing end-to-end credit processes are needed to book a high volume of new project financing loans. |
| Sector Concentration | ✗ | ✓ | ✓ | OJK will need to strike a balance between safeguarding the financial system and supporting the energy transition, especially if RE lending outpaces overall loan growth and leads to concentration in the utility sector. |
| Loan-Deposit Ratio (LDR) | ✓ | ✓ | ✓ | Customer deposits have a large buffer, driven by strong growth over the past decade. This buffer may have come from relaxations during COVID-19 and may not be repeatable. |
| Net Stable Funding Ratio (NSFR) | ✗ | ✓ | ✓ | Only a few large banks have a genuine retail customer base that allows them to raise stable funding organically. Most banks will likely need to tap into the green bond market. |

| Macroprudential Ratio | Best Case | Market Driven | Bank Driven | Commentary |
|---|---|---|---|---|
| Net Open Position (NOP) | ✗ | ✗ | ✓ | Significant US dollar borrowing demands should ideally be hedged either naturally or through the markets. However, the availability of US dollar funding and its potential impact on the USD/IDR exchange rate are beyond the scope of this chapter. A liquid green bond market would certainly help address this challenge. |
| DELTA NII | ✓ | ✓ | | RE financing projects with a fixed interest rate are not expected to have a material impact on bank income. However, due to the complexity of conducting an EVE simulation, this paper does not simulate its effects on bank equity. |

*Source: Author*

## Recommendations

This chapter makes three key recommendations. First, banks need to strengthen their risk management capabilities. This includes enhancing their credit risk assessment, improving expertise in project financing, and streamlining end-to-end credit processes. These improvements will better equip banks to handle larger volumes of RE project financing while managing and monitoring associated risks.

Second, improving access to US dollar funding is essential. Policymakers, such as the OJK, should continue expanding funding sources like green bonds, blended finance, and carbon exchanges while working closely with commercial banks to utilize them fully. This approach helps reduce reliance on limited domestic US dollar liquidity and provides better protection against exchange rate risk.

Third, regulatory support and coordination are essential. While commercial banks, especially the largest banks, can scale up lending, they may hesitate to lend to new investment areas. The OJK should collaborate and engage in regular dialogue with these banks to understand their concerns and work together to address them.

## Conclusion

To reach NZE, RE projects will require approximately USD16.1 billion in financing each year through 2050. Of this amount, commercial bank credit is expected to cover around USD6.1 billion under a 38% LTV scenario and might increase to as much as USD11.2 billion under a 70% LTV scenario.

The USD 16.1 billion financing requirement is 5.6 times the current market demand, highlighting the need for market-driven reforms to meet this goal. It also underscores the importance of improving the economics of RE and increasing government support to scale up existing RE projects.

At the same time, increasing the LTV from banks will require bank-driven reforms, specifically to boost both the capacity and willingness of banks. However, this reform is more limited, with an increase of only 1.8 times, from an LTV of 38% to 70%. This growth is not as significant as the increase needed through reforms in the RE market.

However, a dilemma will arise. If the RE market reform is successful, banks may struggle to meet the 70% LTV due to macroprudential ratios concerning sector concentration risk, funding risk, and foreign exchange risk. All three of these factors present bottlenecks that will require strategic solutions.

The first bottleneck lies in the type of foreign exchange risk, where the NOP ratio could exceed 20% under market-driven and best-case scenarios. While banks will likely hedge to keep the NOP ratio below 20%, the challenge is the adequacy of foreign exchange liquidity in Indonesia. Whether or not there is enough foreign exchange liquidity to support such hedging is a complex issue that falls outside the scope of this discussion.

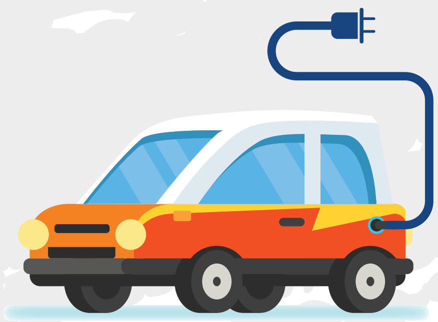
The second bottleneck involves credit concentration risk, with the utility sector's credit ratio potentially exceeding 10% in the best-case scenario (refer to the figure in the Sector Concentration Risk sub-chapter). Currently, Indonesian banks have a capacity of just above USD6.1 billion, assuming an LTV of 38%. However, the 10% limit isn't a strict cap for banks. It can be exceeded, provided that bank management has an appetite for this sector.

The third bottleneck comes from funding risk, as indicated by the NSFR ratio, which is projected to fall below 100% in the best-case scenario (see the figure in the Funding Risk sub-chapter). The banking capacity is estimated to be under USD9 billion or below the LTV assumption of 56%. The NSFR is a strict limit for banks and the lack of NSFR results from their inability to secure long-term stable funding.

All the above align with long-standing weaknesses in Indonesia's financial sector, including its sensitivity to foreign capital inflows due to the weak Rupiah and the lack of stable long-term funding from domestic institutional investors and bankable retail depositors.

To boost the banking sector's contribution to RE financing, commercial banks may require external support, such as green bonds in foreign currencies, to maintain their NOP and NSFR ratios. At the same time, these banks will need to enhance their internal capabilities in credit risk management and streamline their end-to-end credit processes to accommodate and monitor the substantial volume of RE project financing each year.

Beyond the macroprudential capacity discussed in this chapter, greater bank participation can be driven by other key factors, namely banks' willingness or risk appetite. This is influenced by regulatory encouragement from the OJK and the risk-return profile of RE loans.



# 9

# Can Blended Finance Bridge the Financing Gap?

Naila Firdausi and Wisnu Wibisono

## Introduction

As an archipelagic nation with over 17,500 islands and 81,000 kilometers of coastline along the equator, Indonesia faces significant challenges from climate change. In fact, it is among the one-third of countries most at risk with high exposure to increased flooding and extreme temperatures (The World Bank Group and Asian Development Bank, 2021). To mitigate these impacts, Indonesia has committed to reducing emissions by 31.89% through its efforts or by 43.2% with international support by 2030. It aims to achieve net-zero emissions by 2060 (Republic of Indonesia, 2022). Meeting these targets will require not only traditional financing structures and instruments but also innovative approaches to financing.

According to Law Number 59 Year 2024 on the 2025–2045 Medium-Term Development Plan, the Indonesian government estimates that around 319 out of 514 districts/cities face a very high level of vulnerability to climate change. Additionally, 18,000 of the country's 81,000 kilometers of coastline are classified as vulnerable or highly vulnerable (Ministry of State Secretary, 2024). One of the key development targets is to reduce greenhouse gas emission intensity by 93.5% by 2045 compared to 2010 levels, as part of the broader goal of achieving net-zero emissions by 2060.

In 2021, the Ministry of Environment and Forestry estimated that Indonesia would need at least USD285 billion per year through 2030 to meet its emission reduction targets (Republic of Indonesia, 2021). At an exchange rate of IDR15,000 per US dollar, this translates to approximately IDR4.275 quadrillion or IDR4,275 trillion, exceeding the 2025 State Budget revenue target of IDR3,005 trillion (Ministry of Finance, 2024). During COP28 in Dubai in December 2023, President Joko Widodo, in his second term as the 7th President of the Republic of Indonesia, stated that the country will require over USD1 trillion in investment to reach net-zero emissions by 2060 (Antara, 2023).

Given the limited funds, as reflected in the estimated funding needs far exceeding the target budget deficit of IDR616 trillion in 2025, external funding sources beyond the State Budget will be necessary to achieve the net zero emission target by 2060. In the 2025–2045 Medium-Term Development Plan, the government aims to increase the share of financing from the private sector to support the achievement of the Sustainable Development Goals (SDGs), including climate change mitigation efforts. Mobilizing the private sector for net zero emissions presents several challenges, mainly the differing perceptions of risk between the private sector and the risk profile of climate projects that need financing. Blended finance has the potential to play a critical role in bridging this gap.

## Blended Finance Concept

Different institutions define blended finance in various ways. Table 1 provides some examples of these definitions.

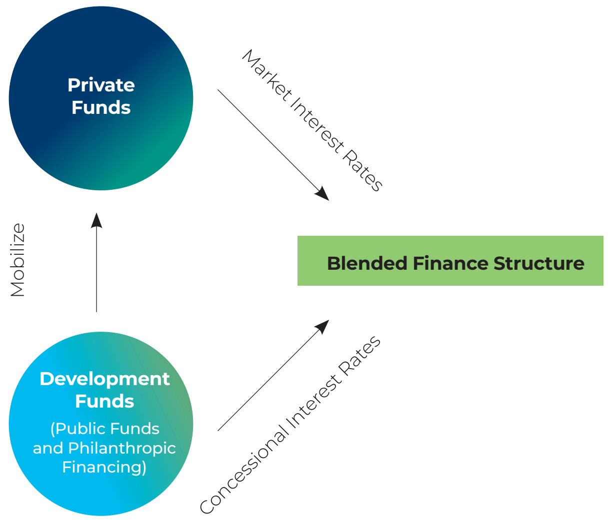
Table 1 Definition Matrix of Blended Finance

| Institution | OECD | IFC | The Addis Ababa Action Agenda | Convergence |
|---|---|---|---|---|
| Description | The strategic use of development funds to attract additional funding for achieving sustainable development in developing countries | The use of relatively small amounts of donor concessional funds to lower specific investment risks and improve the risk-return balance of pioneering investments that wouldn't be feasible with a purely commercial approach | Financing combines public funding with conditions attached and private sector financing, along with expertise from both the public and private sectors. | The use of catalytic funds from government or philanthropic sources to boost private sector investment in sustainable development |

*Source: Various Sources*

In short, blended finance leverages funding or resources from governments, donor agencies, or international development funds to encourage private sector involvement in sustainable projects.

Figure 1 Basic Concept of Blended Finance



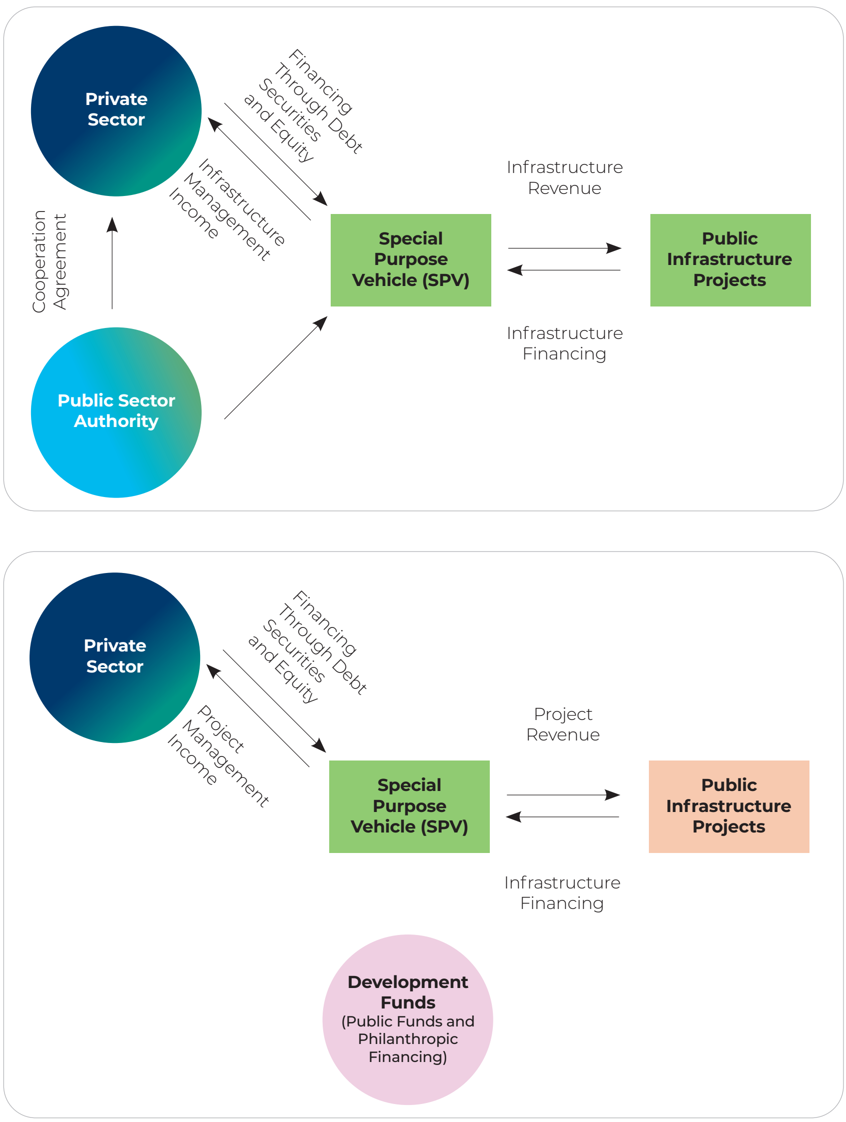

*Source: Convergence*

As of September 2024, blended finance has been incorporated into several Indonesian government policy documents. These include Law Number 59 Year 2024 on the 2025–2045 National Long-Term Development Plan, Government Regulation Number 16 Year 2023 on Project Financing Through the Issuance of State Sharia Securities, Minister of Finance Regulation Number 103 Year 2023 on Fiscal Support Through the Funding and Financing Framework in the Framework of Accelerating the Energy Transition in the Electricity Sector, and Minister of Energy and Mineral Resources Regulation Number 16 Year 2020 on the 2020–2024 Strategic Plans of Minister of Energy and Mineral Resources.

In these documents, the term blended finance is often used interchangeably with mixed funding or integrated financing and is generally categorized as a form of creative or innovative financing.

In Indonesia, the concept of blended finance was initially introduced through public-private partnerships (PPPs), which primarily focus on financing public infrastructure projects. As a result, many government agencies and private sector actors in Indonesia still associate blended finance exclusively with PPPs. However, there is a key difference. While PPPs are centered on infrastructure projects and rely on private-sector financing, blended finance can support a broader range of projects. It involves facilities from the public, both the government and donor institutions, to attract private participation, for example, through the first-loss mechanism, concessional financing, or guarantees.

Figure 2 Differences between PPP and Blended Finance




*Source: Authors*

## Benefits of Blended Finance

The most prominent barriers leading to investors' hesitation to participate in sustainable projects are the high level of both real and perceived risk and uncompetitive risk-return ratios compared to other existing investment options. Blended finance helps lower these two barriers.

Blended finance offers at least six benefits for policymakers involved in sustainable development projects and programs, especially projects that address environmental and social issues.

First, blended finance helps bridge the financing gap left by limited public budgets by bringing in private investors, philanthropic organizations, and other parties. This approach enables investment in projects that might not be commercially viable on their own, ultimately increasing the number of investable sustainable projects.

Second, blended finance allows impact investors to participate alongside other investor groups, leveraging their capital to create a multiplier effect. Third, it serves as a form of concessional financing designed to support and strengthen the creditworthiness of the projects. Therefore, this helps reduce project risk and makes the investment more attractive to commercial capital from the private sector.

Fourth, blended finance offers benefits for investors by reducing investment risk and allowing them to diversify into new asset classes and pioneering sectors that may provide strong long-term returns. Fifth, by incorporating guarantees from institutions with higher credit ratings, blended finance can lower the cost of project financing while expanding to a broader range of investors.

Finally, it can support a wide range of sustainable projects, from environmental conservation and climate change adaptation to social development. Its application is not limited to infrastructure, like financing models through PPPs.

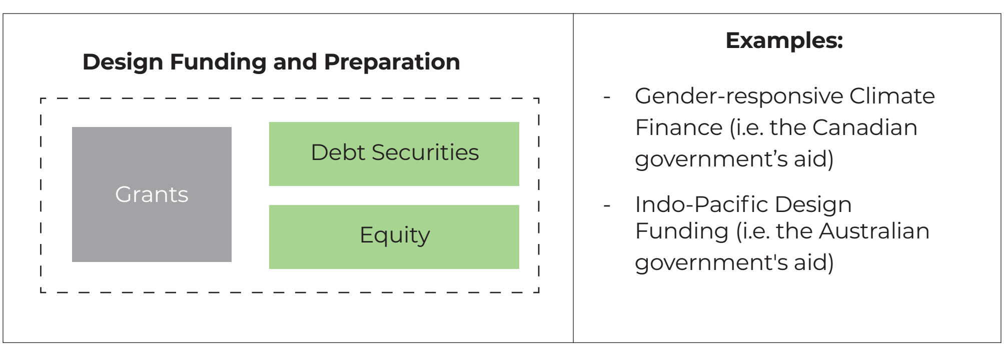
## Blended Finance Structure

Blended finance is an investment structure approach that brings together institutions and organizations with different goals—profit-oriented, social impact, or a mix of both—to invest in the same project.

Blended finance can take many forms, but four funding structures are most often used, namely design funding, technical assistance, credit enhancement through guarantees and insurance, and concessional financing.

The purpose of the design funding structure is to improve a project's feasibility while building a project portfolio that can be financed through blended finance. The ultimate goal is to attract investor's interest in emerging sectors and technologies that are still in development. Design funding typically comes in the form of grants. However, it can also include seed funding for early-stage technology research projects, such as green hydrogen or innovative agricultural solutions. However, design funding remains relatively uncommon, accounting for only about 2% of all blended climate finance transactions, with philanthropic organizations serving as the primary source. Examples of design funding include the Gender-Responsive Climate Finance program, which the Canadian government funds, and the Indo-Pacific Design Funding initiative, which is backed by the Australian government (Convergence, n.d.).

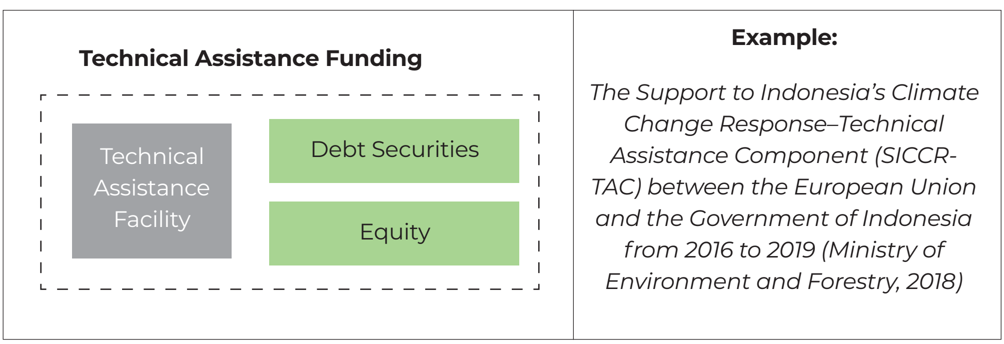
Figure 3 Design Funding and Preparation




*Source: Convergence*

The second structure is technical assistance funding. This structure is primarily used to improve a project's commercial viability through funding to build the capacity of the stakeholders involved, ultimately supporting the implementation and commercial viability of the funded project. In 2022, technical assistance accounted for about 21% of global blended finance transactions. It plays a key role in mobilizing funding from a broader range of sources, including donor institutions, which state budgets may not have a mandate to engage in commercial transactions. This structure uses non-commercial grants to promote the commercial viability of a project and it can attract private institutions or investors. Some of the major players using this structure include the IFC, GuarantCo, the World Bank, and USAID.

Figure 4 Technical Assistance Funding



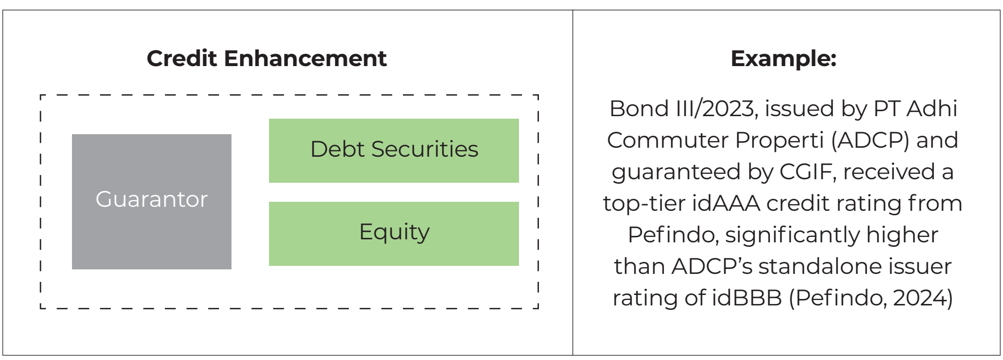

*Source: Convergence*

The third structure is credit enhancement, which involves providing risk coverage to protect against defaults on the principal or returns of a project or debt securities. This type of financing can be supported by public or government funds, as well as by multilateral financial institutions or philanthropic organizations. This structure helps lower the risk for private investors by covering specific risks, such as default, exchange rate fluctuations, or political instability, through insurance or guarantees.

Institutions that often provide guarantees include the World Bank, the IFC, and the CGIF. The most widely used structure is typically a guarantee for bond issuances or loan agreements. A clear example is Adhi Commuter Properti (ADCP) Bond III, issued in December 2023 and guaranteed by CGIF. ADCP's Bond III/2023, guaranteed by CGIF, received a top-tier idAAA rating from Pefindo, significantly higher than ADCP's standalone credit rating of idBBB/Stable. Without CGIF's guarantee, the bond would likely have attracted far less investor interest and required a much higher coupon rate.

.

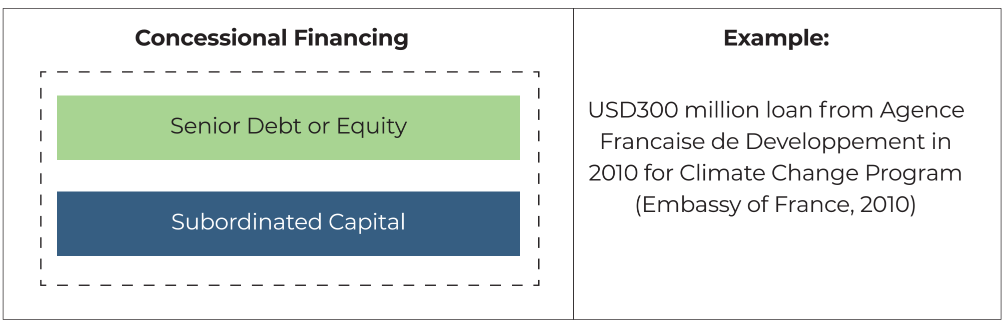
Figure 5 Credit Enhancement




*Source: Convergence*

The fourth structure is concessional financing, which involves providing low-cost capital, either through equity or debt investments, or serving as a first-loss buffer. Public institutions typically offer concessional financing on below-market terms to help mobilize commercial capital. By providing debt or equity at lower interest rates or valuations than the market, funding concessional helps reduce investment costs and encourages participation from more risk-averse investors. In addition to soft debt financing, concessional financing can take the form of loans or junior equity investments in a fund consisting of several series with varying seniority, to be the first to absorb losses and reduce the risk of losses from private investors who take more senior financing schemes. According to Convergence, concessional financing made up 77% of climate-related blended finance in 2022.

Figure 6 Concessional Financing




*Source: Convergence*

A study by Convergence from 2006 to 2015 found that equity investments in blended financing generated slightly higher returns compared to the median returns for investments in emerging markets. Meanwhile, bond returns were broadly in line with global trends for private debt yields.

## Types of Instruments and Investors

Various types of instruments are used as vehicles for participation in blended finance. According to the Blended Finance Taskforce, commonly used instruments in blended finance include guarantees, insurance, hedging, junior or subordinated capital, securitization, contractual mechanisms, results-based incentives, and grants (Blended Finance Taskforce, 2018).

Table 2 Blended Finance Instruments

| Instrument | Definition | Mitigated Risk |
|---|---|---|
| Guarantee | It protects a party if another party fails to fulfill its contractual obligations. A guarantee is provided by a third party that will absorb the loss and it serves as a form of credit enhancement. | Access to funding, credit or counterparty risk, off-take risk, the risk of project delays, the risk of technical challenges, and the risk of declining demand |
| Insurance | Insurance protects by promising compensation for specific losses in exchange for a paid premium. | Political risk, construction risk, operational risk, output or performance risk, and limited access to funding |
| *Hedging* | Hedging protects against asset price declines. Exchange rate hedging reduces exposure to significant fluctuations when investing in foreign currencies. | Exchange rate or commodity price risk |
| *Junior/ Subordinated Capital* | Subordinated debt or junior equity protects investors holding more senior debt or equity. Funds in the most junior position are the first to absorb losses, while investors with higher seniority are better protected. | Various risks, such as off-take risk, construction delays, reputational risk, and access to funding |
| Securitization | The process of converting a collection of illiquid assets into tradable financial instruments | Liquidity risk, duration risk, credit risk, off-take risk, and counterparty risk |
| Results-Based Incentives | Instruments that offer incentives or penalties for meeting specific targets, such as social impact bonds and sustainability-linked bonds | Operational risk and performance risk |
| Contractual Mechanisms | Various agreements and forms of cooperation, including subsidies like feed-in tariffs, support the provision of renewable electricity. | Demand risk and financing risk |
| Grant (especially for Technical Assistance) | Funders grant funds based on specific goals. | Access to funding, operational risks, lack of capacity, and other challenges |

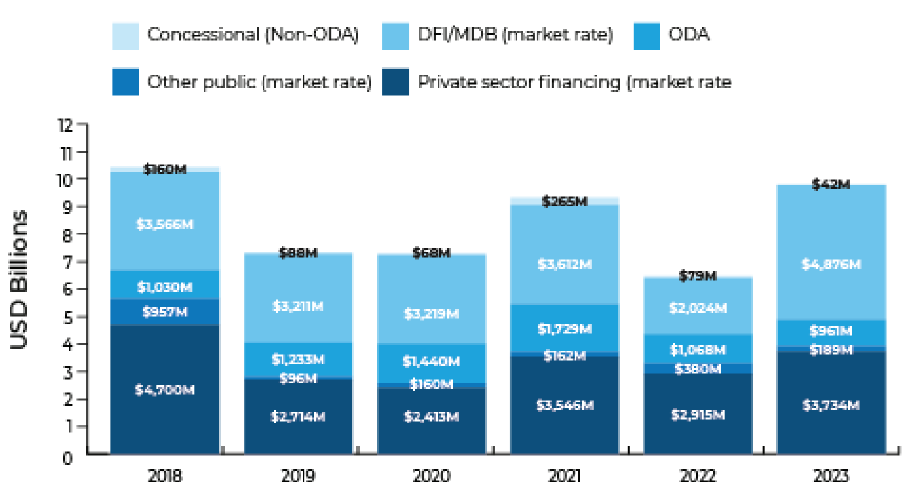
*Source: Better Finance, Better World, Blended Finance Taskforce (2018)*

Table 3 Blended Finance Instruments and Risks Addressed

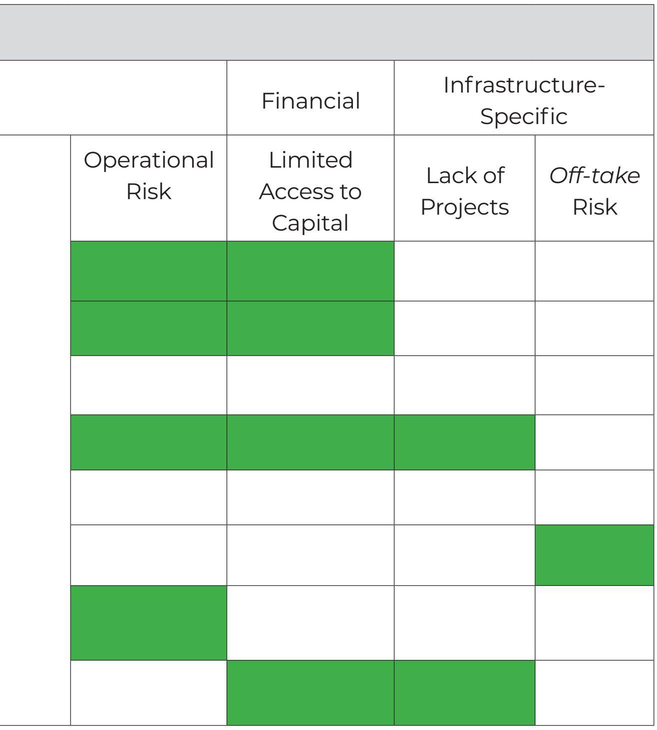
| Mitigation Instrument | Risk | | | | | |
|---|---|---|---|---|---|---|
| | Country-Level | | Credit/Commercial | | | Technical |
| | Political Risk | Exchange Rate Risk | Credit Risk | Liquidity Risk | Demand Risk | Construction Risk |
| Guarantee | | | ✓ | ✓ | | ✓ |
| Insurance | ✓ | | | ✓ | | ✓ |
| Hedging | | ✓ | | | ✓ | |
| Junior/Subordinated | | | ✓ | ✓ | | ✓ |
| Securitization | | | | | | |
| Contractual Mechanism | | | | | ✓ | |
| Performance-Based Incentives | | | | | | |
| Grants | | | | | | |

*Source: Better Finance, Better World, Blended Finance Taskforce (2018)*

Figure 7 Sources of Blended Finance Funding




*Source: Convergence (2024)*




According to Convergence, blended finance commonly utilizes instruments, such as project finance, collective investment funds, corporate funding through loans or equity, bond issuances, and other types of financial instruments. Among these, project finance and collective investment funds are the most frequently used, each accounting for 28% of total transactions (Convergence, n.d.). Corporate funding through private equity or lending ranks third with a 27% share, followed by bond issuances or MTNs at 6%. The remaining involves other instruments, such as impact bonds (Convergence, n.d.).

Based on funding sources or investor types, the public sector, namely Development Finance Institutions (DFIs), governments, and multilateral entities such as Official Development Assistance (ODA) and non-ODA sources, accounted for the largest share of blended finance funding between 2020 and 2023. In fact, more than half of all blended finance commitments during this period came from public sector sources. In comparison, commercial private sector funding made up around 38% in 2023, driven by private companies and commercial banks.

Over the past decade, public climate finance has grown faster than private finance. Several multilateral development institutions have pledged to increase their climate finance by 32% annually through 2030. However, only six out of 27 sovereign or bilateral development institutions currently have defined climate investment targets (Allen & Overy - Climate Policy Initiative, 2023).

## Blended Finance Trends at the Global Level

Blended finance is often used to fund various programs, adaptation, and mitigation projects. More recently, its application has expanded to include nature-based solutions (NbSs), which are actions to address climate-related and disaster-related social challenges through the protection, sustainable management, and restoration of natural and modified ecosystems.

The majority of blended finance is directed toward mitigation efforts, which aim to reduce the impacts of climate change by cutting or eliminating greenhouse gas emissions. According to data from Convergence, total blended finance commitments have reached USD198 billion since 2013. Of this amount, 55%, approximately USD109 billion, has been allocated to climate finance, with more than USD64 billion specifically targeted toward mitigation initiatives. These include projects related to energy efficiency, renewable energy, transportation, energy transmission, and overseas energy. Mitigation projects tend to be more attractive to investors because they are easier to categorize and define, making it possible to link them to emission reductions and income-generating activities directly. Most of the mitigation financing has been funneled into electricity generation, with investments now beginning to extend into related sectors, such as electric vehicles.

Given the slow pace of global decarbonization, climate adaptation has become increasingly vital to safeguard vulnerable communities from the impacts of climate change. However, blended finance for adaptation remains critically underfunded, with only around USD7.5 billion directed toward adaptation-related projects and initiatives. These activities or projects often struggle to attract private investment due to perceptions of higher risk, lower returns, small-scale investment opportunities, extended project timelines, limited financially attractive projects, and data gaps. As a result, most funding for climate adaptation continues to come from the public sector and government sources.

## The Role of the Indonesian Government in Blended Finance

The Organization for Economic Cooperation and Development (OECD) emphasizes that while the international community has shaped blended finance and its guiding principles, many developing countries' awareness and understanding remain limited.

As the government increasingly leverages blended finance to support development initiatives and attract private investment into long-term public projects, Indonesia holds significant potential to serve as a model for how blended finance can drive inclusive and sustainable development.

### SDG Financing Hub

The Indonesian government launched several initiatives to promote blended finance in the last few years. One of the efforts to formalize blended finance in Indonesia was issuing Presidential Regulation Number 59 Year 2017 on the Sustainable Development Goals (SDGs), which emphasizes that development financing can be sourced from non-budgetary sources. In line with this regulation, the Ministry of National Development Planning (Bappenas) established the Indonesia SDG Financing Hub, which mainly aims to accelerate and facilitate blended finance initiatives from various funding sources to support SDG-related projects. Through the SDG Financing Hub, Bappenas collaborates with the Financial Services Authority (OJK) and the Ministry of Finance (MOF) to spur the use of blended finance. Bappenas leads the mobilization of donors and philanthropic actors, the Ministry of Finance contributes through state budget mechanisms, and OJK engages the commercial sector.

### SDG Indonesia One Fund

The MOF is key in advancing blended finance in Indonesia. A notable example is the establishment of the SDG Indonesia One Fund and the Energy Transition Mechanism (ETM) platform, both implemented through PT Sarana Multi Infrastruktur (SMI).

The SDG Indonesia One Fund is designed to pool resources from both the government and the private sector to finance infrastructure projects that support SDG achievement. As of December 2022, the platform had secured USD3.19 billion in commitments toward its USD4 billion target (SMI, n.d.). These commitments come from a diverse group of donors and investors, including Global Affairs Canada, Agence Française de Développement, Bloomberg Philanthropies, Standard Chartered Plc, and the European Investment Bank, among others. In addition, a Green Financing Facility has been established with the support of a USD150 million loan from the Asian Development Bank (ADB), channeled through SMI. This facility aims to give fixed-income incentives to support green projects by providing clear bankability thresholds and outlining a roadmap to facilitate the flow of private capital (Asian Development Bank, 2022).

Under the ETM platform, SMI serves as the investment manager for all funding aligned with the principles of a just transition, utilizing a blended finance approach. Funding sources for this platform fall into three broad categories, namely the Indonesian government's state budget commercial investments or those from the Indonesia Investment Authority (INA); and private funding from philanthropic organizations, multilateral and bilateral development institutions, climate finance mechanisms, and impact funds. The outcomes of this initiative include performance-based loans, the divestment of several coal-fired power plants, and the acquisition of assets from independent power producers. The Indonesian government has identified over 5.5 GW of coal-fired power capacity that could be phased out early, marking an important step toward shifting from fossil fuel-based electricity generation to renewable energy sources (Syahputra, 2022). In addition to these efforts, several other blended finance projects focusing on climate and nature-based financing are underway.

## Tri Hita Karana

The Coordinating Ministry for Maritime Affairs and Investment under the Joko Widodo administration also played a pivotal role in strengthening Indonesia's blended finance ecosystem by spearheading the *Tri Hita Karana* initiative, launched in 2018. This initiative seeks to mobilize capital from leading philanthropic organizations operating in Indonesia. *Tri Hita Karana* laid the groundwork for establishing the Global Blended Finance Alliance (GBFA) during the G20 Summit in Bali. The GBFA is envisioned as a platform for sharing knowledge in implementation and policy innovations in blended finance in developing countries. It also aims to boost financial commitments toward climate action and the Sustainable Development Goals (SDGs).

## JETP Indonesia

One of the most prominent and attractive recent initiatives is the Just Energy Transition Partnership (JETP) Indonesia, launched during the G20 Leaders' Summit in Bali. JETP Indonesia aims to mobilize USD20 billion in combined public and private financing to support Indonesia's energy transition (Ministry of Energy and Mineral Resources, 2023). The partnership is led by the United States and Japan, with additional support from the governments of Canada, Denmark, the European Union, France, Germany, Italy, Norway, and the United Kingdom. The IPG has pledged USD10 billion in funding over the next three to five years to assist the Indonesian government in JETP implementation.

Support from the private sector comes from the Glasgow Financial Alliance for Net Zero (GFANZ), a global coalition of financial institutions committed to advancing a science-based net-zero carbon transition. GFANZ has committed to mobilizing and facilitating at least USD10 billion in private-sector financing for JETP Indonesia. However, the realization of this commitment has yet to be confirmed.

The joint target of the JETP is to ensure that emissions from the electricity sector peak by 2030 at no more than 290 million metric tons of $CO_2$, followed by a rapid decline toward achieving net-zero emissions in the sector by 2050. This target includes the accelerated early phase-out of coal-fired power plants, international support, and a significant scale-up of renewable energy deployment. Therefore, by 2030, renewable energy is expected to account for 34% of total electricity generation (Ministry of Energy and Mineral Resources, 2023).

JETP adopts a portfolio approach to blended finance, which is critical in increasing the scale of private investment and enabling risk diversification for private sector investors. Through this approach, JETP has identified five investment focus areas, as outlined in the Comprehensive Investment and Policy Plan (CIPP) released by the government in November 2023. The focus of the investment includes the development of transmission and grid infrastructure, the early retirement and planned phase-out of coal-fired power plants, the dispatchable renewable energy acceleration, the scale-up of variable renewable energy, and the modernization of the renewable energy supply chain.

JETP holds significant potential to support Indonesia in reducing coal consumption and is a promising model for public-private partnerships in financing energy sector transactions across Asia. However, JETP faces several challenges, including limited grant funding for project preparation and human resources capacity building, IPG's fund availability, JETP's operational environment, and JETP's governance.

## Other Blended Finance Schemes in Indonesia

Alongside the JETP, the Institute for Energy Economics and Financial Analysis (IEEFA) highlights that currently, there are several major blended finance initiatives in the energy transition. These include the Climate Investment Funds-Accelerating Coal Transition (CIF-ACT) program, which operates in conjunction with the Energy Transition Mechanism (ETM) initiatives led by the Asian Development Bank and the World Bank, Indonesia's national ETM platform, the Perusahaan Listrik Negara's (PLN) version of the ETM, and the ETM initiative of the Indonesia Investment Authority (INA). The central objective of these schemes is to support a just energy transition, focusing on the early retirement of coal-fired power plants, among others.

Moreover, several blended finance schemes are also aimed at protecting nature and supporting the well-being of local communities. One such initiative is the Tropical Landscapes Finance Facility (TLFF), managed by ADM Capital. It was launched in 2016 to provide long-term financing to companies operating in new renewable energy (NRE) and sustainable agriculture because it can improve local livelihoods, reduce deforestation, enhance agricultural efficiency, restore degraded land, and achieve other objectives. TLFF is undertaken through a collaboration between ADM Capital or the ADM Capital Foundation, BNP Paribas, the United Nations Environment Programme (UNEP), and the World Agroforestry Centre, with support from the Indonesian government.

As the structuring advisor and arranger for the MTN issuance, BNP Paribas plays a role in securitizing the loans and providing liquidity to the platform. The TLFF blended finance also includes grant funds managed by the UNEP and the World Agroforestry Centre (ICRAF). This grant fund is designed to offer technical assistance and contribute to the supervision and evaluation of the facility. One of its flagship projects involves the issuance of a long-term bond with multiple tranches by PT Royal Lestari Utama, aimed at combating deforestation and improving the livelihoods of communities in Bukit Tigapuluh, Jambi.

Another blended finance scheme in Indonesia is the Green Fund, a corporate debt investment facility managed by Sail Ventures. The fund aims to support the transformation of global commodity supply chains in ways that positively impact climate and biodiversity. The Green Fund is supported by philanthropic and public funding, of which USD400 million of its total contribution has been disbursed through grants and concessional loans. The Green Fund's major contributors include Norway's International Climate and Forest Initiative, Unilever, and the United Kingdom's Mobilising Finance for Forests (MFF) program.

As of 2020, the Green Fund selected 80 projects for financing, including a USD30 million investment in a 10-year loan to PT Dharma Satya Nusantara Tbk. The loan was intended to support the palm oil company in implementing No-Deforestation, No-Peat, and No-Exploitation (NDPE) policies across its entire supply chain and in achieving compliance with the Roundtable on Sustainable Palm Oil (RSPO) standards and certification.

Additionally, the Asia Climate-Smart Landscapes Fund (ACLF) for Indonesia was launched by ADM Capital in 2023 to help bridge the substantial financing gap faced by MSME players in the sustainable agriculture, land restoration, and forest conservation sectors in Indonesia. The fund has secured initial support from several philanthropic organizations and aims to raise a total commitment of USD200 million. Moreover, this fund is backed by a 50% guarantee on the overall portfolio assets provided by the International Development Finance Corporation (DFC) from the United States.

## Challenges of Blended Finance in Indonesia

Despite the presence of various funding schemes and commitments, the development of blended finance in Indonesia remains relatively slow. Several challenges hinder its practical implementation, as outlined by USAID (USAID, 2020). One of the primary obstacles is the limited availability of projects or portfolios capable of attracting investors. This is primarily attributed to business uncertainty due to regulatory and government policies that do not fully support blended finance initiatives' sustainability.

The second challenge lies in the limited availability of funding capable of mobilizing private sector investment, particularly given the high reliance on conventional financing in developing emerging markets. Nevertheless, this chapter acknowledges that in recent years, the government has addressed this issue by establishing blended finance initiatives and platforms.

On the other hand, Indonesia holds significant potential to harness blended finance opportunities, particularly in light of the substantial financing gap to achieve the Sustainable Development Goals (SDGs), especially for meeting the 2030 emission reduction targets as outlined in the 2022 Enhanced NDC, and funding for climate change

Table 4 Challenges for Blended Finance in Indonesia

| Challenges on the Supply Side | Challenges on the Demand Side |
|---|---|
| • Lack of prudent mechanisms or platforms<br>• Limited understanding of blended finance among domestic stakeholders<br>• Weak or infrequent regulatory initiatives (many perceive blended finance as PPP)<br>• Misalignment of priorities between partners/DFI and the government<br>• Lack of data and transparency on blended finance transactions<br>• Unbalanced securities and capital markets | • Inconsistent policies across technical ministries and unclear regulatory implementation<br>• Limited feasible projects or programs in medium to large enterprises due to insufficient data<br>• Low business professionalism and capacity among SMEs<br>• Limited projects<br>• Underdeveloped market conditions<br>• Weak coordination among regulator and policymakers<br>• Insufficient capacity at both national and regional government<br>• Limited transparency in regulatory development |

*Source: USAID (2020)*

adaptation initiatives. Moreover, the proliferation of the voluntary carbon market (VCM) and the establishment of the Indonesian Carbon Exchange can be used as leverage to enhance the financial viability of nature-based projects supported through blended finance in Indonesia.

In 2023, the G20 released implementation principles to enhance blended finance in developing countries. These principles emphasize that governments should target the implementation of blended finance by considering local development priorities, supporting financial systems and domestic market infrastructure, increasing investment-ready projects through systemic and transformational approaches, and improving transparency and measurement (G20, 2022).

Table 5 Principles to Scale up Blended Finance in Developing Countries

| 1: Align blended finance with local development priorities | 2: Strengthen domestic financial systems and market development | 3: Development through a systemic approach | 4: Improvements in impact management and measurement – transparency and accountability |
|---|---|---|---|
| 1.A. Focus on domestic development priorities | 2.A Support domestic institutions, laws, and policy frameworks | 3.A Ensure the availability of investable projects | 4.A Develop performance metrics and results at the outset of the project |
| 1.B. Simplify implementation, identify priority sectors with the government | 2.B. Facilitate domestic stakeholders to participate in blended finance transactions | 3.B Facilitate portfolio and program approaches | 4.B Dedicate resources to reporting on impact, financial flows, financial performance, and development outcomes. |
| 1.C. Engage with development banks and commercial banks at national and regional levels | 2.C. Develop the capacity of domestic stakeholders | 3.C Encourage coordination among stakeholders and respect the stakeholders' mandates | 4.C Promote public transparency and shared responsibility |

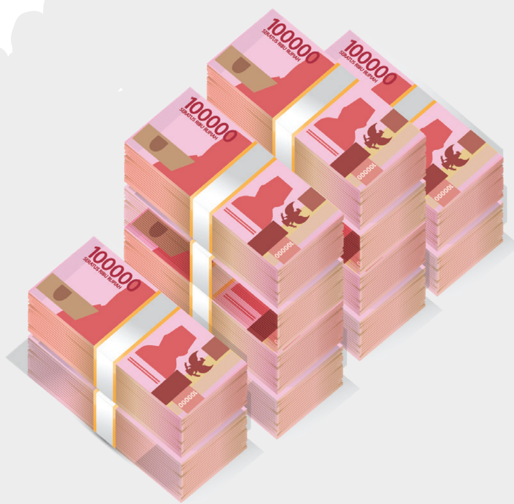
*Source: G20 (2022)*

## Conclusion

Blended finance can help finance projects that struggle to attract private investment due to their perceived lack of commercial viability. The public sector, donors, and MDBs have a crucial role in the blended finance scheme because they help improve the risk-return profile of such projects, thereby encouraging greater participation from the private sector.

Although the government facilitates several blended finance schemes in Indonesia, their implementation remains suboptimal. Some challenges include a lack of financing transparency, ineffective fund governance, regulatory frameworks that are not yet fully supportive, and limited awareness within the private sector. Nevertheless, blended finance holds significant potential to drive green investment, reduce carbon emissions, strengthen local economies, enhance community resilience to climate change, and support the achievement of the Sustainable Development Goals (SDGs).

Several strategic actions need to be undertaken to enhance the role of blended finance. First, regulatory and policy improvements are essential to support the effective use of blended finance. Second, transparency and accountability in fund management must be ensured. Third, outreach, information dissemination, and training initiatives are needed to raise awareness within the private sector. Fourth, strengthening stakeholder collaboration is crucial to building Indonesia's robust blended finance ecosystem.


100000
100000
100000
100000

# 10

# What Is Wrong with Indonesia's Carbon Market?

Akhmad R. Shidiq and Adrian T. P. Panggabean

## Introduction

On October 29, 2021, the Government of Indonesia announced its plan to introduce a carbon pricing mechanism. Presidential Regulation Number 98 Year 2021 refers to this initiative as the Implementation of Carbon Pricing in Indonesia called Nilai Ekonomi Karbon or NEK. NEK is integral to Indonesia's commitment to reducing global greenhouse gas (GHG) emissions. According to the government, carbon trading is one of the instruments for implementing NEK.

Two years later, on September 26, 2023, the seventh President, Joko Widodo, who was serving his second term (2019–2024), officially launched the Indonesia Carbon Exchange, known as IDX Carbon, as a concrete step in the country's contribution to the global fight against the climate crisis.[38] The launch drew significant public attention. Five months later, in March 2024, the Presidential Staff Office established a task force to accelerate the implementation of carbon trading[39] before President Joko Widodo's term ends in October 2024.[40]

One year after its launch, in September 2024, the total transaction value on IDX Carbon reached IDR37 billion, with 613,000 tons of $CO_2e$ traded from three different projects. On average, using simple arithmetic or accounting for the varying contract prices depending on the project type, the implied cost of carbon contracts on IDX Carbon is approximately IDR60,000 per ton. For comparison, at the nearest neighboring carbon exchange in Malaysia, the contract prices for Solar REC were MYR23 per ton, Nature-based Carbon Credit Plus at MYR50 per ton, and Bioenergy at MYR5.7 per ton. The average price across these three is roughly MYR26 per ton, equivalent to IDR90,000 per ton. This raises some critical questions: Why is the price in Indonesia relatively low? Why is the achievement after one year not as remarkable as initially targeted?

By examining the processes and policy trajectory surrounding Indonesia Carbon Exchange, this chapter identifies several unresolved fundamental and technical issues. It highlights key concerns framed by the question: What does the public know about Indonesia’s carbon trading plans so far?

An observation of various news reports, opinion pieces, and articles from multiple sources suggests that public knowledge about carbon trading in Indonesia remains quite limited, even among financial market players and academics. There are two possible reasons for this. First, while the concept may appear straightforward, building an effective carbon trading ecosystem is inherently complex in practice. Second, detailed information regarding the government’s plans to establish a carbon trading mechanism, if available at all, is not easily accessible.

This chapter seeks to piece together various sources of information to provide an overview of Indonesia's current state of carbon trading plans as of early June 2024. The discussion is presented systematically while aiming to use clear and accessible language. This chapter may serve as an “Indonesian Carbon Market 101."

## Why Carbon Trading?

The short answer is that Indonesia is a signatory to the Paris Agreement,[41] an international treaty that commits countries to reducing carbon dioxide and greenhouse gas emissions to limit global warming to below 2.0 degrees Celsius. Carbon trading is part of Indonesia’s commitment to reducing global emissions.

The longer answer is more complex. According to government projections, without any changes in climate policy or under a business-as-usual (BAU) scenario, Indonesia’s annual GHG emissions are expected to reach nearly 3 billion tons of $CO_2$eq by 2030. On paper, Indonesia currently has pledged to unilaterally reduce its GHG emissions by almost 32% from the projected 2030 level. With international cooperation, the reduction target could reach approximately 43% of the projected figure.[42]

In its planning, climate change mitigation efforts focus on five key sectors, namely energy, agriculture, FOLU (forestry and land use), IPPU (industrial processes and product use), and waste. The most significant emission reduction targets are set for the energy and forestry sectors, which have been the two most important sources of GHG emissions over the past 15 years.

The initial question is whether the emission reduction targets are ambitious enough. The answer depends on who is doing the calculations. For comparison, Indonesia's GHG emissions target, assuming with international cooperation, is set at 1.6 billion tons of $CO_2$eq in 2030. However, global estimates indicate that Indonesia's GHG emissions have risen since 2007 and reached 2.1 billion tons of $CO_2$eq by 2022.[43] In that context, the target appears ambitious. In contrast, the Ministry of Environment and Forestry (MoEF) reports different figures. According to the 2023 GHG Inventory Report, the emissions in 2022 stood at approximately 1.2 billion tons of $CO_2$eq, below the target of nearly 1.3 billion tons for that year, as set with the assistance of international cooperation. Therefore, the numbers released by the ministry suggest the targets are less ambitious, possibly due to an overly high BAU projection.

Interestingly, among the various policy approaches available, the Indonesian government has chosen an economic approach to meet its emission reduction commitments. Through this lens, the government, either implicitly or explicitly, acknowledges climate change as a massive market failure. Humans have released excessive amounts of GHG into the atmosphere for years without accounting for their limited capacity to regulate the Earth's temperature. This oversupply of carbon emissions has occurred mainly because there has been no effective signal to reflect the scarcity or limits of the atmosphere's capacity nor the consequences of climate change on our shared survival.

By assigning a price or economic value to carbon emissions based on the scarcity of the atmosphere's capacity to absorb them, the carbon market is expected to provide signals reflecting fluctuations in the remaining atmospheric space for emissions from human production and consumption activities. In practice, however, as with all asset markets, price signals in the carbon market are likely to be influenced by various global geopolitical and geoeconomic interests and non-economic factors. Among these non-economic considerations, one of the questions and a subject of ongoing debate among scientists is the precise elasticity of carbon emissions from economic activity about the rise in global temperatures.

## Carbon Market Design

From an economic perspective, the price of carbon can be determined through a carbon market mechanism. Carbon prices can also be influenced by carbon taxes or subsidies for emission reductions. However, the implementation timeline for both carbon tax and subsidy mechanisms remains unclear. According to public information, the carbon tax will likely be introduced in 2025.

In an efficient carbon market, the equilibrium carbon price is expected to determine the emissions levels that are both environmentally sustainable and optimal. Under Indonesia’s NEK Framework, two types of carbon markets are being developed. They are an Emissions Trading System (ETS) and a GHG offset mechanism.

The ETS is essentially a cap-and-trade mechanism. The government sets an upper limit (cap) on the total carbon emissions allowed within a specific period, for example, one, three, or five years. Ideally, this cap aligns with the national commitments to global emission reduction efforts.

Indonesia's sectoral or subsectoral carbon emission cap is called *Persetujuan Teknis Batas Atas Emisi* or PTBAE (Technical Approval of Upper Emission Limits). Based on the PTBAE, the government allocates emission quotas to individual business entities. This quota, commonly known as allowances, is named *Persetujuan Teknis Batas Atas Emisi-Pelaku Usaha* or PTBAE-PU (Technical Approval of Upper Emission Limits-Business Actors) and can be traded under the emissions trading scheme.

Under this scheme, business entities that can keep their emissions below the PTBAE-PU cap, thus generating a surplus, may sell the excess to those whose emissions exceed their allocated cap, resulting in a deficit. In the short term, the lower the PTBAE set, meaning fewer emissions are permitted, the greater the potential for deficits, leading to increased demand and, consequently, higher carbon prices. Over the long term, elevated carbon prices incentivize businesses to shift toward more carbon-efficient production technologies.

Emissions trading is essentially a government-regulated market established through the setting of PTBAE. For sectors not covered by PTBAE, carbon trading is conducted through a balancing market known as the GHG emissions offset market.

In the offset market, the government sets a baseline or standard for carbon emissions and the types of activities that qualify as emission reduction efforts. Business entities may claim the emissions reduced or avoided through such activities. These claims are commonly referred to as carbon credits.

Once carbon credits (offsets) are verified, *Sertifikat Pengurangan Emisi Gas Rumah Kaca* or SPE-GRK (Greenhouse Gas Emission Reduction Certificate) is issued in Indonesia. Holders of SPE-GRKs may sell them to parties seeking to offset the carbon emissions generated by their business activities, such as commercial airlines.

Unlike the ETS, participation in the emissions offset market does not oblige business entities to purchase carbon credits. However, the underlying logic remains the same. The higher the demand and market price for SPE-GRKs, the greater the economic incentive for businesses to undertake emission reduction efforts to generate additional SPE-GRKs for sale.

Thus, two types of carbon units are traded within Indonesia's carbon markets. The first one is PTBAE-PU, which is used in Indonesian ETS, and the second one is SPE-GRK, which is utilized in Indonesia's emissions offset market.

## What Is the Potential Value of Carbon Trading?

Estimates vary widely, from IDR350 trillion to IDR8,000 trillion, depending on who conducts the analysis and the methodology used. Currently, at least three figures are commonly cited as the estimated value of Indonesia's carbon trading potential.

First, the figure of IDR350 trillion was released by the Ministry of Environment and Forestry (MoEF) in 2020, representing the potential revenue for the State Budget from carbon absorption in peatlands.[44] Second, the estimate of IDR3,000 trillion is based on the potential for capturing one gigaton of $CO_2$ in carbon credits, as the seventh President, Joko Widodo, stated during the Carbon Exchange launch in September 2023.[45] Third, the projection of IDR8,000 trillion, as the Coordinating Ministry for Economic Affairs reported in 2022,[46] was calculated from the potential carbon absorption in the forestry, peatland, and mangrove sectors, assuming a price of USD5 per ton of $CO_2$eq.[47]

Notably, these figures seem to be calculated solely from the total value of offset units derived from carbon absorption through nature-based solutions, which could potentially be sold in the offset market at a certain market price. These estimates do not account for the potential of the emissions trading scheme. The variation in estimates from various government agencies indicates the weakness of the current basic information system in Indonesia's carbon market.

## How Does It Work?

Regarding emissions trading, as of the time this chapter was written, Indonesia's national ETS remains highly limited. The official administration and information system for NEK in Indonesia, known as *Sistem Registri Nasional Pengendalian Perubahan Iklim* or SRN-PPI (the National Registry System for Climate Change Control), has yet to record a single PTBAE-PU unit. Similarly, in the Indonesia Carbon Exchange, no PTBAE-PU units have been registered for trading. In other words, most of Indonesia's national emissions trading scheme is still in its infancy, primarily focused on drafting regulations as a follow-up to the Ministry of Environment and Forestry Regulation Number 21 Year on the Implementation of NEK.

Of the five targeted sectors, only the energy and forestry sectors have begun preparing and issuing regulations for carbon trading. The regulations for the energy sector are being developed by the Ministry of Energy and Mineral Resources (MEMR), particularly in the electricity subsector.[48] Meanwhile, the Ministry of Environment and Forestry (MoEF) handles regulations for the forestry sector.[49] As for the other three sectors, namely waste, IPPU, and agriculture, there is currently no available information on whether similar preparations or regulations are underway.

Based on publicly available information, to what extent can the elements of the national ETS be found in Indonesia? How many national PTBAEs or total PTBAE-PU units exist in the country? As of now, these figures are not yet available.

Ideally, Indonesia should have a national PTBAE figure for each year. This figure represents the total amount of carbon units or the supply side that can be traded within Indonesia's emissions trading market. Additionally, fluctuations in PTBAE also determine the demand for carbon units. The lower the PTBAE set, the higher the demand for carbon units in the emissions market from businesses seeking to comply with increasingly stringent emission caps. The PTBAE figure should serve as a benchmark to estimate the expected reduction in emissions through the emissions trading scheme mechanism.

As part of Indonesia's commitment to global emission reduction (through nationally determined contribution or NDC), the target figures for national emission levels are already available and have been calculated from 2010 to 2030.

Figure 1 Projected and Reported Emission Levels


*Source: MoEF(2023); Jones, et al., (2024)*

The difference between the BAU estimate and the target can be considered the emission reduction target. In this context, there are two key points to discuss further. First, excluding the wildfire in 2015, actual emissions from 2010 to 2030 generally have been well below the BAU estimates. This suggests that the BAU projections are too high. As a result, emission reduction targets based on BAU are likely to be easily achieved, with little or even no actual reduction in emissions. Second, given its role in the NEK, what percentage of the reduction target is expected to come specifically from the emissions trading scheme? Additionally, what other efforts, besides emissions trading, are being pursued?

According to regulations, PTBAE is set at the subsector level by the relevant ministries/agencies and its value must be below the emission reduction target for that subsector. To date, annual emission target figures are only available at the sector level and only for the years that have already passed (2010-2022). This means there are no projections for emission reductions beyond these years up to 2030.

Interestingly, there is an exception in this case. Although the national PTBAE agreement has not yet been reached, the energy sector, particularly the power generation subsector,[50] has not only issued regulations regarding PTBAE (cap) and PTBAE-PU (allowance), but has also launched its own ETS. From this phenomenon alone, this chapter observes how the ETS is being designed and applied to Indonesia's context.

The MEMR has set the PTBAE for the power generation subsector in three phases, namely 2023-2024, 2025-2027, and 2028-2030. In the first phase, the PTBAE covers only four types of coal-fired power plants (CFPP)[51] connected to the electricity grid of PT Perusahaan Listrik Negara (PLN). This PTBAE is defined in terms of carbon emission intensity per unit of electricity generated ($CO_2$eq/MW).

Thus, the business units subject to PTBAE are situated in the midstream, between the upstream, which consists of fossil energy sources such as coal, and the downstream, which refers to electricity installations.

However, it is not entirely clear how the alignment of PTBAE with the emission reduction targets in the national commitment is structured. Nonetheless, the difference in the measurement of emissions is evident. The emission targets in Indonesia's commitment are measured in total GHG emissions (tons of $CO_2$eq per year). However, the PTBAE for the CFPP sector is measured in terms of emission intensity (tons of $CO_2$eq per MW each year). At this point, the issue of metrics becomes a concern.

The PTBAE (cap) for the CFPP subsector is allocated directly, without an auction mechanism, to each relevant power plant. On the other hand, the allowances (PTBAE-PU) for business entities in this subsector are determined using the following formula.

$$PTBAE\text{-}PU = \frac{PTBAE}{GHG\ Intensity} \times GHG\ Emissions$$

The formula measures PTBAE in emission intensity (tons $CO_2$eq/MWh). GHG intensity refers to the average GHG emission intensity in the previous year (tons $CO_2$eq/MWh), while GHG emissions represent the average total emissions during the previous year (tons $CO_2$eq). For new business entities, the values are based on the industry average. This means that the lower a business entity's emission intensity in the previous year, the greater its emission allowance (in tons $CO_2$eq) for the current year compared to the previous year.

Shortly after establishing the PTBAE-PU formula, in February 2023, the MEMR officially launched an ETS for the power generation subsector.[53] In its first year of implementation, the carbon market was limited to CFPPs connected to the PT PLN grid, with an installed capacity of 100 MW or more.

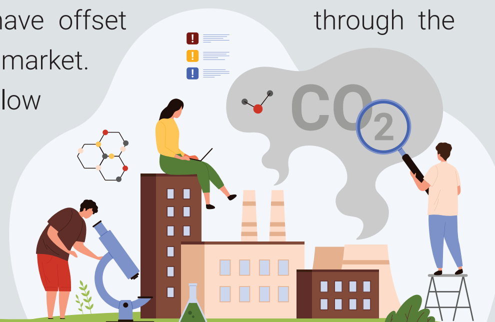
The ETS currently involves 99 CFPP units that have received PTBAE-PU,[54] with a total installed capacity of 33,569 MW, representing approximately 86% of the total CFPPs. Of these 99 CFPP units, 55 are owned by the PLN Group, while the remainder are privately owned. The recording and reporting of carbon trading under this scheme are carried out through *Aplikasi Penghitungan dan Pelaporan Emisi Ketenagalistrikan* or APPLE-Gatrik (the Electricity Emissions Calculation and Reporting Application).

Unfortunately, APPLE-Gatrik operates as a closed system and has yet to be integrated with the national ETS through the SRN-PPI.[55] Access to the application is currently limited to power generation companies and the Directorate General of Electricity as the system administrator. As a result, crucial, fundamental, and real-time information, such as the volume of PTBAE-PU carbon units allocated, the emission levels of individual CFPPs, transaction volumes, and carbon prices, remains inaccessible to the public. Whether a similar ETS will be adopted and launched by other subsectors is also unknown. The lack of transparency in information hinders one of the most essential components of the price discovery process.

**Pilot Carbon Trading for CFPPs, March–August 2021**

Before officially launching the carbon ETS in 2023, the MEMR conducted a pilot program from March to August 2021[56]. The pilot involved 32 CFPP units connected to the PLN grid, 26 of which were owned by the PT PLN, with the remaining units operated by private entities. Based on PTBAE-PU calculations using each company's emission data in 2000, there was a surplus of PTBAE-PU or an emission level below the PTBAE-PU, amounting to 5.153 million tons of $CO_2$e from the CFPPs.

During the pilot period, a total of 28 transactions were recorded, with a trading volume of 42,455 tons of $CO_2$eq (or 0.04 million tons of $CO_2$eq) and an average carbon price of USD2 per ton, significantly below the ideal price range of USD40–80 per ton of $CO_2$eq considered effective for emission reduction at the time (Santikarn et al, 2021). This indicates that the volume and value of carbon trading were relatively low, particularly considering the PTBAE deficit of 5.15 million tons of $CO_2$eq, which CFPPs should have offset through the purchase of PTBAE-PU in the carbon market. One of the key factors contributing to the low trading activity and market price was the relatively low penalty (in the form of a carbon tax), set at only IDR30,000 per ton of $CO_2$eq.




In addition to the energy sector, the forestry sector has also issued several regulations related to ETS, including a carbon trading roadmap for the forestry sector[57]. However, the information provided in these documents remains limited. According to the roadmap, the ETS will be implemented only in specific subsectors, namely peatland and mangrove forest management.

On the one hand, the forestry sector has established a baseline, which is business-as-usual (BAU) or projection of carbon emissions, assuming no carbon reduction policies are implemented at the forestry sector level through 2030. This sector has also set annual emission targets for its three subsectors from 2020 to 2030. However, these targets remain unchanged throughout the period. The targets are 165.1 million tons of $CO_2eq$ per year for the forestry subsector, 531.7 million tons of $CO_2eq$ for the peat subsector, and 315 million tons of $CO_2eq$ for the mangrove subsector.

However, unlike in the electricity subsectors, there are no clear regulations specifying the emission cap (PTBAE) for the forestry sector, either in terms of absolute emissions or emission intensity. Additionally, it remains unclear what percentage of the expected emission reductions will come from the carbon trading scheme. Without a defined emission cap, there is, of course, no information available regarding PTBAE-PU and its allocation formula. Consequently, no carbon trading scheme has been launched in the forestry sector.

Second, the energy and forestry sectors are ahead regarding emission offsetting, like the ETS. In launching the carbon trading scheme for CFPPs, some businesses also participated through offset mechanisms, such as CFPPs that use renewable energy or implement emission reduction mitigation actions. However, no further information is available about who these participants are, the volume of carbon units traded, or the criteria for the types of businesses eligible for these offset activities.

Has emission offset trading already been implemented in Indonesia? According to records, some Indonesian companies have engaged in verified emission offset activities and are registered in the international voluntary carbon offset market. These include projects owned by PLN, Pertamina, and several private companies, such as renewable energy, geothermal, or land conservation projects.[58]

Domestically, the National Registry System (SRN-PPI) has recorded several verified emissions offset activities that have received SPE-GRK certification.[59] Some of these offsets are traded outside the exchange, while others have already been traded through the carbon exchange. Three companies, namely PT Pertamina Geothermal Energi, PT UPC Sidrap Bayu Energi, and PT PJB Muara Karang, have sold the SPE-GRKs in the SRN-PPI.

Thus, the emission offset market has shown to be slightly more active within Indonesia's national carbon trading than the ETS. At the very least, registered products are already openly traded in the national market. However, there are at least two key issues that require further clarification. First, what baseline emission level is used to issue the SPE-GRK and how is it determined? Second, how do the SPE-GRKs trade in the carbon market and exchange align with national and sectoral climate mitigation policies? Are they formally integrated into the country's emission reduction commitments or are they merely preliminary initiatives by a few parties aiming to jumpstart the carbon market as quickly as possible?

## Several Structural Challenges

Several structural challenges in Indonesia's current carbon market plans have become apparent through the policy-tracing analysis described above.

First, the national PTBAE (cap) and its allocation in the form of PTBAE-PU (allowance) have yet to be established and must be agreed upon urgently. Not only is it important for the ETS, but PTBAE can also increase demand in the offset market if business actors in the ETS, such as in the pilot CFPPs, are allowed to purchase SPE-GRK from the energy sector to cover excess emissions.[60]

The absence of a nationally integrated PTBAE and weak demand for SPE-GRKs in the offset market have made carbon prices too low. For instance, in the first four months of 2024, the cost per unit of SPE-GRK on the Indonesian carbon exchange hovered around IDR59,000 (approximately USD3.5)[61] per ton of $CO_2$eq, significantly below the ideal price range for effective emission reductions in 2022 estimated at USD61–122 per ton of $CO_2$eq (World Bank, 2023). This indicates that the market-based incentive to reduce carbon emissions remains insufficient.

Second, both emission trading and carbon offset schemes require accurate and detailed data on actual emission levels, down to the level of individual business units or when PTBAE-PU allocations are to be distributed. This is no simple task. Even in the European Union, when it launched its ETS in 2005, governments did not have precise data on emissions by sector or individual business entities (Ellerman et al, 2010).

In Indonesia, most emission data are calculated using Tier 1 methodology, which relies on activity data from global sources and standardized international emission factors. Some sectors have progressed to using Tier 2 methodology, which involves national or local activity data combined with directly measured emission factors.[62]

Ideally, emissions should be calculated using Tier 3 methodology, which employs robust sampling techniques and accounts for the diverse conditions.

Accurate emissions data are critical for determining PTBAE levels and allocating PTBAE-PU. In the first phase of the European Union Emissions Trading System (EU-ETS), the absence of precise data led to an overallocation of allowances that exceeded actual emissions. This oversupply of allowances was one of the main factors contributing to the low carbon prices during the initial phase of the EU-ETS (Schmalensee et al, 2017).

Third, regarding the political economy, climate change and carbon trading are policy areas with long-term and global benefits, but the costs, such as carbon pricing, are immediate and local (Tirole, 2017). Unsurprisingly, in Indonesia, which is not yet classified as a high-income nation, these issues are not seen as top priorities by voters or policymakers. Even in developed countries, only 50% of voters and approximately 30% of politicians consider climate change a critical social issue.[63]

Climate change ranks among the lowest priorities compared to other pressing social issues such as healthcare, education, and the economy. In Indonesia, issues like poverty, income inequality, public health, employment, and the provision of affordable and accessible basic services are considered far more urgent and essential than climate change.

In addition, PTBAE-PU essentially functions as a tradable permit for carbon emissions within the emissions trading market. The economic value of these permits, often referred to as rents, arises from their scarcity, created through regulatory emissions limits. As with other forms of economic rent, the rules governing carbon limits and their allocation are determined through political processes rather than purely market-based or efficiency-driven mechanisms. Consequently, discussions surrounding the implementation of the NEK framework have been contentious and heavily influenced by political interests.

The NEK framework also challenges carbon-intensive industries, such as coal mining. Furthermore, NEK places these industries in direct competition with carbon offset commodities, such as timber and palm oil, that benefit from forest conservation initiatives. These industrial interest groups maintain close ties with political power holders in Indonesia. The concentrated benefits they receive from lenient carbon policies reflect their capacity to mobilize political support to preserve the status quo. Additionally, the wider community does not yet agree on the importance of climate issues. In other words, NEK's contentious implementation illustrates a classic political economic dilemma, which is 'the logic of collective action.'

The carbon trading scheme can potentially address the collective action problem. Economists across different spectrums often favor carbon taxes as the most effective climate policy for several straightforward reasons. First, carbon taxes are relatively more flexible in responding to demand fluctuations. Second, they are more efficient. Third, they generate government revenue. Fourth, the policy is straightforward to understand.

However, it must be acknowledged that, from the political economic perspective, business actors are more likely to offer political support for ETS. This is because they gain access to and can control PTBAE-PU, which holds economic value. As observed in the experiences of developed countries, owners of PTBAE-PU will form new interest groups with strong incentives to protect the ETS, countering the opposition from anti-carbon trading groups (Mesquita, 2016). Ultimately, in the medium to long term, capital owners who understand and know how to navigate the carbon market will be the ones to benefit the most.

In Indonesia, based on all the points outlined above, the high level of complexity and administrative challenges in implementing the carbon trading system, at least in the short term, will diminish the advantages of emissions trading compared to a carbon tax policy.

## After Regulations Are Established, What Are the Next Steps?

Conceptually, a carbon exchange operates like a stock exchange based on similar market principles. The key differences, however, lie in the underlying assets, the primary objectives, and their environmental impact.

Regarding the underlying assets, while stock exchanges trade ownership rights in a company, carbon exchanges trade the right to emit GHG. Regarding primary objectives, stock exchanges are designed to facilitate capital raising for businesses, whereas carbon exchanges aim to create incentives for emission reductions and support climate action.

The similarity of market principles of carbon and stock is reflected in the incentives for capital mobilization. Adherence to market principles requires asset buying and selling activities, dynamic price discovery, and financial incentives in the form of potential gains.

At the practical level, the structure, direction, and depth of regulation will largely determine the success of a carbon exchange. Observations show that Indonesia, Singapore, and Malaysia are developing their carbon markets with distinct characteristics.

The Financial Services Authority (OJK) is the carbon exchange regulator in Indonesia. Law Number 4 Year 2023 explicitly grants OJK the authority to oversee financial services activities within the carbon market sector. In response, OJK issued OJK Regulation (POJK) Number 14 Year 2023, which outlines the regulatory framework to ensure the integrity and transparency of Indonesia's carbon market while supporting the country's climate action goals. This regulation focuses on several key areas.

First, it focuses on classifying carbon units as securities and eventually bringing them under capital market regulations. This classification has significant implications for trading, settlement, and oversight mechanisms. Second, it establishes licensing requirements for carbon exchanges. The aim is to ensure that only qualified and regulated entities can participate in carbon trading activities.

Third, regarding market integrity and transparency, the POJK outlines fair trading practices, risk management, and consumer protection regulations to ensure a level playing field for all market participants. Fourth is supervision. The OJK is authorized to oversee all aspects of carbon trading activities on the exchange, including market operations, regulatory compliance, and the financial health of market participants. While these features are intended to establish a strong and well-regulated carbon market, the provisions remain generic.

Compared to the regulatory frameworks and strategic direction of carbon markets in Singapore and Malaysia, Indonesia's approach appears to lack a clear niche or distinctive identity. This absence of differentiation may limit its appeal to global investors.

Table 1 Comparative Summary of Carbon Exchanges in Singapore, Malaysia, and Indonesia

| Feature | Singapore | Malaysia | Indonesia |
|---|---|---|---|
| Market Type | Prioritize compliance | Initially, voluntary | Taking both areas, namely compliance and voluntary |
| Focus | Carbon taxes and the compliance market | Voluntary market, development of sharia carbon products | To facilitate national targets. |
| Innovation Trajectories Shaped by Regulation | A strong emphasis on high-quality carbon credits | Pioneering sharia-compliant carbon trading. | Unclearly stated in the existing regulation |

*Source: Synthesis conducted by the author from various carbon market regulations in Singapore, Malaysia, and Indonesia.*

Despite the existing POJK, five key elements remain critical to building an effective carbon market. The first is the standardization of methodologies. Consistent methodologies for measuring, reporting, and verifying emission reductions are essential to build trust and ensure the credibility of carbon credits.

The second key element is market liquidity, which relies on several essential factors. They include sufficient supply and demand as well as a diverse and active pool of market participants. Trading volume can be increased to raise liquidity by expanding the scope of industries subject to emission limits. This expansion would likely result in more companies being required to purchase carbon allowances while also creating opportunities for companies that can reduce their emissions to sell their excess credits. Additionally, broadening the market would increase the likelihood of attracting reliable, large-scale participants who can serve as market leaders. Moreover, emission caps must be progressively tightened over time to maintain the relevance and urgency of carbon trading activities (Siagian, 2023).

High-quality carbon credits are essential to reflect genuine emission reduction efforts. Third parties must rigorously verify them to prevent double counting, where the same reduction is claimed multiple times. Regarding this aspect, the government should encourage several major players' active participation in carbon market transactions. For example, PLN is a key player in Indonesia's power sector. The government must establish emission limits that incentivize fossil-fuel power plants under PLN to innovate in reducing emissions and engage in carbon credit trading among themselves.

As discussed in the analysis above, implementing a carbon tax is crucial. Suppose the tax on each ton of carbon exceeds the price of carbon credits in the market. In that case, it will incentivize carbon emitters to purchase carbon credits from the market rather than paying the higher carbon tax, thereby increasing market transactions.

As mentioned in the analysis, the third key element is transparency and trust. Transparent and accessible public information about carbon projects, trading volumes, and credit prices is essential for building trust and facilitating informed decision-making. As for trust, a necessary component of trading infrastructure is the custodian, a third party responsible for securely storing, calculating, administering, and settling transactions fairly and justly.

The fourth key element is the importance of strong risk management and compliance regulations. This is essential because the market's integrity, the absence of market manipulation, the stability of rules concerning price volatility, and the management and mitigation of legal and operational risks are crucial to the price discovery process in the carbon exchange.

The fifth key element is the role of intermediaries or brokers, which is crucial for facilitating transactions between buyers and sellers of carbon credits. Brokers not only merely act as agents who match buyers and sellers, but also play a vital role in expanding market access, evaluating climate projects, managing risks, and ensuring the efficiency of the transaction execution process. In Indonesia, however, there are currently no brokerage firms specializing in carbon trading.

## Conclusion

If the government is genuinely committed to developing its carbon market, three fundamental aspects must be prepared immediately, comprehensively and detailed, with well-coordinated incentive and disincentive mechanisms. Without these key elements, Indonesia’s carbon market will remain an empty discourse.

First, the government must establish carbon commodities through clear and binding regulations on emission limits, such as caps or PTBAE. Additionally, the government can allocate emission quotas to businesses, often called allowances or PTBAE-PU. A strong political will is not enough. Qualified professionals with proven expertise must oversee the market’s preparation.

Second, the government must select a carbon market design that aligns with Indonesia’s socio-economic context, focusing on identifying a niche market that differentiates it from other Asian carbon markets. This approach is essential to ensuring active buying and selling transactions, attracting both domestic and foreign investors, establishing efficient pricing that effectively reduces national emissions, and generating economic benefits for the market participants.

Third, it is equally important to carefully calculate the structure of incentives and disincentives within the carbon market relative to the broader asset market. This is crucial to prevent price or even market arbitrage. Such measures are necessary to avoid market asymmetry, which could potentially harm Indonesia’s entire asset market ecosystem.

## ENDNOTES

**Chapter 1**

[1] *Our World in Data.* (n.d.).

[2] *IMF Datamapper.* (n.d.).

**Chapter 2**

[3] Indonesia Investments. (n.d.). *Analisis pertambangan batubara* [Coal mining analysis].

[4] Badan Pusat Statistik. (n.d.). *Neraca energi Indonesia* [2001–2022 Indonesia energy balance].

[5] Indonesia Investments. (n.d.). *Analisis pertambangan batubara* [Coal mining analysis].

[6] *Tempo Data Science & the Global Energy Monitor.* (n.d.).

**Chapter 7**

[7] *Kebijakan Energi Nasional [National Energy Policy] as outlined in Peraturan Pemerintah Nomor 79 Tahun 2014 [Government Regulation Number 79 Year* 2014]. (2014).

[8] Dewan Energi Nasional. (2023). *Ketahanan energi Indonesia untuk menghadapi perubahan iklim* [Indonesia's energy security in facing climate change]

[9] Dewan Energi Nasional. (2024). *Capaian sektor ESDM tahun 2023 dan program kerja tahun 2024* [2023 MEMR achievements and 2024 work plan] presented at DEN's press conference.

[10] *Undang-Undang Nomor 16 Tahun 2016 tentang Pengesahan Persetujuan Paris Atas Konvensi Kerangka Kerja PBB Mengenai Perubahan Iklim [Law Number 16 Year* 2016 on the ratification of the Paris agreement to the United Nations framework convention on climate change]. (2016).

[11] Kementerian Lingkungan Hidup dan Kehutanan. (2022). E*nhanced nationally determined contribution Republic of Indonesia* or emission reduction targets calculated based on the expected Business-as-Usual (BAU) emission projections. The data reflects the growth in emissions if no mitigation measures are taken.

[12] Kementerian Energi dan Sumber Daya Mineral. (2024). *No. 031.Pers/04/SJI/2023 Capaian sektor ESDM tahun 2023 dan program kerja tahun 2024* [2023 MEMR achievements and 2024 work program] [Press release].

[13] Menteri Energi dan Sumber Daya Mineral. (2008). *Peraturan Menteri Energi dan Sumber Daya Mineral nomor 32 tahun 2008 penyediaan, pemanfaataan, dan tata niaga bahan bakar nabati (biofuel) sebagai bahan bakar lain* [Ministerial regulation number 32 year 2008 on providing, utilizing, and trading biofuels as alternative fuels].

[14] Kementerian Koordinator Bidang Perekonomian. (2023). *HM.4.6/29/ SET.M.EKON.3/01/2023 Peningkatan mandatori biodiesel B35 untuk mendukung energi ramah lingkungan dan transisi energi yang adil dan merata* [The mandatory increase in B35 biodiesel to support environmentally friendly energy and a fair and equitable energy transition] [Press release]

[15] *Data sistem informasi bantuan pembelian kendaraan bermotor roda dua* [Information system data of two-wheeled motor vehicle purchase assistance]. (2023, November).

[16] Menteri Energi dan Sumber Daya Mineral. (2023). P*eraturan Menteri Energi dan Sumber*

*Daya Mineral nomor 13 tahun 2023* [The Minister of Energy and Mineral Resources regulation number 13 year 2023].

[17] IDX. (2024, June). *IDX carbon monthly*.

[18] Dewan Energi Nasional. (n.d.). *Proyeksi energi Indonesia 2050* [2050 Indonesian energy outlook].

[19] International Energy Agency. (2022). *An energy sector roadmap to net zero emissions in Indonesia*.

[20] Kementerian Keuangan. (2023). *Paparan upaya Indonesia wujudkan transisi energi* (angka pendanaan kumulatif 2023–2030) [Presentation on Indonesia's efforts to realize energy transition (2023–2030 cumulative financing)] [Unpublished presentation, COP28 UAE].

[21] International Energy Agency. (2023). Inflation Reduction Act of 2022.

[22] Inflation Reduction Act (IRA). In *Building a clean energy economy guidebook*. (2023).

[23] Inflation Reduction Act (IRA). In *Building a clean energy economy guidebook*. (2023).

[24] Inflation Reduction Act (IRA). In *Building a clean energy economy guidebook*. (2023).

[25] Inflation Reduction Act (IRA). In *Building a clean energy economy guidebook*. (2023).

[26] Inflation Reduction Act (IRA). In *Building a clean energy economy guidebook*. (2023).

[27] International Energy Agency. (n.d.). *An energy sector roadmap to net zero emissions in Indonesia*.

[28] Kementerian Energi dan Sumber Daya Mineral. (2022). *Laporan kinerja Direktorat Jenderal EBTKE* [Performance report of the Directorate General of New and Renewable Energy and Energy Conservation].

[29] SKK Migas. (2023). *Capaian kinerja hulu migas 2023* [2023 upstream oil and gas performance results] [Press release].

[30] Kementerian Energi dan Sumber Daya Mineral. (2022). *Statistik migas semester 1* [Oil and gas statistics, Semester I].

[31] International Council on Clean Transportation. (2021).

[32] Kementerian Lingkungan Hidup dan Kehutanan. (2023).

[33] Kementerian Lingkungan Hidup dan Kehutanan. (2019). *Satu peta mangrove nasional 2013–2019* [2013–2019 National mangrove map].

[34] LEMIGAS. (2009, 2012, 2015). *Studi CCS/CCUS Indonesia* [CCS/CCUS studies in Indonesia].

[35] Dewan Energi Nasional. (2022). *Evaluasi capaian bauran energi nasional* [Evaluation of national energy mix achievements].

[36] Direktorat Jenderal Minyak dan Gas Bumi. (2022). *Rencana implementasi CCS/CCUS di Indonesia* [CCS/CCUS implementation plan in Indonesia].

[37] The short- to medium-term phases reflect actions that can be initiated immediately and sustained over a period of three to five years. The long-term phases reflect actions that require the foundation to be laid now, so they can be implemented at scale and commercially after five years. (n.d.).

**Chapter 10**

[38] Sekretariat Kabinet. (2023). *Sambutan Presiden Joko Widodo* [Speech]. The launch and first trading of the Indonesian carbon exchange, Indonesia.

[39] Berita Kantor Staf Presiden Republik Indonesia. (2024). *Bentuk satgas percepatan implementasi perdagangan karbon* [Formation of the task force to accelerate carbon trading implementation].

[40] Berita Kantor Staf Presiden Republik Indonesia. (2024). *Moeldoko: Penerapan Perdagangan Karbon Harus Berjalan Optimal Sebelum Oktober 2024* [Moeldoko: Carbon trading must operate optimally before October 2024].

[41] Undang-Undang nomor 16 tahun 2016 tentang pengesahan persetujuan Paris atas konvensi kerangka kerja Perserikatan Bangsa-Bangsa mengenai perubahan iklim (Law number 16 year 2016 on the ratification of the Paris agreement to the United Nations framework convention on climate change). (2016).

[42] United Nations Framework Convention on Climate Change. (2022). *Climate change enhanced- Republic of Indonesia nationally determined contributions (NDCs).*

[43] Annual greenhouse gas emissions, national contributions to climate change 2024. In *Our world in data*. (2024).

[44] Katadata.co.id. (2020). *Punya hutan luas, RI bisa raup Rp350 triliun dari perdagangan karbon* (With vast forests, Indonesia could earn IDR350 trillion from carbon trading). Katadata.

[45] *Sambutan Presiden Republik Indonesia* [Speech]. (2023). The launch and first trading of the Indonesian carbon exchange, Indonesia.

[46] Kementerian Koordinator Perekonomian Republik Indonesia. (2022). *Ekonomi hijau dan pembangunan rendah karbon mendorong pertumbuhan ekonomi dan meningkatkan kesejahteraan sosial* (Green economy and low-carbon development drive economic growth and improve social welfare) [Press release].

[47] Katadata Insight Center. (2022). *Indonesia carbon trading handboo*k.

[48] Menteri Energi dan Sumber Daya Mineral Republik Indonesia. (2022). *Peraturan Menteri Energi dan Sumber Daya Mineral nomor 16 tahun 2022 tentang tata cara penyelenggaraan nilai ekonomi karbon subsektor pembangkit tenaga listrik* (Ministerial regulation number 16 year 2022 on procedures for implementing the carbon economic value in the electricity generation sub-sector).

[49] Menteri Lingkungan Hidup dan Kehutanan Republik Indonesia. (2023). *Peraturan Menteri Lingkungan Hidup dan Kehutanan nomor 7 tahun 2023 tentang tata cara perdagangan karbon sektor kehutanan* (Ministerial regulation number 7 year 2023 on procedures for carbon trading in the forestry sector).

[50] Menteri Energi dan Sumber Daya Mineral Republik Indonesia. (2022 & 2023). *Peraturan Menteri Energi dan Sumber Daya Mineral nomor 16 tahun 2022 dan Keputusan Menteri Energi dan Sumber Daya Mineral nomor 14.K/TL.04/MEM.L/2023 tentang persetujuan teknis batas atas emisi gas rumah kaca pembangkit listrik tenaga uap batubara yang terhubung ke jaringan tenaga listrik PT Perusahaan Listrik Negara (Persero) fase kesatu* [Ministerial regulation number 16 year 2022 and ministerial decree no. 14.K/TL.04/MEM.L/2023 on technical approval of upper greenhouse gas emission limits for coal-fired power plants connected to the phase one PT Perusahaan Listrik Negara (Persero) electricity grid].

[51] Non-mine-mouth and mine-mouth CFPPs, with installed capacities ranging from 25 to 100 MW; non-mine-mouth CFPPs, between 100 and 400 MW; non-mine-mouth CFPPs,

above 400 MW; and mine-mouth CFPPs, above 100 MW. For each type of CFPP, the emissions are 1.297 tons $CO_2$eq/MW, 1.011 tons $CO_2$eq/MW, 0.911 tons $CO_2$eq/MW, and 1.089 tons $CO_2$eq/MW for 2023 and 2024.

[52] Fundamentally, setting the PTBAE in intensity-based units, as practised in China, establishes an upper limit on production capacity at a specified emissions rate. This approach places greater emphasis on production capacity rather than emission levels. As a result, achieving emission reduction targets, as stated in Indonesia's national commitment, becomes more uncertain.

[53] Direktorat Jenderal Energi Baru Terbarukan & Konservasi Energi Kementerian ESDM. (2023). *Menteri ESDM luncurkan perdagangan karbon subsektor pembangkit listrik* [Minister of Energy and Mineral Resources launches carbon trading for the power generation sub-sector].

[54] Kontan.co.id. (2023). Perusahaan pembangkit listrik dipastikan ikut serta dalam perdagangan karbon [Power generation companies confirmed to participate in carbon trading]. *Kontan*.

[55] The Aplikasi Perhitungan dan Pelaporan Emisi Ketenagalistrikan/APPLE-GATRIK (Electricity Emissions Calculation and Reporting Application) is a web-based platform for power generation companies to collect GHG emissions data, calculate, and report GHG emissions from individual power generation units to the government.

[56] Direktorat Jenderal Ketenagalistrikan. (2021). *Penyelenggaraan nilai ekonomi karbon di subsektor ketenagalistrikan* [Webinar, in Indonesian]. Kementerian Energi dan Sumber Daya Mineral. Presentation on the trial of carbon trading in CFPPs.

[57] Kementerian Lingkungan Hidup dan Kehutanan. (2023). *Keputusan Menteri Lingkungan Hidup dan Kehutanan no. SK.1027/MENLHK/PHL/KUM.1/9/2023 tentang peta jalan perdagangan karbon Indonesia* [Ministerial decree on the indonesian carbon trading roadmap].

[58] Katadata Insight Center. (2022). Indonesia carbon trading handbook.

[59] Kementerian Lingkungan Hidup dan Kehutanan. (n.d.). *Sistem registri nasional – Perubahan iklim* [National registry system – Climate change].

[60] At the national level, it remains unclear whether entities participating in the emissions trading scheme are allowed to purchase SPE-GRK to compensate for actual emissions that exceed the limits stipulated in their Technical Approval of Upper Emission Limits–Business Actors (PTBAE-PU).

[61] IDX. (2024). *Monthly 2024 Indonesia carbon exchange*.

[62] Kementerian Lingkungan Hidup dan Kehutanan. (n.d.). Laporan inventarisasi gas rumah kaca [Greenhouse gas inventory report].

[63] Hsiao, A., & Kuipers, N. (2024). Mismatch for environmental policy in Indonesia [Seminar presentation]. Indonesia Project Seminar, The Australian National University (ANU).

## GLOSSARY

**A**

ACE : ASEAN Centre for Energy
ACLF : Asia Climate-Smart Landscape Fund
ADB : Asian Development Bank
ADCP : Adhi Commuter Properti
AFOLU : Agriculture, Forestry, and Other Land Use
AI : Artificial Intelligence
ALM : Asset Liability Management
Apple-Gatrik : Aplikasi Penghitungan dan Pelaporan Emisi Ketenagalistrikan
APS : Announced Pledges Scenario
ASF : Available Stable Funding

**B**

BAU : Business-as-Usual
BECCS : Biomass Energy with Carbon Capture and Storage
BIL : Bipartisan Infrastructure Law
BOE : Barrel of Oil Equivalent
BOEPD : Barrel of Oil Equivalent per Day
BOI : Board of Investment
BPS : Best Policy Scenario
BRGM : Badan Restorasi Gambut dan Mangrove
BSI : Bank Syariah Indonesia
BTU : British Thermal Unit
BUR : Biennial Update Report
BYD : Build Your Dream

**C**

CAPEX : Capital Expenditure
CAGR : Compound Annual Growth Rate
CAR : Capital Adequacy Ratio
CCS : Carbon Capture and Storage
CCUS : Carbon Capture, Utilization, and Storage
CFI : Commercial Financial Institutions
CFPP : Coal-Fired Power Plants
CGIF : Credit Guarantee and Investment Facility
CIF-ACT : Climate Investment Fund - Acceleration Coal Transition
CIPP : Comprehensive Investment and Policy Plan
CM : Counter Measure
$CO_2$ : Carbon Dioxide
$CO_2e$ : Carbon Dioxide Equivalent
COP : Conference of the Parties
CPI : Climate Policy Initiative
CPOS : Current Policy Scenario

**D**

DFC : Development Finance Corporation
DFI : Development Financial Institution
DMO : Domestic Market Obligation
DPP : Diesel Power Plant
DPS : Delayed Policy Scenario
DRE : Dispatchable Renewable Energy

**E**

EaR : Earnings-at-Risk
EaaS : Energy-as-a-Service
ECA : Export Credit Agencies
EMAS : Eco-Management and Audit Scheme
ENDC : Enhanced Nationally Determined Contribution
ETC : Energy Transitions Commission
ETM : Energy Transition Mechanism
ETP : Energy Transition Partnership
ETS : Emissions Trading System
EU-ETS : European Union - Emissions Trading System
EV : Electric Vehicle
EVE : Economic Value of Equity

## F

| | | |
|---|---|---|
| FAME | : | Faster Adoption and Manufacturing of Hybrid and Electric Vehicles |
| FAME | : | Fatty Acid Methyl Ester |
| FiT | : | Feed-in Tariff |
| FOLU | : | Forestry and Other Land Use |
| FYP | : | Five-Year Plan |

## G

| | | |
|---|---|---|
| G-20 | : | Group of Twenty |
| GBFA | : | Global Blended Finance Alliance |
| GDP | : | Gross Domestic Product |
| GEOP | : | Green Energy Option Program |
| GFANZ | : | Glasgow Financial Alliance for Net Zero |
| GRDP | : | Gross Regional Domestic Product |
| GW | : | Giga Watt |
| GWP | : | Global Warming Potential |

## H

| | | |
|---|---|---|
| HEFA | : | Hydroprocessed Esters and Fatty Acids |
| HVAC | : | Heating, Ventilation, and Air Conditioning |
| HQLA | : | High Quality Liquid Assets |
| HPP | : | Hydro Power Plant |
| HVO | : | Hydrotreated Vegetable Oil |

## I

| | | |
|---|---|---|
| ICRAF | : | International Centre for Research in Agroforestry |
| IDX | : | Indonesia Stock Exchange |
| IEA | : | International Energy Agency |
| IEEFA | : | Institute for Energy Economics and Financial Analysis |
| IESR | : | Institute for Essential Services Reform |
| IEVA | : | Indonesia Electric Vehicle Association |
| IFC | : | International Finance Corporation |
| IMF | : | International Monetary Fund |
| INA | : | Indonesia Investment Authority |
| IoT | : | Internet of Things |
| IPCC | : | Intergovernmental Panel on Climate Change |
| IPG | : | International Partners Group |
| IPP | : | Independent Power Producer |
| IPPU | : | Industrial Processes and Product Use |
| IRA | : | Inflation Reduction Act |
| IRENA | : | International Renewable EnergyAgency |
| IRRBB | : | Interest Rate Risk in the Banking Book |

## J

| | | |
|---|---|---|
| JETP | : | Just Energy Transition Partnership |

## K

| | | |
|---|---|---|
| KWh | : | Kilo Watt-hour |

## L

| | | |
|---|---|---|
| LCCP | : | Low Carbon Scenario Compatible with Paris Agreement Target |
| LCR | : | Liquidity Coverage Ratio |
| LDR | : | Loan to Deposit Ratio |
| LED | : | Light Emitting Diode |
| LEED | : | Leadership in Energy and Environmental Design |
| LNG | : | Liquefied Natural Gas |
| LSS | : | Large Scale Solar |

| | | |
|---|---|---|
| LTS | : | Long-Term Low- Emission Development Strategies |
| LTS-LCCR | : | Long-Term Strategy Low Carbon and Climate Resilience |
| LTV | : | Loan To Value |

**M**

| | | |
|---|---|---|
| M4CR | : | Mangrove for Coastal Resilience |
| MDB | : | Multilateral Development Bank |
| MFF | : | Mobilising Finance for Forests |
| MEMR | : | Ministry of Energy and Mineral Resources |
| Mission LiFE | : | Mission Lifestyle for Environment |
| MSP | : | Mineral Security Partnership |
| MOEF | : | Ministry of Environment and Forestry |
| $MtCO_2$ | : | Million tonnes of Carbon Dioxide Equivalent |
| MTN | : | Medium-Term Note |
| MSW | : | Municipal Solid Waste |
| MW | : | Mega Watt |
| MYR | : | Malaysian Ringgit |
| MUDS | : | Million US Dollars |

**N**

| | | |
|---|---|---|
| NBS | : | Nature-Based Solution |
| NDC | : | Nationally Determined Contribution |
| NDPE | : | No-Deforestation, No-Peat, and No-Exploitation |
| NEP | : | National Energy Policy |
| NETR | : | National Energy Transition Roadmap |
| NII | : | Net Interest Income |
| NIM | : | Net Interest Margin |
| NOP | : | Net Open Position |
| NRE | : | New and Renewable Energy |
| NSFR | : | Net Stable Funding Ratio |
| NZE | : | Net Zero Emission |

**O**

| | | |
|---|---|---|
| OB GDP | : | Overall Balance to Gross Domestic Product |
| OCED | : | Office of Clean Energy Demonstration |
| ODA | : | Official Development Assistance |
| OECD | : | Organization for Economic Cooperation and Development |
| OFMSW | : | Organic Fraction of Municipal Solid Waste |
| OJK | : | Otoritas Jasa Keuangan |
| OPEC | : | Organization of the Petroleum Exporting Countries |

**P**

| | | |
|---|---|---|
| PB GDP | : | Primary Balance to Gross Domestic Product |
| PDR | : | Public Debt Ratio |
| POJK | : | Peraturan Otoritas Jasa Keuangan |
| POME | : | Palm Oil Mill Effluent |
| PPP | : | Public Private Partnership |
| PTBAE | : | Persetujuan Teknis Batas Atas Emisi |
| PTBAE-PU | : | Persetujuan Teknis Batas Atas Emisi - Pelaku Usaha |

**R**

| | | |
|---|---|---|
| R&D | : | Research and Development |
| REC | : | Renewable Energy Certificate |
| REGF | : | Renewable Energy Generation and Fuels |
| REIT | : | Real Estate Investment Trust |

| | | |
|---|---|---|
| RSF | : | Required Stable Funding |
| RSPO | : | Roundtable on Sustainable Palm Oil |
| RWA | : | Risk-Weighted Assets |

**S**

| | | |
|---|---|---|
| SDG | : | Sustainable Development Goals |
| SMI | : | Sarana Multi Infrastruktur |
| SNDC | : | Second Nationally Determined Contribution |
| SPE-GRK | : | Sertifikat Pengurangan Emisi - Gas Rumah Kaca |
| SPP | : | Solar Power Plant |
| SPV | : | Special Purpose Vehicle |
| SRN-PI | : | Sistem Registrasi Nasional - Perubahan Iklim |
| SRN-PPI | : | Sistem Registrasi Nasional - Pengendalian Perubahan Iklim |
| STEPS | : | Stated Policies Scenario |
| Susenas | : | Survei Sosial Ekonomi Nasional |

**T**

| | | |
|---|---|---|
| tCO2e | : | ton of Carbon Dioxide Equivalent |
| T&D | : | Transmisi dan Distribusi |
| TEPG | : | Total Electricity / Power Generation |
| TES | : | Transforming Energy Scenario |
| TFEC | : | Total Final Energy Consumption |
| TIC | : | Total Installed Capacity |
| TLFF | : | Tropical Landscapes Finance Facility |
| TOE | : | Tons of Oil Equivalent |
| TPA | : | Third-Party Access |
| TPES | : | Total Primary Energy Supply |
| TPF | : | Third Party Funding |
| TPL | : | Third Party Liability |
| TRNS | : | Transition Scenario |

**U**

| | | |
|---|---|---|
| UNCLOS | : | United Nations Convention on the Law of the Sea |
| UNCTAD | : | United Nations Conference on Trade and Development |
| UNEP | : | United Nations Environmental Program |
| UNFCCC | : | United Nations Framework Convention on Climate Change |
| USAID | : | United States Agency for International Development |
| US EPA | : | United States Environmental Protection Agency |

**V**

| | | |
|---|---|---|
| VCM | : | Voluntary Carbon Market |
| VRE | : | Variable Renewable Energy |

**W**

| | | |
|---|---|---|
| WEF | : | World Economic Forum |

## REFERENCES

### Chapter 1

Buntoro, K. (2018). Wilayah nusantara dalam perspektif hukum laut dan beberapa implikasi [The Nusantara region from the perspective of the law of the sea and some implications]. TNI-AL, Jakarta, Indonesia.

Daley, J. (2020). US exits Paris climate accord after Trump stalls global warming action for four years. Scientific American.

Davies, E. (2022). WTO backs EU in nickel dispute, Indonesia plans appeal. Reuters.

Dorling, P. (2013). Singapore, South Korea revealed as five eyes spying partners. The Sydney Morning Herald, Sydney, Australia.

European Capacity Building Initiative. (2020). Pocket guide to NDCs under the UNFCCC, 20th edition. European Capacity Building Initiative.

Greenfeld, L. (2003). The spirit of capitalism: Nationalism and economic growth. Harvard University Press, Cambridge, United Kingdom.

Hall, S. (2015). Exxon knew about climate change almost 40 years ago. Scientific American, New York.

Itawan, D. (2022). Colonialism and climate crisis: The root of environmental changes and the rise of environmental awareness in Indonesia. Indonesian historical studies, Vol. 6 (2), pp. 192-205.

Jack, V. (2023). EU 'coal rebound' in 2022 less significant than feared: Report. Politico.

Kahozy, L, Malenga, B., & Makumeno, E. (2024). Tensions grow as China ramps up global mining for green tech. BBC.

Kusmayadi, R. (2024). Bukti nyata hilirisasi nikel, Indonesia siap produksi massal baterai kendaraan listrik pada April 2024 [Tangible proof of nickel downstreaming: Indonesia ready for mass production of electric vehicle batteries in April 2024]. BKPM.

Mazzucato, M. (2013). The entrepreneurial state: Debunking public vs private sector myths. Anthem Press, London, United Kingdom.

Muliawati, F. D. (2023a). Banyak pabrik nikel RI dibangun investor China, ini alasannya [Many of Indonesia's nickel plants are built by Chinese investors: Here's why]. CNBC Indonesia.

Muliawati, F. D. (2023b). Pemerintah masih otak-atik dana pensiun dini PLTU Batubara [The government is still tweaking funding for CFPP early retirement]. CNBC Indonesia.

Neill, W. T. (1973). Twentieth-Century Indonesia. Columbia University Press, New York.

Pirlot, A. (2021). How and why a global carbon tax could revolutionize international climate change law? Oxford University Centre for Business Taxation.

Robinson, J. (1962). Economic Philosophy. The Chaucer Press, Bungay, United Kingdom.

Sanchez, I. C., & Botts, J. (2024). A program meant to help developing nations fight climate change is funneling billions of dollars back to rich countries. Reuters.

Siagian, A. P., Haesra, A., Marzuki, F., & Hamonangan, M. (2023). Inovasi ekonomi hijau: Integrasi pumped storage pada sistem ketenagalistrikan Indonesia [Green economy innovation: Integration of pumped storage into Indonesia's power system]. LAB 45 monograf [LAB 45 monograph]. Laboratorium Indonesia 2045.

Stein, J., & Cocco, F. (2024). How four US presidents unleashed economic warfare across the globe. The Washington Post.

Tabeta, S. (2024). China says rare earths belong to state in new regulation. Nikkei Asia.

Winata, E., Handika, I., Ginting, M. G., & et al. (2021). Model bisnis untuk memperkuat peran pemerintah daerah dalam pemanfaatan potensi energi terbarukan di Indonesia [Business model to strengthen the role of local governments in utilizing renewable energy potential in Indonesia]. Pusat Studi Energi UGM.

Yanwardhana, E. (2021). Bikin Kesal! Kabel Laut Singapura Masuk, RI Tak Dapat Apa-Apa [Frustrating! Singapore's submarine cable enters, Indonesia gains nothing]. CNBC Indonesia.

Zahira, N. (2023). JETP dinilai tidak adil, lebih besar utang dibandingkan dana hibah [JETP considered unfair, with more debt than grant funding]. Katadata.

**Chapter 2**

Adhiguna, P., & Hamdi, E. (2021). Indonesia wants to go greener, but PLN is stuck with excess capacity from coal-fired power plants. Institute for Energy Economics and Financial Analysis.

Agung, F. (2024). Lebih rendah dari realisasi 2023, target produksi batubara tahun ini 710 juta ton [Lower than 2023 realization, target coal production for this year is 710 million tons]. Kontan.

Amir, H. (2017). Kontribusi minyak bagi perekonomian Indonesia [The contribution of oil to the Indonesian economy]. In R. Kurniawan & H. Amir (Eds.), Aspek fiskal bisnis hulu migas [Fiscal aspects of the upstream oil and gas business] (pp. 1–14). Badan Kebijakan Fiskal, Jakarta, Indonesia.

Argamaya. (2012). Economic trends and macroeconomic management in Indonesia: 1960s–1980s. Universitas Bakrie, Jakarta, Indonesia.

Crouch, H. A. (1986). Militer dan politik di Indonesia [The military and politics in Indonesia]. Sinar Harapan, Jakarta, Indonesia.

Erianto, D. (2022a). Batubara: Sejarah, proses pembentukan, manfaat, dan cadangan dunia [Coal: History, formation processes, uses, and global reserves]. Kompas.

Erianto, D. (2022b). Minyak bumi dalam negeri: Produksi, impor, dan perkembangan harga BBM [Domestic oil: Oil-based fuel production, imports, and price developments]. Kompaspedia from Kompas.

Grahadyarini, B. M. L. (2024). Telusuri penyelundupan BBM ke kapal ikan asing ilegal [Tracking fuel smuggling to illegal foreign fishing vessels]. Kompas.

Hafidz, M. Y. (2008). Pendudukan Jepang di Kalimantan Timur, 1942–1945 [The Japanese occupation of East Kalimantan, 1942–1945]. Universitas Indonesia, Jakarta, Indonesia.

Henriarso, H. (1974). Peranan Jepang dalam dunia perminyakan Indonesia [Japan's role in Indonesia's oil industry]. Centre for Strategic and International Studies (CSIS) Indonesia, Jakarta, Indonesia.

Hobley, A., Fulton, M., & Bond, K. (2019). The political tipping point: Why the politics of energy will follow the economics. Carbon Tracker Initiative, London, United Kingdom.

Indonesia Corruption Watch, Greenpeace, Mining Advocacy Network, & Auriga. (2018). Coalruption: Shedding light on political corruption in Indonesia's coal mining sector. Indonesia Corruption Watch, Jakarta, Indonesia.

Joshua, N. (2016). The failure of Indonesia's state oil monopoly: The Pertamina crisis of 1975–1978. Northwestern University, Evanston.

Kartini, A. P. P. (2023). Mengenal PLTU Paiton, salah satu pembangkit listrik terbesar di Indonesia [Getting to know Paiton CFPP, one of the largest power plants in Indonesia]. Tempo.

Kementerian ESDM. (2013). Sejarah pertambangan [History of mining]. Dinas ESDM Provinsi Banten, Serang, Indonesia.

Koninklijke Nederlands Indonesisch Leger. (1949). De strijd op het eiland Tarakan in Januari 1942 [The battle of Tarakan Island in January 1942]. Militaire Spectator, Amsterdam, Netherlands.

Kosasih, E. (2024). Perusahaan raksasa migas AS investasi Rp157T di Kota Serang, begini rencananya [US oil giant invests IDR157 trillion in Serang City: Here's the plan]. TribunBanten.

Marks, D. (2007). The development of the Indonesian service sector, 1900–2000:

A historical national accounting approach. International Institute of Social History, Amsterdam, Netherlands.

Muliawati, F. D. (2023). Pemerintah masih otak-atik dana pensiun dini PLTU Batubara [The government is still tweaking funding for CFPP early retirement]. CNBC Indonesia.

Ningsih, W. L., & Nailufar, N. N. (2021). Sejarah listrik di Indonesia [The history of electricity in Indonesia]. Kompas.

Nortier, J. J. (1980). Tarakan Januari 1942: Een gevecht uit de vergeten oorlog [Tarakan, January 1942: A battle from the forgotten war]. Militaire Spectator, Amsterdam, Netherlands.

Pakkanna, M. (2021). Malapetaka asing-isasi minyak [The disaster of oil foreignization]. Institut Teknologi dan Bisnis Ahmad Dahlan.

Perkins, J. (2004). Confessions of an economic hitman. Berrett-Koehler Publishers, Oakland.

Permatasari, D. (2022a). Kronologi penyesuaian harga BBM bersubsidi periode Orde Lama dan Orde Baru [Timeline of subsidized oil-based fuel price adjustments during the Old Order and New Order]. Kompaspedia from Kompas.

Permatasari, D. (2022b). Kronologi penyesuaian harga BBM era reformasi hingga kini [Timeline of subsidized oil-based fuel price adjustments from the Reform Era to the present]. Kompaspedia from Kompas.

Pradnyana, G. (2010). Optimalisasi pemanfaatan sumber daya migas guna peningkatan kesejahteraan masyarakat dalam rangka pembangunan SDM [Optimizing the use of oil and gas resources to improve public welfare for HR]. Lembaga Ketahanan Nasional Republik Indonesia, Jakarta, Indonesia.

Primayogha, E., Ilyas, F., Wasef, M., & Taher, M. I. (2020). Siapa di balik pembangkit listrik? [Who's behind the power plants?]. Indonesia Corruption Watch.

Robison, R. (2009). Indonesia: The rise of capital. Equinox Publishing, Singapore.

Rupaidi, B. (2023). Rekonstruksi regulasi penegakan hukum tindak pidana pertambangan mineral dan batubara berbasis keadilan [Reconstruction of regulatory enforcement in mineral and coal mining crimes based on justice]. Universitas Islam Sultan Agung.

Santosa, I. (2004). Tarakan, the Pearl Harbor of Indonesia (1942–1945). Yayasan Indonesia Berdikari, Jakarta, Indonesia.

Sasongko, I. D. (2012). Sejarah dan perkembangan industri batubara di Indonesia [History and development of the coal industry in Indonesia]. Excellentia (19th). Project Management Institute Indonesia, Jakarta, Indonesia.

Singgih, V., & Kresna, M. (2023). Profil & peta koneksi bisnis dan politik 10 oligark batubara terbesar di Indonesia di bawah pemerintah Jokowi [Profiles and business-political networks of the 10 largest coal oligarchs in Indonesia under President Jokowi]. Project Multatuli.

Umah, A. (2021). Hampir 1 abad Chevron di RI, begini cikal bakal Blok Rokan [Almost a century of Chevron in Indonesia: The origins of the Rokan Block]. CNBC Indonesia.

Umar, A. R. M. (2012). Ekonomi politik perminyakan Indonesia: Analisis kebijakan liberalisasi sektor hulu migas Indonesia pasca-1998 [The political economy of oil in Indonesia: An analysis of upstream Indonesian oil and gas liberalization after 1998]. Jurnal Ilmu Sosial dan Ilmu Politik, 16(1), 45–61.

Yuniarto, T. (2023). Rekam jejak industri perminyakan Indonesia [The historical journey of Indonesia's oil industry]. Kompaspedia from Kompas.

**Chapter 3**

Climate Policy Initiative. (2023). Landscape of Indonesia power sector finance.

Dewanthi, L. (2021). Third biennial update report. Directorate General of Climate Change, Ministry of Environment and Forestry.

Institute for Essential Services Reform. (2021). Deep decarbonization of Indonesia's energy system: A pathway to zero emissions by 2050. Agora Energiewende.

Intergovernmental Panel on Climate Change. (2006). 2006 IPCC guidelines for national greenhouse gas inventories. Japan.

International Energy Agency. (2022). An energy sector roadmap to net zero emissions in Indonesia.

International Renewable Energy Agency. (2022). Indonesia energy transition outlook.

Just Energy Transition Partnership. (2023). Comprehensive investment and policy plan 2023.

Republic of Indonesia. (2016). First nationally determined contribution. Jakarta, Indonesia.

Republic of Indonesia. (2018). Second biennial update report. Jakarta, Indonesia.

Republic of Indonesia. (2021). Long-term strategy for low carbon and climate resilience 2050.

Republic of Indonesia. (2022a). Energy transition towards NZE 2060.

Republic of Indonesia. (2022b). Enhanced nationally determined contribution.

**Chapter 4**


Afonso, A., & Jalles, J. T. (2016). Economic performance and government size. Journal of Economic Studies. Leeds, United Kingdom.

Asian Development Bank. (2023). Renewable energy in Southeast Asia. ADB Publications.

Beaton, C., & Lontoh, L. (2010). Lessons learned from Indonesia's attempts to reform fossil fuel subsidies. International Institute for Sustainable Development.

Blanchard, O. (2019). Public debt and low interest rates. American Economic Review. Pittsburgh.

Booth, A. (1998). The Indonesian economy in the nineteenth and twentieth centuries: A history of missed opportunities. Macmillan Press, London, United Kingdom.

Edwards, S. (2005). Is the U.S. current account deficit sustainable? And if not, how costly is adjustment likely to be? Brookings Papers on Economic Activity. Washington, D.C.

Feith, H., & Castles, L. (1970). Indonesian political thinking 1945–1965. Cornell University Press, New York.

Gallagher, K. S., Zhang, F., Orvis, R., Rissman, J., & Liu, Q. (2021). The energy transition in developing countries: A review of trends and opportunities. Energy Policy.

Glassburner, B. (1978). The economy of Indonesia: Selected readings. Cornell University Press, New York.

Green Climate Fund. (2023). Country profile: Indonesia.

Grenville, S. (1981). The Indonesian economy in crisis. Australian National University Press, Canberra, Australia.

Hill, H. (2000). The Indonesian economy. Cambridge University Press, United Kingdom.

International Energy Agency. (2023). Indonesia energy transition.

International Monetary Fund. (2020). Fiscal monitor: Policies for the recovery.

International Monetary Fund. (2021). Indonesia: Selected issues on energy subsidies.

International Renewable Energy Agency. (2022). Renewable energy: A key enabler of economic diversification.

Kumar, M. S., & Woo, J. (2010). Public debt and growth (IMF Working Paper No. 10/174). International Monetary Fund, Washington, D.C.

McCulloch, N., & Timmer, C. P. (2008). Fuel subsidies and the poor: A review of evidence from Indonesia. Bulletin of Indonesian Economic Studies.

McKinsey & Company. (2020). The role of renewable energy in sustainable economic development. McKinsey & Company. Jakarta, Indonesia.

Ministry of Finance of the Republic of Indonesia. (2021). APBN kita: Energy subsidy and compensation details.

Panizza, U., Sturzenegger, F., & Zettelmeyer, J. (2009). The economics and law of sovereign debt and default. Journal of Economic Literature. Pennsylvania.

Prawiro, R. (1998). Indonesia's struggle for economic development: Pragmatism in action. University Press, New York.

Reinhart, C. M., & Rogoff, K. S. (2010). Growth in a time of debt. American Economic Review. Pittsburgh.

Román, M. V., & Arto, I. (2018). Why do some economies benefit more from climate finance than others? A case study on North-to-South financial flows. Economic Systems Research. Virginia.

Sovacool, B. K., Griffiths, S., Kim, J., & Bazilian, M. (2020). Climate change and energy transitions in the Middle East and North Africa. Nature Energy.

World Bank. (2007). Spending for development: Making the most of Indonesia's new opportunities. Washington D.C.

World Bank. (2022). Indonesia Climate Investment Fund project overview.

Zhao, J., Zhou, B., & Li, X. (2022). Do good intentions bring bad results? Climate finance and economic risks. Finance Research Letters.

**Chapter 5**

Asian Development Bank. (2020a). Energy sector assessment, strategy, and road map: Indonesia.

Asian Development Bank. (2020b). Technical assistance consultant's report: Promoting sustainable energy for all in Asia and the Pacific – Renewable energy mini-grids and distributed power generation (Subproject A) (Issue August).

Derks, M., & Romijn, H. (2019). Sustainable performance challenges of rural microgrids: Analysis of incentives and policy framework in Indonesia. Energy for Sustainable Development. Jakarta, Indonesia.

Direktorat Jenderal Ketenagalistrikan. (2023). Statistik ketenagalistrikan tahun 2022 [2022 Electricity statistics].

Indonesian Ministry of Energy and Mineral Resources. (2022). Handbook of energy & economic statistics of Indonesia (HEESI).

International Energy Agency. (2022). Security of clean energy transitions.

International Renewable Energy Agency. (2021a). NDCs and renewable energy targets in 2021: Are we on the right path to a climate-safe future? (Vol. 1).

International Renewable Energy Agency. (2021b). Renewable capacity statistics 2021.

Kementerian Energi dan Sumber Daya Mineral. (2019). Indonesia energy outlook 2019.

Sekretariat Jenderal Dewan Energi Nasional. (2023). Indonesia energy outlook.

United Nations Development Programme. (2020a). The next frontier—Human development and the Anthropocene: UNDP Human Development Report 2020. Environment, 63 (3).

United Nations Development Programme. (2020b). Transition can help deliver the Paris Agreement.

World Bank. (2017). Assessing and measuring the performance of energy efficiency projects (ESMAP Technical Report 011/17). Washington D.C.

World Bank. (2021). Indonesia: Energy Sector Management Assistance Program (ESMAP).

**Chapter 6**

Amri, F. (2019). Renewable and non-renewable categories of energy consumption and trade: Do the development degree and the industrialization degree matter? Energy Policy, Elsevier, Amsterdam, Netherlands.

Apple. (2020). Environmental progress report 2020.

ASEAN Centre for Energy. (2019). Research and development (R&D) on renewable energy in ASEAN. Jakarta, Indonesia.

ASEAN Centre for Energy. (2021). ASEAN plan of action for energy cooperation (APAEC) 2016–2025. Phase II: 2021–2025.

Aslani, A., Helo, P., & Naaranoja, M. (2014). Role of renewable energy policies in energy dependency in Finland: System dynamics approach. Applied Energy, Elsevier, Amsterdam, Netherlands.

Baker, L., & Sovacool, B. (2017). The political economy of technological capabilities and global production networks in South Africa's wind and solar photovoltaic (PV) industries. Political Geography, Elsevier, Amsterdam, Netherlands.

BPS-Statistics Indonesia. (2020). Statistics of Indonesia manufacturing industry.

BPS-Statistics Indonesia. (2022). Greenhouse gas emissions by sector type (thousand tons $CO_2e$), 2000–2019.

British Petroleum. (2021). Statistical review of world energy: Globally consistent data on world energy markets and authoritative publications in the field of energy. BP Energy Outlook.

British Petroleum. (2022). BP statistical review of world energy 2022. BP Energy Outlook.

Bundesministerium für Wirtschaft und Energie. (2021). Energiewende: The energy transition in Germany.

California Energy Commission. (2020). California clean energy almanac.

Canadian Environmental Assessment Agency. (2019). Environmental impact assessment process. Ontario, Canada.

Cargill Indonesia. (2020). Corporate responsibility and sustainable development.

Clean Energy Ministerial. (2020). The Clean Energy Ministerial: Advancing clean energy together.

Danish Energy Agency. (2019). Energy education and training. Denmark.

Dutch Ministry of Infrastructure and Water Management. (2020). Dutch Ministry of Infrastructure and Water Management.

Edwin, M., Nila, J. N., & Nair, M. S. (2023). Chapter 7 - Biofuel production: An initiative of environmentally sound technologies (ESTs) or green technologies. In K. R. Hakeem, S. A. Bandh, F. A. Malla, & M. A. B. Mehmood (Eds.), Environmental sustainability of biofuels (pp. 99–136). Elsevier.

European Commission. (2012). Energy efficiency. Official Journal of the European Union. Brussels, Belgium.

European Commission. (2020). Renewable Energy Directive.

Fraunhofer-Gesellschaft. (2021). Research for the energy transition.

Google. (2021). Sustainability report.

Hapsari, I. (2023). Clean power for Indonesia: Leading the way in the energy transition. Indonesia's energy transition preparedness framework towards 2045.

Indonesia Investment Coordinating Board. (2022). Indonesia sustainable investment guideline.

Indonesian Electric Vehicle Association. (2020). Electric and hybrid vehicles in Indonesian manufacturing.

Indonesian Ministry of Energy and Mineral Resources. (2017). General plan for national energy (RUEN). Jakarta, Indonesia.

Indonesian Ministry of Energy and Mineral Resources. (2021). Handbook: Energy & economic statistics Indonesia.

Indonesian Ministry of Energy and Mineral Resources. (2022). Handbook of energy & economic statistics of Indonesia (HEESI).

Indonesian Ministry of Industry. (2020). Indonesia's national artificial intelligence strategy 2020–2045.

Indonesian Palm Oil Association. (2022). Palm oil industry provides solutions to global energy crisis.

International Energy Agency Bioenergy. (2020). Biomass and bioenergy in Sweden.

International Energy Agency. (2020). Energy efficiency regulations in Indonesia.

International Energy Agency. (2021). Indonesia energy policy review.

International Energy Agency. (2021a). The energy progress report 2021.

International Energy Agency. (2021b). World energy outlook 2021. IEA Publications.

International Energy Agency. (2022). An energy sector roadmap to net zero emissions in Indonesia: Special report.

International Renewable Energy Agency. (2019). Innovation landscape for a renewable-powered future: Solutions to integrate variable renewables. Abu Dhabi, United Arab Emirates.

International Renewable Energy Agency. (2020a). Renewable capacity statistics 2020.

International Renewable Energy Agency. (2020b). Renewable energy policies in a time of transition: Heating and cooling.

International Renewable Energy Agency. (2020c). Rise of renewables in cities: Energy solution for the urban future.

International Renewable Energy Agency. (2022). Indonesia energy transition outlook. In Essential concepts of global environmental governance.

Kementerian Energi dan Sumber Daya Mineral. (2014). Keputusan Menteri ESDM No. 3784 K/12/MEM/2014 tentang harga indeks pasar bahan bakar nabati (biofuel) yang dicampurkan ke dalam jenis bahan bakar minyak tertentu [Ministerial Decree No. 3784 K/12/MEM/2014 regarding the market price index of biofuel mixed into certain types of fuel oil]. Jakarta, Indonesia.

Kementerian Lingkungan Hidup dan Kehutanan, Direktorat Jenderal Pengendalian Perubahan Iklim, & Direktorat Inventarisasi Gas Rumah Kaca dan Monitoring. (2024). Laporan inventarisasi gas rumah kaca (GRK) dan monitoring, pelaporan, verifikasi (MPV) 2023 [Greenhouse gas (GHG) inventory report and monitoring, reporting, verification (MRV) 2023] (Vol. 9).

Kementerian Perindustrian. (2021). Terapkan industri hijau, sektor manufaktur hemat energi hingga Rp3,2 triliun [Implement green industry, manufacturing sector saves energy up to IDR3.2 trillion].

KfW. (2021). KfW renewable energy program.

Koplitz, S. N., Jacob, D. J., Sulprizio, M. P., Myllyvirta, L., & Reid, C. (2017). Burden of disease from rising coal-fired power plant emissions in Southeast Asia. Environmental Science and Technology, 51(9), 5277–5285. Illinois.

Korea Energy Technology Evaluation and Planning. (2020). Korea energy technology evaluation and planning.

Low Carbon Development Indonesia. (2020). Enabling waste to energy conditions for waste management in Indonesia.

Ministry of Economy, Trade, and Industry (METI). (2018). Energy policy of Japan. Tokyo, Japan.

Ministry of Economy, Trade, and Industry (METI). (2023). Energy efficiency subcommittee interim report—Prospects for demand-side energy.

Murray, A., & Skene, K. (2021). Sustainable consumption and production: Challenges and solutions. Springer.

Navigant Research. (2019). Energy as a service market report. Colorado.

Nisa, F. U. (2023). Chapter 12 - Biofuel: A unique solution for the future energy crisis. In K. R. Hakeem, S. A. Bandh, F. A. Malla, & M. A. B. Mehmood (Eds.), Environmental sustainability of biofuels: Prospects and challenges (pp. 219–236). Elsevier.

Pertamina. (2020). PT Pertamina's renewable energy initiatives.

Presiden Republik Indonesia. (2017). Perpres 22 Tahun 2017 RUEN

[Presidential regulation 22 of 2017 on the national energy plan]. LL LN RI 2017. Jakarta, Indonesia.

PwC Indonesia. (2022). Power in Indonesia: Investment and taxation guide.

Sitra. (2019). Leading the cycle: Finnish road map to a circular economy 2016–2025. Helsinki, Finland.

Thailand BOI. (2021). Investment promotion.

U.S. Environmental Protection Agency. (2015). Overview of the clean power plan: Cutting carbon pollution from power plants. In U.S. carbon dioxide emissions: Trends, the role of the clean power plan and FAQs. Washington, D.C..

U.S. Green Building Council. (2021). LEED certification.

UK Department for Business, Energy & Industrial Strategy. (2020). Planning for renewable energy projects.

UK Parliament. (2008). Climate change act 2008. London, United Kingdom.

Unilever Indonesia. (2020). Sustainability report 2020.

Usmani, R. A. (2023). Chapter 10 - Biofuel consumption and global climate change: Solutions and challenges. In K. R. Hakeem, S. A. Bandh, F. A. Malla, & M. A. B. Mehmood (Eds.), Environmental sustainability of biofuels: Prospects and challenges (pp. 183–200). Elsevier.

World Bank. (2019). State and trends of carbon pricing 2019. Washington, D.C.

World Bank. (2022). Indonesia's emission profile.

**Chapter 7**

Dewan Energi Nasional. (2022). Evaluasi capaian bauran energi nasional [Evaluation of the national energy mix achievements].

Dewan Energi Nasional. (2023). Ketahanan energi Indonesia untuk menghadapi perubahan iklim [Indonesia's energy resilience to face climate change].

IDX Carbon. (2024). Monthly report June 2024.

Inflation Reduction Act. (2023). Building a clean energy economy guidebook. U.S. Government.

International Council on Clean Transportation. (2021). Jalur produksi bahan bakar nabati (biofuel) potensial di Indonesia: Gambaran umum tentang proses, bahan baku, dan jenis bahan bakar [Potential biofuel production pathways in Indonesia: An overview of processes, feedstocks, and fuel types].

International Energy Agency. (2023). Inflation Reduction Act of 2022.

International Energy Agency. (n.d.). An energy sector roadmap to net zero emissions in Indonesia.

Kementerian Energi dan Sumber Daya Mineral. (2021). Handbook of energy & economic statistics of Indonesia (HEESI).

Kementerian Energi dan Sumber Daya Mineral. (2022a). Handbook of energy & economic statistics of Indonesia (HEESI).

Kementerian Energi dan Sumber Daya Mineral. (2022b). Laporan kinerja Direktorat Jenderal EBTKE [Performance report of the Directorate General of New Renewable Energy and Energy Conservation].

Kementerian Energi dan Sumber Daya Mineral. (2022c). Statistik migas semester 1 [Oil and gas statistics, first semester].

Kementerian Energi dan Sumber Daya Mineral. (2023, April). Berkat biodiesel, emisi turun 27,8 juta $CO_2$e sepanjang 2022 [Thanks to biodiesel, emissions decreased by 27.8 million $CO_2$e in 2022] (Press release no. 484. Pers/04/SJI/2023).

Kementerian Lingkungan Hidup dan Kehutanan. (2022). Enhanced Nationally Determined Contribution Republic of Indonesia.

Kementerian Lingkungan Hidup dan Kehutanan. (2023, September). Siaran pers No. SP.290/HUMAS/PPIP/HMS.3/09/2023 [Press release].

Percepatan pengembangan energi terbarukan untuk penyediaan tenaga listrik. (2022). Peraturan presiden no. 112 Tahun 2022 [Presidential regulation no. 112 of 2022].

World Economic Forum. (2023). Fostering effective energy transition.

**Chapter 8**

Bank Central Asia. (2023). Annual report 2023 dan laporan NSFR Q4 2023 [2023 Annual report and 2023 NSFR report Q4].

Bank CIMB Niaga. (2023). Annual report 2023 dan laporan NSFR Q4 2023 [2023 Annual report and 2023 NSFR report Q4].

Bank Danamon. (2023). Annual report 2023 dan laporan NSFR Q4 2023 [2023 Annual report and 2023 NSFR report Q4].

Bank HSBC Indonesia. (2023). Annual report 2023 dan laporan NSFR Q4 2023 [2023 Annual report and 2023 NSFR report Q4].

Bank Mandiri. (2023). Annual report 2023 dan laporan NSFR Q4 2023 [2023 Annual report and 2023 NSFR report Q4].

Bank Mayapada International. (2023). Annual report 2023 dan laporan NSFR Q4 2023 [2023 Annual report and 2023 NSFR report Q4].

Bank Maybank Indonesia. (2023). Annual report 2023 dan laporan NSFR Q4 2023 [Annual report 2023 and NSFR report Q4 2023]. Bank Maybank Indonesia.

Bank Mega. (2023). Annual report 2023 dan laporan NSFR Q4 2023 [2023 Annual report and 2023 NSFR report Q4].

Bank Negara Indonesia. (2023). Annual report 2023 dan laporan NSFR Q4 2023 [2023 Annual report and 2023 NSFR report Q4].

Bank OCBC NISP. (2023). Annual report 2023 dan laporan NSFR Q4 2023 [2023 Annual report and 2023 NSFR report Q4].

Bank Pan Indonesia. (2023). Annual report 2023 dan laporan NSFR Q4 2023 [2023 Annual report and 2023 NSFR report Q4].

Bank Permata. (2023). Annual report 2023 dan laporan NSFR Q4 2023 [2023 Annual report and 2023 NSFR report Q4].

Bank Rakyat Indonesia. (2023). Annual report 2023 dan laporan NSFR Q4 2023 [2023 Annual report and 2023 NSFR report Q4].

Bank Syariah Indonesia. (2023). Annual report 2023 dan laporan NSFR Q4 2023 [2023 Annual report and 2023 NSFR report Q4].

Bank Tabungan Negara. (2023). Annual report 2023 dan laporan NSFR Q4 2023 [2023 Annual report and 2023 NSFR report Q4].

Bank Tabungan Pensiunan Nasional. (2023). Annual report 2023 dan laporan NSFR Q4 2023 [2023 Annual report and 2023 NSFR report Q4].

Bank UOB Indonesia. (2023). Annual report 2023 dan laporan NSFR Q4 2023 [2023 Annual report and 2023 NSFR report Q4].

CPI. (2023). Landscape of Indonesia power sector finance [Report].

IESR, Agora Energiewende, & LUT University. (2021). Deep decarbonization of Indonesia’s energy system: A pathway to zero emissions by 2050 [Report].

Intergovernmental Panel on Climate Change. (2006). IPCC guidelines for national greenhouse gas inventories [Guidelines].

International Energy Agency. (2022). An energy sector roadmap to net zero emissions in Indonesia [Report].

International Renewable Energy Agency. (2022). Indonesia energy transition outlook [Report].

Just Energy Transition Partnership. (2023). Comprehensive investment and policy plan 2023 [Report].

Otoritas Jasa Keuangan.  (2017). Indonesia banking statistics 2017 [Report].

Otoritas Jasa Keuangan. (2013). Indonesia banking statistics 2013 [Report].

Otoritas Jasa Keuangan. (2014). Indonesia banking statistics 2014 [Report].

Otoritas Jasa Keuangan. (2015). Indonesia banking statistics 2015 [Report].

Otoritas Jasa Keuangan. (2016). Indonesia banking statistics 2016 [Report].

Otoritas Jasa Keuangan. (2018). Indonesia banking statistics 2018 [Report].

Otoritas Jasa Keuangan. (2019). Indonesia banking statistics 2019 [Report].

Otoritas Jasa Keuangan. (2020). Indonesia banking statistics 2020 [Report].

Otoritas Jasa Keuangan. (2021). Indonesia banking statistics 2021 [Report].

Otoritas Jasa Keuangan. (2022). Indonesia banking statistics 2022 [Report].

Otoritas Jasa Keuangan. (2023). Indonesia banking statistics 2023 [Report].

Republic of Indonesia. (2016). First nationally determined contribution [Report].

Republic of Indonesia. (2018). Second biennial update report [Report].

Republic of Indonesia. (2021). Long-term strategy for low carbon and climate resilience 2050 [Report].

Republic of Indonesia. (2021). Third biennial update report [Report].

Republic of Indonesia. (2022). Energy transition towards NZE 2060 [Report].

Republic of Indonesia. (2022). Enhanced nationally determined contribution [Report].

**Chapter 9**

Allen & Overy & Climate Policy Initiative. (2023). How big is the net zero financing gap [Report].

Antara. (2023). RI butuh investasi 1 triliun dolar AS untuk wujudkan emisi nol bersih 2060 [Indonesia needs $1 trillion investment to achieve net-zero emissions by 2060].

Asian Development Bank. (2022, June). SDG Indonesia One [Report].

Blended Finance Taskforce. (2018). Better finance better world: Consultation paper of the blended finance taskforce [Consultation paper]. Business &

Sustainable Development Commission, London, United Kingdom.

Convention on Biological Diversity. (2023).

Convergence. (2024). State of blended finance 2024 [Report].

Convergence. (n.d.). Blended finance [Report].

Convergence. (n.d.). Design funding [Report].

Embassy of France. (2010). Program perubahan iklim AFD [Climate change program AFD]. Jakarta, Indonesia. https://id.ambafrance.org/Program-perubahan-iklim-AFD-dan, dikunjungi 20 Juli 2024.

G20. (2022). G20 principles to scale up blended finance in developing countries [Report].

International Finance Corporation . (n.d.). How blended finance works [Report].

International Union for Conservation of Nature (2022). IUCN position paper for UNFCCC COP27 [Position paper].

Kementerian Energi dan Sumber Daya Mineral (ESDM). (2023). Sekretariat JETP terbentuk, siap realisasikan kerja sama pendanaan transisi energi [JETP Secretariat formed, ready to implement energy transition funding collaboration].

Kementerian Keuangan. (2024). DPR sahkan UU APBN 2025 [House of Representatives approves the 2025 state budget law].

Kementerian Lingkungan Hidup dan Kehutanan. (2018). SICCR-TAC [Report].

Kementerian Sekretariat Negara. (2024). Rencana pembangunan jangka panjang nasional tahun 2025-2045 [National long-term development plan 2025-2045].

Organisation for Economic Co-operation and Development (OECD). (2018). Making blended finance work for the sustainable development goals [Report]. OECD Publishing, Paris, France.

Pefindo. (2024). PT Adhi Commuter Properti Tbk. Rating summary [Report

Republic of Indonesia. (2021). Indonesia: Biennial update report (BUR) BUR3 [Report].

Republic of Indonesia. (2022). Enhanced nationally determined contribution (ENDC) [Report].

Sarana Multi Infrastruktur (SMI). (n.d.). SDG Indonesia One [Report].

Simanjuntak, S. D. (2024). Indonesia masih butuh Rp280,63 triliun per tahun untuk mitigasi perubahan iklim [Indonesia still needs IDR 280.63 trillion annually for climate change mitigation]. Bisnis Indonesia.

Syahputra, E. (2022). Jokowi: PLTU 5,5 GW akan disetop, kiamat batu bara mendekat [Jokowi: 5.5 GW coal power plants to be stopped, the coal apocalypse approaches].

The World Bank Group & Asian Development Bank. (2021). Climate risk profile: Indonesia (2021) [Report].

United Nations. (2015). Addis Ababa Action Agenda of the Third International Conference on Financing for Development [Report]. United Nations, New York.

United States Agency for International Development. (2020). Blended finance in Indonesia [Report]. USAID. https://pdf.usaid.gov/pdf_docs/PA00XHG7.pdf

World Bank Group. (n.d.). (2021). The economic case for nature [Report].

World Wide Fund for Nature. (2022). Living planet report 2022 [Report].

**Chapter 10**

Ellerman, A. D., Convery, F., & Denny, E. (2010). Pricing carbon: The European Union emissions trading scheme. Cambridge University Press, United Kingdom.

Mesquita, E. B. (2016). Political economy for public policy. Princeton University Press, New Jersey.

Santikarn, M., & World Bank Group. (2021). State and trends of carbon pricing 2021 [Report]. World Bank Group.

Schmalensee, R., & Stavins, R. N. (2017). Lessons learned from three decades of experience with cap and trade. Review of Environmental Economics and Policy. Association of Environmental and Resource Economists, United States.

Siagian, A. P. (2023). Indonesian carbon market: Hope or hype? CSIS Commentaries No. CSISCOM00423 [Report]. Centre for Strategic and International Studies.

Tirole, J. (2017). Economics for the common good. Princeton University Press, New Jersey.

World Bank. (2023). State and trends of carbon pricing 2023 report [Report].

## About the Authors

This book is a compilation of research papers by the following authors. The views expressed in these articles do not reflect the official standpoint of the institutions with which they are affiliated.

### Adrian T. P. Panggabean

Adrian is a senior Indonesian economist and an Independent Director at CIMB Investment Bank in Kuala Lumpur, Malaysia. He is also a regular columnist for various national and international media outlets. Adrian holds a degree from the Faculty of Economics at the University of Indonesia and earned both his Master's and Doctoral degrees from the University of Birmingham, UK. He began his career as a lecturer at the University of Indonesia's Faculty of Economics. He went on to spend 25 of his 35 years of professional experience in the financial and investment industry, both domestically and abroad. His previous roles included being an economist at the UNDP Indonesia Country Office, Nomura Singapore, and the Asian Development Bank. He also served as an economic adviser in the Office of the Prime Minister of Brunei Darussalam for five years.

Upon returning to Indonesia, Adrian held senior positions as director and later CEO at several investment firms, as well as Chief Economist and Treasury Strategist at Bank CIMB Niaga. He currently works as a consultant for various multilateral institutions and international financial companies.

### Akhmad R. Shidiq

An alumnus of the Faculty of Economics at the University of Indonesia, he holds a Doctoral degree and currently teaches economics at the Leiden Institute of Area Studies, at the Leiden University, in the Netherlands, specializing in development economics. In Leiden, he primarily teaches courses on Southeast Asian Economies and Economic Development and Social Change in Southeast Asia. He has also extensively researched various topics, including political economy, trade, and poverty. His current research focuses on the impact of political connections on economic efficiency and carbon trading in Indonesia.

**Albertus P. Siagian**

Albertus is known as an economist at the Climate Policy Initiative. He earned his Bachelor's degree in economics from the Faculty of Economics at the University of Indonesia and a Master's in environmental economics from the Department of Geography at the London School of Economics, UK. He also holds an Expert on Climate and Renewable Energy Finance certification from the Frankfurt School of Finance. Prior to his current role, Albertus worked as an energy market researcher at the Boston Consulting Group. Throughout his career, his insights have been cited in national newspapers on several occasions. His publications include opinion pieces and monographs on renewable energy and carbon markets. He also leads the *EKONIKLIM* podcast on YouTube, which features economic and financial perspectives on Indonesia's energy transition agenda.

**Andreas N. Tjendro**

Andreas is a senior practitioner in corporate banking, risk management, and banking transformation in Southeast Asia. He has led strategic projects at DBS (Singapore), CIMB Niaga (Indonesia), and UOB (Indonesia) and he has over a decade of professional experience in Singapore. After a 17-year career in the banking sector, he founded a consulting practice serving multilateral banks, commercial banks, and fintech companies. Andreas holds the Chartered Financial Analyst (CFA) designation from the CFA Institute and the Financial Risk Manager (FRM) certification from GARP in the United States. He earned a Bachelor's degree in engineering from Nanyang Technological University, Singapore, and an LL.B. in Law from the University of London, UK. His current interests include climate change, artificial intelligence, and blockchain technology.

**Fadli Rahman**

Fadli is the Strategic Planning and Business Development Director at Pertamina New and Renewable Energy. He holds a Bachelor's degree in petroleum engineering from the Bandung Institute of Technology (ITB). He earned both his Master's and Doctoral degrees in mineral and energy economics from the Colorado School of Mines in the United States. Fadli has held various roles at the Ministry of State-Owned Enterprises, served as Commissioner of Pertamina Hulu Energi, and brings extensive industry experience as a former Principal at the Boston Consulting Group, Senior Field Engineer at Schlumberger, and Reservoir Engineer at ConocoPhillips.

**Martin D. Siyaranamual**

Martin is a graduate of and lecturer at the Faculty of Economics, Universitas Padjadjaran. He earned his Doctoral degree in economics from Ca' Foscari University of Venice, Italy. Martin is an economist who focuses on sustainable development issues. With experience as both an academic and an advisor to government and private sector entities, he has contributed to formulating policies for inclusive growth and sustainable infrastructure. Martin firmly believes that empirical research must be grounded in sound theory and theoretical research must be rooted in real-world conditions, ensuring that policy recommendations are theoretically robust and practically relevant.

**Naila Firdausi**

Formerly a journalist at Bloomberg, Naila now works at one of Indonesia's largest investment management firms. As a capital market practitioner, she actively participates in forums on sustainable finance and Islamic investing across Indonesia and Southeast Asia. An alumna of the Faculty of Economics and Business at the University of Indonesia, Naila holds a Capital Market Sharia Expert license from Indonesia's Financial Services Authority (OJK). She is also a Chartered Financial Analyst (CFA) charter holder and earned a Master's degree in leadership in sustainable finance from the Frankfurt School of Finance & Management in Germany.

**Wisnu Wibisono**

Before joining the Asia Investor Group on Climate Change (AIGCC) as the Project Lead for Nature, Forest, and Land Use, Wisnu Wibisono was the Sustainable Finance Engagement Manager at the Carbon Disclosure Project (CDP).

Before transitioning into environmental consulting, Wisnu began his career as a Forex Product Manager at Commonwealth Bank Indonesia. He holds a Bachelor's degree from the Bandung Institute of Technology (ITB) and a Master's degree (M.Sc.) in environmental science from Wageningen University in the Netherlands.

He is a Chartered Financial Analyst (CFA) charter holder and holds the CFA Institute Certificate in ESG Investing.

**Sugiharso Safuan**

Sugiharso Safuan is a Professor in the Department of Economics at the University of Indonesia. He earned his Bachelor’s degree from Bogor Agricultural University, a Master’s degree in economics from the University of Indonesia, and a Ph.D. in economics from the University of Southampton, UK. His areas of expertise include monetary economics, labor markets, financial inclusion, and the digital economy, with research focusing on macroeconomic policy, exchange rates, and sustainable finance. Actively engaged in academic and policy discussions, he explores various topics, such as monetary policy transmission, ASEAN integration, and ESG, while advocating for collaborative research to address contemporary economic challenges.

**Adrian T.P. Panggabean**

A senior Indonesian economist and a graduate of the University of Indonesia and the University of Birmingham. He spent 25 of his 35-year career in the national and international financial industry. He currently works as a consultant for various multilateral institutions and global financial companies.

**Albertus P. Siagian**

An economist at the Climate Policy Initiative and a graduate of the University of Indonesia and the London School of Economics. He also holds an Expert on Climate and Renewable Energy Finance certification from the Frankfurt School of Finance. As the producer of the *EKONIKLIM* podcast, his views have been featured in several national media outlets.