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To cite this article: Budy P. Resosudarmo, Jahen F. Rezki & Yuventus Effendi (2023) Prospects of Energy Transition in Indonesia, *Bulletin of Indonesian Economic Studies*, 59:2, 149-177, DOI: [10.1080/00074918.2023.2238336](https://doi.org/10.1080/00074918.2023.2238336)

To link to this article: <https://doi.org/10.1080/00074918.2023.2238336>



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Published online: 25 Aug 2023.



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Survey of Recent Developments

PROSPECTS OF ENERGY TRANSITION IN INDONESIA

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The Indonesian government has submitted its plan for nationally determined contributions (NDCs) to the United Nations and has committed to achieving net-zero emissions (NZE) by 2060. While looking to reduce emissions from forestry, the government has prioritised a transition to renewable energy in the energy sector. However, Indonesia faces challenges owing to its lower-middle-income status, limited budgets and constraints in attracting international finance. This paper aims to assess Indonesia's potential for realising its energy transition goals. It evaluates the country's economic strength, past experiences in energy transition and the current status of ongoing initiatives. It concludes that significant progress is possible, but achieving NZEs by 2060 remains a major challenge.

Keywords: *climate change policy, energy transition, climate finance, carbon market, Indonesian economy*

JEL classifications: Q54, Q58, Q42, Q48

INTRODUCTION

Since the 15th session of the Conference of the Parties (COP15) to the United Nations Framework Convention on Climate Change (UNFCCC) in 2009, the Indonesian government has been committed to reducing its greenhouse gas (GHG) emissions and meeting the targets set as part of its intended nationally determined contributions (NDCs). Set under the UNFCCC, these targets have been repeatedly revised, reflecting the country's evolving circumstances. Before COP27 in 2022, the government announced its enhanced NDCs. As part of these, it committed to reducing the country's annual emissions by 31.9% by 2030 compared with the business-as-usual (BAU) projections, which were based on national economic growth before the mid-2010s. The government hopes to achieve these reductions mainly by reducing deforestation, forest degradation and emissions from the energy sector. With

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ISSN 0007-4918 print/ISSN 1472-7234 online/18/000149-77
<http://dx.doi.org/10.1080/00074918.2023.2238336>

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TABLE 1 *Indonesia’s Nationally Determined Contributions (MTCO2e and %)*

	First NDC (2010–30)		Updated		Enhanced	
	2016		2021		2022	
	GHG emissions in 2030 (BAU)	GHG emission reduction from the BAU level by 2030				
CM1		CM2	CM2	CM1	CM2	
Energy	1,669	314	398	446	358	446
		10.90%	13.90%	15.50%	12.50%	15.50%
Waste	296	11	26	40	40	43.5
		0.40%	0.90%	1.40%	1.40%	1.50%
Industry processes and product uses	70	3	3.25	3.25	7	9
		0.10%	0.10%	0.10%	0.20%	0.30%
Agriculture	120	9	4	4	10	12
		0.30%	0.10%	0.10%	0.30%	0.40%
Forestry and other land uses	714	497	650	692	500	729
		17.30%	22.70%	24.10%	17.40%	25.40%
Total	2,869	834	1,081	1,185	915	1,240
		29%	38%	41%	31.90%	43.20%

Source: unfccc.int (2010, 2016, 2021, 2022).

Note: MTCO2e = metric tonnes of carbon dioxide equivalent. CM1 = counter measure 1 (without international support). CM2 = counter measure 2 (with international support).

international support, however, Indonesia has the potential to achieve emissions reductions of up to 43.2%.¹

Table 1 details the government’s NDC targets, highlighting the specific emission reductions planned for each sector. Comparing the targets shows that the government is determined to accelerate its emission reductions in the energy sector to surpass the BAU levels.

We must, however, acknowledge that changes in the actual economic growth compared with the BAU projections would affect the emission reductions needed to achieve the NDC goals (Pramita 2022; Basri and Riefky 2023). In the case of Indonesia, its economic growth since the mid-2010s has been lower than first predicted under the BAU scenario, mainly owing to the commodity bust and the effects of the Covid-19 pandemic. Consequently, this lower economic growth trajectory suggests that a smaller emission reduction is needed to meet the targets of the NDCs. This could be a factor behind the government’s decision to elevate its targets in the enhanced NDCs.

1. This generally necessitates significant international funding.

The government, however, has also made a commitment independent of any projected BAU scenarios. During COP26 in 2021, Indonesia's leaders, alongside those from other nations, pledged to achieve net-zero emissions (NZE) by 2060 or earlier, aiming to limit the rise in global temperatures to 1.5 degrees Celsius above pre-industrial levels. Irrespective of Indonesia's future economic growth, the government appears determined to significantly reduce carbon emissions.

Achieving NZEs by 2060 presents significant challenges for Indonesia, given its budget constraints and aspirations to become a high-income country by the early 2040s (Bappenas 2019). As of 2018, Indonesia was among the top 10 carbon emitters in the world, with net emissions of almost 2,000 metric tonnes per year, accounting for about 4% globally. The energy sector alone contributed about 650 metric tonnes, or 1.7% of global emissions from the energy sector (Friedrich, Pickens and Vigna 2023).

While the difficulties of reducing emissions from deforestation and forest degradation have been discussed extensively (Sunderlin et al. 2018; Dwisatrio et al. 2021; Resosudarmo, Tacconi and Waluyo 2023), few studies explore the energy transition required, particularly for achieving NZE in the power sector by 2060. This is a crucial issue because Indonesia must have affordable energy to improve its welfare and achieve the economic growth needed to reach high-income status.

Indonesia will need large financial resources to achieve NZEs by 2060, or earlier, through the energy transition. To secure the necessary funding, Indonesia must develop robust financial systems combining domestic resources, international loans and carbon market mechanisms. Whether Indonesia will successfully secure the required funding for the energy transition remains uncertain. However, the government appears optimistic that its commitments to the energy transition will attract investment in the country (*Kompas* 2023).

This paper explores the potential for Indonesia to achieve NZEs by 2060, with a focus on funding needs and the shift to renewable energy sources. The analysis begins by evaluating the economic strength of Indonesia, considering its capacity to mobilise domestic resources and secure international loans to finance the energy transition. It then outlines Indonesia's energy transition goals and assesses the historical progress made in adopting renewable and low-carbon energy sources, particularly within the power plant sector. Additionally, it examines the ongoing development of financial mechanisms such as the Energy Transition Mechanism (ETM) Country Platform, the Indonesian Just Energy Transition Partnership (JETP-Indonesia) between Indonesia and other economies, and programs related to the carbon market and pricing, which are crucial for generating funds to support the energy transition targets.

ECONOMIC ENVIRONMENT

Since the outbreak of Covid-19 in 2020, the Indonesian economy has shown signs of improvement, with economic growth returning to or exceeding the levels typically seen before the pandemic. After falling to about -2.0% in 2020, the economic growth rate bounced back to above 7% in the first quarter of 2021. The economy then grew by more than 5% in each quarter of 2022. Through the first quarter of 2023, the growth rate remained robust, at more than 5% (BPS 2023a)—similar to the levels seen before the pandemic (Burke and Siyaranamual 2019). A report by

the World Bank (2022) suggests that commodity windfalls and the reopening of the economy have aided this recovery.

Despite the robust economic recovery in Indonesia, concerns have arisen regarding whether the recent performance of the economy has been strong enough to support an ambitious energy transition. To address this question, we examine Indonesia's economic performance before and after the pandemic. This involves analysing the drivers of current economic growth trends, inflationary pressure, trade balance improvement and government spending expansion.

Economic Growth

Let us start by examining Indonesia's recovery from the Covid-19 economic shock. Table 2 shows the year-on-year quarterly growth rates of GDP in the past year in comparison with the average during the pre-pandemic period of 2017–19. This shows that the GDP growth rate began to rebound in the second quarter of 2021 and had nearly returned to the pre-pandemic trends by the fourth quarter of 2021.

Consumption and investment were the main drivers of the Indonesian economy, with their shares in GDP remaining stable at about 60% and 30%, respectively. However, the growth rates of these drivers have fluctuated post-pandemic, showing a declining trend. During 2017–19, the average year-on-year quarterly growth rate of consumption was about 4.9%, which is considerably higher than the average in 2022. Although the rate in the first quarter of 2023 reached 4.5%, it still fell short of the pre-pandemic level.

The slowdown in consumption in 2022 was likely due to the large contraction in government spending since the first quarter of 2022. This contraction aligns with the government's pursuit of fiscal consolidation to maintain a budget deficit of below 3% of GDP in 2023. Another possible factor, as highlighted by Al Izzati, Yusrina and Suryahadi (2023), is the increase in energy prices due to the reduction in fuel subsidies in September 2022. This led to a price increase of more than 30% for Pertalite fuel and about 16% for Pertamax, resulting in decreased fuel consumption. Nonetheless, in the first quarter of 2023, overall consumption accelerated as government spending recovered.

Investment, represented by gross fixed capital formation (GFCF) in table 2, has also underperformed since 2022. During 2017–19, the average year-on-year quarterly growth rate for GFCF was 5.8%. Growth has failed to reach that level since the first quarter of 2022 and reached only 2.1% in the first quarter of 2023. However, since the second quarter of 2022, there has been relatively high year-on-year growth in vehicle-related investment, which peaked at 24.1% in the first quarter of 2023. Nevertheless, this increased investment in the vehicle sector could not compensate for the investment contraction in buildings and structures, as well as in other equipment since 2022. In the first quarter of 2023, the growth rate of investment in buildings and structures was 0.3%, while the rate for other equipment was negative.

Looking at the sectoral components of GDP, we see that the average year-on-year quarterly growth rate of tradable goods and services in 2022 was slightly higher than the average in 2017–19 (table 2). However, the growth rate declined to 3.3% in the first quarter of 2023. The positive growth in the tradable sectors can be attributed mainly to the resurgence of the mining and quarrying sectors, driven by high demand and prices for commodities, particularly coal. Notably, the International Energy Agency (IEA 2022a) reported an increasing trend in coal demand, driven by rising needs from Europe, India, and China.

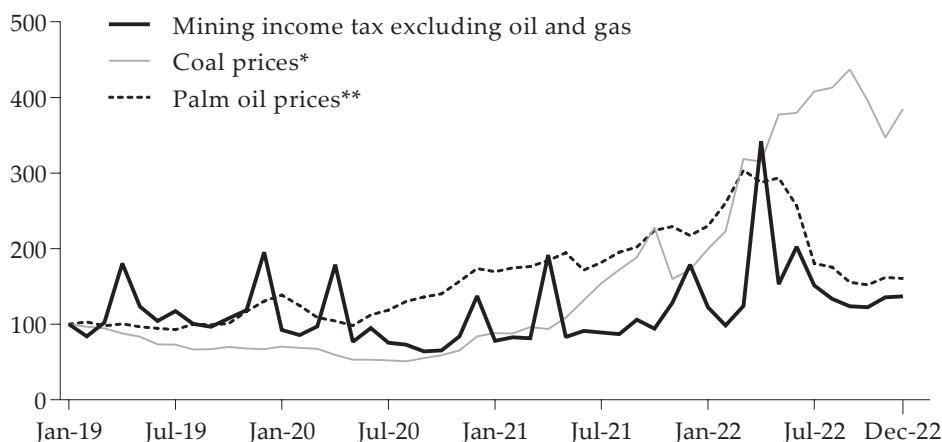
TABLE 2 *Components of GDP Growth (2010 prices, % year-on-year)*

	Average	2021				2022				2023
	2017–19	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
GDP	5.1	-0.7	7.1	3.5	5.0	5.0	5.5	5.7	5.0	5.0
By expenditure										
Consumption	4.9	-1.8	6.2	1.0	3.8	3.3	4.2	4.3	3.0	4.5
Private	5.0	-2.2	6.0	1.0	3.6	4.3	5.5	5.4	4.5	4.5
Government consumption	3.5	2.6	8.2	0.6	5.3	-6.6	-4.6	-2.6	-4.8	4.0
Gross fixed capital formation	5.8	-0.2	7.5	3.8	4.5	4.1	3.1	5.0	3.3	2.1
Building and structures	5.7	-0.7	4.4	3.4	2.5	2.6	0.9	0.1	0.1	0.1
Machine and equipment	11.5	3.5	19.0	11.5	13.5	19.2	16.3	36.5	18.4	4.6
Vehicles	4.8	2.1	42.4	9.0	3.6	0.3	7.0	17.1	17.1	24.1
Other equipment	5.0	-4.9	36.7	10.0	3.4	6.0	-4.3	0.1	-2.7	-5.3
Others	1.5	-0.5	2.1	-4.9	12.2	0.4	5.0	3.1	3.5	3.8
Export	5.0	2.2	28.4	20.7	22.2	14.2	16.4	19.4	14.9	11.7
Import	4.4	5.2	33.2	31.1	32.6	16.0	12.7	25.4	6.3	2.8
By sector										
Tradable	3.5	-0.1	4.3	3.6	4.2	3.6	3.2	3.6	5.5	3.3
Agriculture	3.8	3.5	0.6	1.4	2.3	1.2	1.7	2.0	4.5	0.3
Mining and quarrying	1.4	-2.0	5.2	7.8	5.2	3.8	4.0	3.2	6.5	4.9
Manufacturing	4.1	-1.4	6.6	3.7	4.9	5.1	4.0	4.8	5.6	4.4
Non-tradable	6.0	-1.6	9.2	2.5	4.1	5.3	5.0	6.5	5.9	5.0
Electricity, water and gas	9.3	-13.3	-4.5	-3.3	5.9	12.4	13.7	8.1	3.6	-0.1
Construction	6.2	-0.8	4.4	3.8	3.9	4.8	1.0	0.6	1.6	0.3
Trade, hotel and restaurant	4.9	-2.4	11.5	4.2	5.4	5.9	5.4	7.4	7.9	6.1
Transport and communication	8.1	-0.4	12.9	3.2	6.9	10.3	12.9	13.7	11.9	10.5
Finance, real estate and company	5.8	-2.4	6.7	3.0	0.2	3.2	3.0	2.7	4.0	3.5
Services	6.0	-1.9	9.2	-2.9	2.9	1.3	1.7	6.9	3.1	3.5

Source: BPS through CEIC (<https://www.ceicdata.com/en>).

In Europe, the conflict between Russia and Ukraine resulted in a reduction in natural gas sales to Europe, prompting the region to substitute gas with coal for electricity generation. This contributed to an increase in the demand for coal. Additionally, in India and China, the demand for coal grew significantly owing to the countries' ongoing economic growth (IEA 2022a). IEA (2023) predicts that renewable electrical capacity in the member states of the European Union will double during 2022–27 owing to energy security concerns.

The non-tradable goods and services sector exhibited slightly lower average growth rates in 2022 compared with the rates seen during 2017–19. Furthermore, this growth waned to reach only 5.0% in 2023. Among the subsectors, the trade, hotel and restaurant sector has recovered strongly from the initial pandemic shock, as has the transport and communication sector, particularly from the fourth quarter of 2021 onwards. Conversely, the performance of sectors such as utilities; construction; finance, real estate and company; and services indicates that the economy has

FIGURE 1 *Prices of Coal and Palm Oil, and Tax Revenue from Mining Income*

Source: World Bank and BPS (<https://www.bps.go.id>).

Note: Levels in 2019 are indexed to 100. The tax revenue excludes oil and gas income tax revenue.

* Free-on-board coal prices at Newcastle, Australia. ** Free-on-board palm oil prices, Malaysia.

not fully rebounded. These sectors, in general, have been growing more slowly than before the pandemic. The varying growth across non-tradable sectors suggests a complex recovery process with sector-specific challenges. While some sectors have shown resilience and regained momentum, others continue to face hurdles in achieving pre-pandemic growth levels.

A promising development has been the performance of net exports. The year-on-year quarterly growth rates of exports have been in double digits since the second quarter of 2021, although showing a declining trend. In the third quarter of 2023, the growth rate reached 11.7%, much higher than the rate of imports (2.8%). According to the World Bank (2023a), the strong results in Indonesian trade since the second quarter of 2021 can be attributed to surging commodity prices, particularly for coal and palm oil (figure 1). The World Bank recorded that the global coal price almost quadrupled from January 2019 to December 2022, rising from about \$99 per metric tonne to about \$379 per metric tonne. Coal prices had begun to rise in 2021 following the Russian invasion of Ukraine (World Bank 2023b). Similarly, the price of palm oil in December 2022 had risen by 60% compared with January 2019. The price rise began with an increase of more than 30% in January 2020 compared with January 2019. By the end of 2021, the price had doubled, before it then declined in 2022. A study by Halimatussadiyah et al. (2022) asserts that the palm oil price had a significant impact on the agricultural sector in Indonesia, resulting in increased output and export values, and an improved trade balance.

Regional growth patterns show that Sumatra, Kalimantan and Eastern Indonesia, encompassing Nusa Tenggara, Maluku Islands and Papua, have benefited from the commodity boom, which has contributed to their recovery (table 3). Their growth rates in 2022 have been higher than during 2017–19. Java, with a contribution of almost 60% of national GDP, has largely sustained the country's growth momentum and is heading towards pre-pandemic levels of growth. In the fourth quarter of 2022 and the first of 2023, Java produced year-on-year quarterly growth rates of

TABLE 3 *Growth in Gross Regional Domestic Product (2010 prices, % year-on-year)*

	Average	2021					2022				2023
	2017–19	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	
Sumatra	4.5	-0.8	5.3	3.8	4.6	4.1	5.0	4.7	5.0	4.8	
Java	5.6	-1.1	7.8	3.0	4.7	5.0	5.6	5.8	4.8	5.0	
Kalimantan	4.4	-2.3	6.3	4.7	4.5	3.5	4.5	5.7	6.0	5.8	
Sulawesi	7.6	1.4	8.8	4.8	7.7	5.5	6.5	8.2	7.8	7.0	
Eastern Indonesia	1.7	5.4	7.3	6.8	9.1	8.5	9.9	6.8	4.7	2.6	

Source: BPS through CEIC (<https://www.ceicdata.com/en>)

4.8% and 5%, respectively. Before the pandemic, the average year-on-year quarterly growth rate on the island was about 5.6%.

Meanwhile, the economic growth of Sulawesi has fluctuated significantly. In this region, the economic recovery of Gorontalo and North Sulawesi has faced challenges, while the economy of Central Sulawesi has grown strongly, at a rate of about 15.2% in 2022. Remarkably, even during the pandemic, in 2020 and 2021, Central Sulawesi's economy grew by 4.9% and 11.7%, respectively, owing to the development of the smelting industry, particularly in the Morowali *kabupaten* (district).

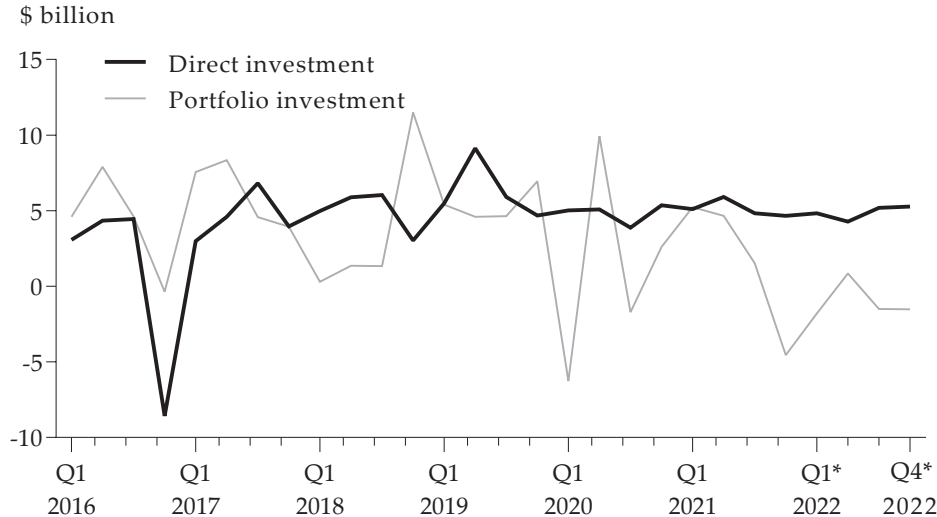
Overall, we can confirm that the Indonesian economy has been showing signs of recovery. The main driver behind this has been the growth in commodity exports. However, as of the first quarter of 2023, economic growth had not yet fully returned to the levels seen before the pandemic, particularly in the non-tradable goods sectors and in Java. This raises concerns, as both private consumption and investment, which are the two largest components of GDP expenditure, have tended to decline.

External Factors

In 2023, Indonesia faces a possible trade slowdown owing to declining commodity prices, geoeconomic fragmentation and a weakened global trade outlook. Export growth decreased by three percentage points in the first quarter of 2023 compared with the fourth quarter of 2022. This decline can be attributed to a 4.8% reduction in the nominal term of oil and gas exports in March 2023 compared with March 2022. Furthermore, non-oil and gas exports declined by 11.7% nominally in the same period (BPS 2023b). These reductions indicate a potential trade slowdown for Indonesia, driven by decreasing commodity prices, particularly for coal and palm oil, which are projected to fall by 42% and 23%, respectively, in 2023 (World Bank 2023a).

The rivalry between the United States and China has presented additional challenges. The contention has led to trade and investment restrictions, which appear to have caused geoeconomic fragmentation and varying degrees of global economic loss. In scenarios where the fragmentation is limited and adjustment costs are low, the loss could amount to 0.2% of global GDP. However, in cases of severe fragmentation, with high-cost adjustment, the loss could be as much as 7% of global GDP (Aiyar et al. 2023). Similarly, Bolhuis, Chen and Kett (2023) argue that geoeconomic fragmentation could reduce real GDP by 4.2% for advanced economies and by

FIGURE 2 *Direct Investment and Portfolio Investment*



Source: Bank Indonesia (<https://www.bi.go.id/id/statistik/default.aspx>).

Note: * Provisional.

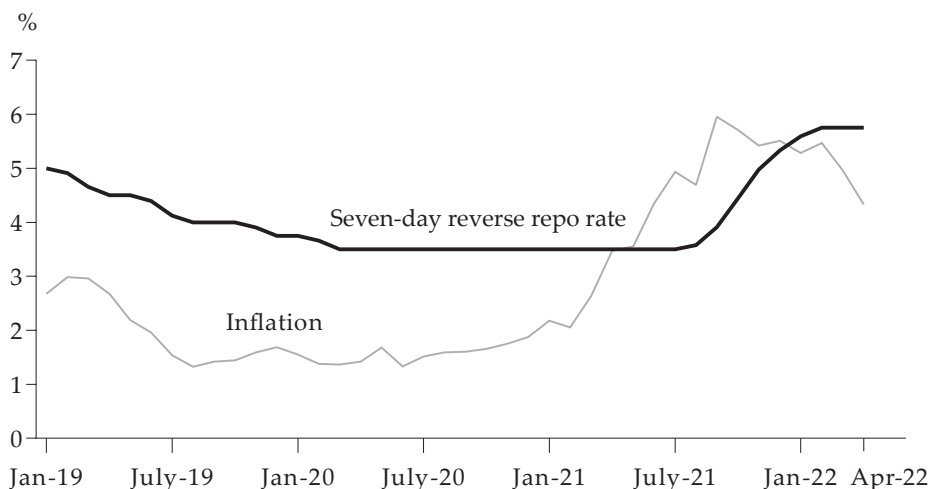
5.2% for emerging economies. In contrast, low-income countries may experience a GDP contraction of 10.8%. Notably, Indonesia is not immune to the effects of geoeconomic fragmentation.

In addition to these concerns, a report by the World Trade Organization (WTO 2023) highlights a below-par global trade outlook. The projected trade growth for the year is estimated to slow down to 1.7%. The fourth quarter of 2022 already produced a slump influenced by factors such as the ongoing war in Ukraine, high inflation rates, tighter monetary policies and financial uncertainty.

These factors pose risks to Indonesia’s trade performance and contribute to the weakened global trade outlook. The reduction in exports, particularly in the oil and gas and non-oil and gas sectors, combined with the challenging global trade environment, indicates a potential trade slowdown for Indonesia in 2023.

Regarding investment and capital movement, recent years have shown relatively stable levels of direct investment, while portfolio investment has fluctuated significantly, especially after the onset of the pandemic (figure 2). In 2023, capital outflow from Indonesia is projected to continue owing to relatively high interest rates in the United States and Europe. The IMF (2023a) expects the policy rate to reach slightly more than 5%, according to the median projection of participants in the Federal Open Market Committee. Moreover, Europe may experience high interest rates owing to the risk of higher and persistent inflationary pressures resulting from increases in energy prices in 2023 (IMF 2023b).

It has been argued that Indonesia can mitigate the potential trade and investment slowdown by actively participating in the global value chain through negotiating limited free trade agreements (FTAs) that focus on critical minerals for the country and developing the value chain for electric vehicles and batteries (Aswicahyono 2023). It is worth noting that these trade agreements and down-stream supply chain strategies may have unintended costs in certain sectors.

FIGURE 3 *Inflation (year-on-year) and the Interest Rate (% per year)*

Source: Bank Indonesia (<https://www.bi.go.id/id/statistik/default.aspx>) and BPS through CEIC (<https://www.ceicdata.com/en>).

Internal Factors

Inflation and Interest Rates

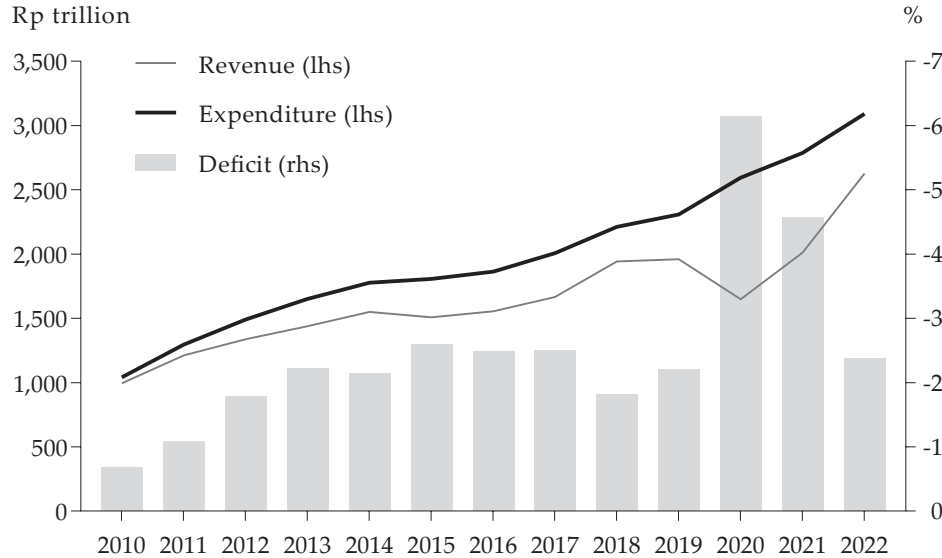
Relatively low inflation in 2021 and mid-2022 allowed Bank Indonesia, the country's central bank, to keep its policy interest rate low (Suroyo and Christina 2021). This reduced borrowing costs for both Indonesian businesses and individuals, ultimately supporting economic growth in the country. Furthermore, the benchmark interest rate in Indonesia, known as the seven-day reverse repo rate, was reduced to 3.50% in March 2021. Remarkably, this rate remained unchanged until August 2022. However, from August 2022, the rate was adjusted to respond to inflationary pressures. By the end of 2022, the interest rate had been raised to 5.5% (figure 3).

Looking ahead to 2023, Bank Indonesia has set a target inflation rate of 3%, plus or minus 1% of deviation. This means that the central bank aims to maintain inflation within the range of 2%–4%. Furthermore, there are forecasts indicating that the interest rate will be adjusted upwards. This suggests that Bank Indonesia may increase the policy rate in response to evolving economic conditions and inflationary pressures.

Fiscal Policy

In general, despite the pandemic in the past three years, the government's budget position has been robust with a manageable deficit (figure 4). In 2020, there was a significant fall in government revenue. Conversely, the government spent more during the early stages of the pandemic than in previous fiscal years. As a result, in 2020, the budget deficit reached around 6% of GDP. Nonetheless, the government managed to increase revenue and narrow the budget deficit to 4.5% of GDP in 2021 and 2.2% of GDP in 2022.

FIGURE 4 *Government Budget*



Source: BPS through CEIC (<https://www.ceicdata.com/en>).

The improvement in revenue in late 2021 and mid-2022 can be attributed to the reopening of the economy and to the commodity boom. The reopening was evident through strong private consumption, particularly in the trade, hotel and restaurant sector, and the transport and communication sector (table 2). Additionally, a report by the Asian Development Bank (ADB 2023) states that robust consumer spending has accelerated economic growth in Indonesia. Revenue collection also benefited from the commodity boom, particularly in palm oil and coal, which began in 2020 and 2021. As a result, in the first quarter of 2022, income tax revenue from non-oil and gas mining had more than tripled compared with the revenue in 2019 (figure 1). Similarly, non-tax revenue from this sector surged in 2021 and 2022. Consequently, the commodity boom bolstered the collection of both tax and non-tax revenue by the government. However, such dependency on the current geoeconomic fragmentation could pose risks. A slowdown in the commodity boom, for example, could threaten national revenue.

Regarding expenditure, the government plans to increase spending by 12.7% in nominal terms in 2023. However, it will cut spending in two main accounts: health by 30% and social protection by 4.2%. These reductions are mainly due to the high base values in 2021 and 2022. For example, in 2022, the government allocated more than 7% of its expenditure to the health sector and more than 13% to social protection. The reductions in these accounts also reflect the easing of the pandemic’s impact on the economy (Ministry of Finance 2022b).

In 2023, the Indonesian government’s focus is to achieve fiscal consolidation and produce a budget deficit below 3% of GDP, as mandated under Law 17/2003. The budget deficit is expected to be about 2.6%–2.9% of GDP, as revenue is projected to range between Rp 2,267 trillion and Rp 2,399 trillion, while expenditure is estimated

to be between about Rp 2,796 trillion and Rp 2,993 trillion (Ministry of Finance 2022b). Nevertheless, despite efforts to reduce the deficit, the budget will continue to prioritise human resource development through investments in education.

DEVELOPMENT OF RENEWABLE ENERGY

Targets of Energy Transition

After announcing its intended NDCs in 2009,² the government set targets for the country's energy transition under Government Regulation 79/2014 on National Energy Policy. The targets include:

- increasing the contribution of renewable energy to the mix of total energy consumption to 23% by 2025 and at least 31% by 2050
- reducing the contribution of oil to the mix to less than 25% by 2025 and less than 20% by 2050
- controlling the use of coal to contribute a minimum of 30% to the mix by 2050 and a minimum of 25% by 2050
- controlling the use of gas to contribute a minimum of 22% to mix by 2050 and a minimum of 24% by 2050.

At the time of writing, Regulation 79/2014 remains in effect as the highest regulation outlining the government's energy transition target. This document outlines three main strategies to achieve the targets: constructing additional power plants for renewable energy, reducing dependence on non-renewable energy sources, and enhancing energy efficiency by improving energy intensity. However, the implementation of any of these strategies is likely to face significant challenges, and immediate results should not be expected (Wahyuni and Ardiansyah 2022).

After the government committed in 2021 to achieving NZE by 2060, it was urged to develop a comprehensive roadmap for the energy transition that extends beyond the targets specified in Regulation 79/2014. Various ministries and agencies have been involved in producing roadmaps, although their plans are not uniform and continue to undergo revisions. While most roadmaps outline a possible pathway towards NZE by 2060, none of them yet claim to be the definitive strategy (IEA 2022c). Notably, the National Energy Council (DEN) released its roadmap for the energy transition in January 2023, which provides insights into the envisioned trajectory (table 4).

The DEN roadmap emphasises the intended steps towards energy transition on both the supply side and demand side. The first priority is to increase the share of renewable energy sources and develop nuclear power plants for the supply side. Then, addressing demand, the roadmap highlights steps in the energy transition for transport and for household cooking sectors. For Indonesia to meet these ambitious supply and demand targets, a robust economy is vital, especially considering the currently low contribution of renewables to the energy supply and the almost complete lack of infrastructure for electric and hydrogen vehicles. Moreover, the

2. For more, see https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Indonesia/1/INDC_REPUBLIC%20OF%20INDONESIA.pdf.

TABLE 4 DEN Roadmap for Energy Transition (presented January 2023)

2025	2030	2035
Supply side	Supply side	Supply side
Renewable energy is 23% of the total energy mix	Renewable energy is 25% of the total energy mix Gas and renewable energy replaces 50% of diesel power plants	Renewable energy is 30%–31% of the total energy mix Diesel power plants are abolished Retirement of coal power plants enters phase one Nuclear power plants generating up to 2 gigawatts are in use
Demand side	Demand side	Demand side
Gas is piped to 5 million households Induction cookers are used in 2 million households Electric cars total 1 million Electric motorcycles total 6 million	Gas is piped to 5.8 million households Induction cookers are used in 5 million households Dimethyl ether is used in households Electric cars total 5.5 million Electric motorcycles total 8.5 million	Gas is piped to 10.8 million households Induction cookers are used in 10 million households Electric cars total 6.7 million to 7.3 million Electric motorcycles total 28.5 million to 30.2 million Electric buses total 219,000 Electric trucks total 595,000 Gas fuel powers 500,000 cars and 300 ships Hydrogen trucks total 245,000
Gas fuel powers 200,000 cars and 100 ships Fuel must be B30 blend	Gas fuel powers 440,000 cars and 257 ships	

	2040	2050	2060
	Supply side	Supply side	Supply side
	Renewable energy is 36%–38% of total energy mix	Renewable energy is 53%–54% of total energy mix	Renewable energy is 62%–63% of total energy mix
	Retirement of coal power plants enters phase two		Carbon capture, utilisation and storage technology is installed at non-renewable power plants
	Nuclear power plants generating up to 8 gigawatts are in use	More nuclear power plants are in use	
	Demand side	Demand side	Demand side
	Gas is piped to 15.5 million households	Gas is piped to 20.5 million households	Gas is piped to 23 million households
	Induction cookers are used in 15 million households	Induction cookers are used in 46.6 million households	Induction cookers are used in 52 million households
	Electric cars total 12 million to 13 million	Electric cars total 25 million to 27.7 million	Electric cars total 44 million to 47 million
	Electric motorcycles total 48.5 million to 52 million	Electric motorcycles total 88.5 million to 95 million	Electric motorcycles total 128.4 million to 138 million
	Electric buses total 388,000	Electric buses total 777,000	Electric buses total 1.3 million
	Electric trucks total 1.3 million	Electric trucks total 2.7 million	Electric trucks total 4.1 million
	Gas fuel powers 550,000 cars and 310 ships	Gas fuel powers 600,000 cars and 320 ships	Gas fuel powers 650,000 cars and 330 ships
	Hydrogen trucks total 558,000	Hydrogen trucks total 1.1 million	Hydrogen trucks total 1.7 million

Source: DEN presentation in Jakarta on 6 January 2023.

country's capacity to develop and safely manage nuclear power plants is uncertain and remains a topic for discussion.

To support the targets outlined in Regulation 79/2014, President Joko Widodo issued Presidential Regulation 112/2022 in September 2022. This regulation aims to incentivise the state electricity company, Perusahaan Listrik Negara (PLN), to prioritise the development of renewable power plants while halting the construction of new coal plants. According to the government, the regulation aims to address four key points to facilitate this transition (Ministry of Finance 2022a).

First, it details plans for PLN to work with the Ministry of Energy and Mineral Resources to close coal-fired power plants (CFPPs) early, underscoring the urgent need for an energy transition. Second, the regulation proposes a more feasible price-ceiling regime for buying electricity from renewable energy projects, instead of benchmarking renewable energy against subsidised coal. Third, it outlines the tender procedures for PLN's project procurement, encouraging transparency and fairness in the selection of renewable energy projects. Fourth, the regulation provides general incentives to support the development of renewable energy projects, which promotes a favourable environment for their implementation.

However, Presidential Regulation 112/2022 does not address certain challenges of the energy transition. For instance, it does not specify the funding source for the early closure of CFPPs. It also does not allow PLN the flexibility needed to increase electricity prices, which would enable it to purchase electricity from renewable power plants at a higher rate. Furthermore, the incentives outlined for the development of renewable energy projects lack detail, often referring to existing regulations that are not tailored for renewable power plant development.

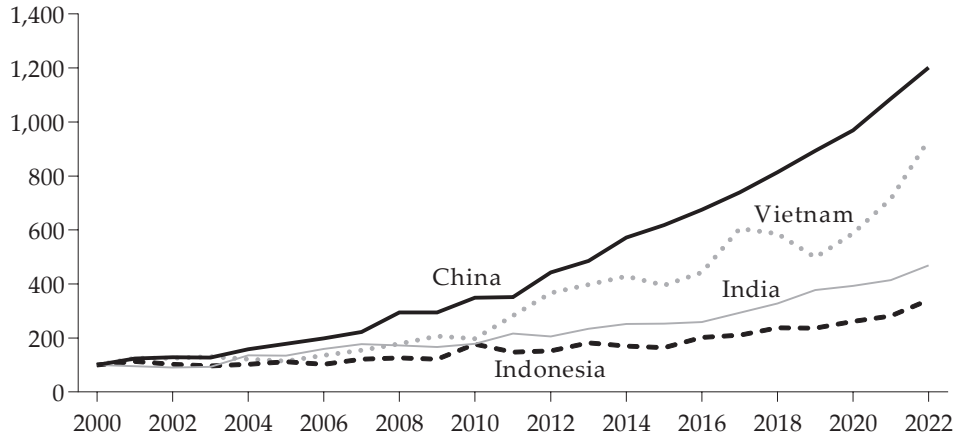
Several estimates have been made regarding the funding needed to meet Indonesia's energy transition targets by 2060. The Ministry of Finance estimates that the transition will cost Rp 3,500 trillion (\$0.23 trillion) (*Bisnis.com* 2022), while *BloombergNEF* predicts \$3.5 trillion (Rp 52,500 trillion) (*BloombergNEF* 2022). These estimates underscore the significant amount of funding needed to support the energy transition.

Past Experiences and Lessons

In recent decades, the prices of renewable technologies have been rapidly declining. The cost of solar photovoltaic (PV) panels was about \$32 per watt in 1980. By 2000, this price had plummeted to \$5.7 per watt. Another notable price drop occurred while oil prices were high between 2008 and 2013. In this period, the cost of solar PV panels plummeted from \$4.15 per watt to \$0.73 per watt. In 2021, the cost of solar PV panels reached a remarkable low of \$0.26 per watt (Our World in Data 2023). These reduced prices for renewable energy conversion have not only encouraged countries to commit to carbon emission control but also allowed them to transition their energy resources to renewable alternatives (IRENA 2022).

Notably, China and India witnessed substantial growth in their renewable electricity production, including solar power, wind energy and hydroelectric power sources. China's renewable electricity generation surged from 223 terawatt hours in 2000 to an impressive 2,283 terawatt hours in 2021. Similarly, India experienced a significant increase from 79 terawatt hours in 2000 to 297 terawatt hours in 2021. Figure 5 illustrates the pace of the energy transition in China, India, Vietnam and Indonesia since 2000. It shows that Indonesia has fallen behind the three other countries in adopting renewable power generation.

FIGURE 5 *Rate of Energy Transition (indexed) in Selected Asian Countries*



Source: EMBER (<https://ember-climate.org/data/data-tools/data-explorer/>. Accessed 10 June 2023).
Note: The amount of renewable power generation in all countries was set to 100 in 2000.

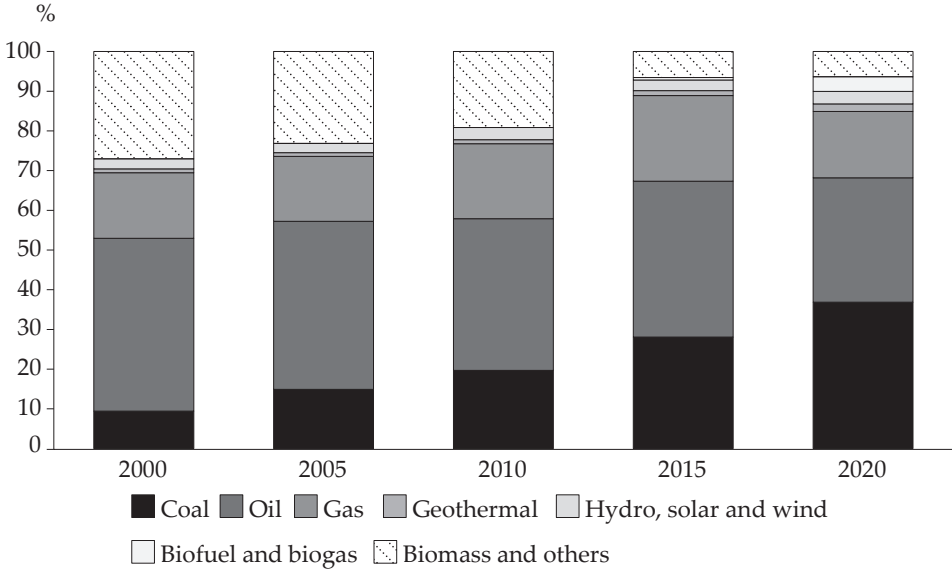
According to Burke et al. (2019), there are at least three main reasons for this slow transition in Indonesia. First, the market position of fossil fuel energy holds significance in the Indonesian economy. Fossil fuel mining has been a crucial source of income for the Indonesian government. As a result, the country has been reliant on fossil fuels, hindering the widespread adoption of renewable energy.

Second, the persistent resistance from the utility sector has made it challenging for private entities to embrace renewable power generation. The electricity sector in Indonesia, in particular, has been dominated by the state-owned enterprise PLN. Over the past decade, PLN has been committed to expanding the electricity supply in the country, mainly driven by optimistic projections of the country’s growth. This has led to the construction of CFPPs and the signing of power purchase agreements with private corporations operating coal power plants. The optimistic predictions of electricity demand, coupled with the government’s program, outlined in Presidential Decree 5/2006, to increase the proportion of coal in the country’s energy sources,³ from 26% of total energy consumption in 2008 to 33% by 2025, has resulted in the development of mainly coal-based power plants during the past decade (Resosudarmo, Alisjahbana and Nurdianto 2012).

Third, energy (fuel and electricity) subsidies have been prevalent in Indonesia for some time. The government has exercised control over fuel and electricity prices, resulting in fluctuating energy subsidies. In 2022, the energy subsidy was about Rp 134 trillion (\$9 billion), which made up about 7% of the government’s total expenditure or 0.7% of the country’s GDP. To grasp the extent of the energy subsidy, consider that the price of 92-octane petrol (Pertamax) was Rp 13,300 per litre in May 2023. In comparison, in May 2023, the prices of 91-octane petrol in Melbourne, Australia, and 92-octane petrol in Singapore were about A\$1.7 (Rp 17,000) and S\$2.67 (Rp 26,700) per litre, respectively. Owing to the relatively low

3. All sources of energy including biomass sources such as wood.

FIGURE 6 *Composition of Total Energy Consumption in Indonesia*



Source: *Handbook of Energy and Economic Statistics of Indonesia*, Ministry of Energy and Mineral Resources (<https://www.esdm.go.id/en/publication/handbook-of-energy-economic-statistics-of-indonesia-heesi>).

domestic prices of fuel, Indonesians have been less motivated to consume non-renewable energy more efficiently or to adopt renewable alternatives.

In the case of electricity, the government allocates the electricity subsidy to PLN based on the expected deficit of the company each year. This deficit arises owing to the government’s control over the price of electricity sold by PLN, which is typically lower than global electricity prices. To minimise the magnitude of the subsidy, both the government and PLN are strongly motivated to seek the most cost-effective energy sources for their power plants. In the past two decades, coal has been the preferred choice for the country, as it has been the cheapest energy source available.

Therefore, it is not surprising that fossil fuels have dominated Indonesia’s energy consumption for a considerable period. Figure 6 breaks down Indonesia’s total energy consumption. Note the significant growth of non-renewable resources, particularly coal, between the early 2000s and mid-2010s. As of 2020, renewables—including geothermal energy, biofuel, solar power, wind energy and hydroelectricity—made up less than 10% of the total energy consumption, with solar power and wind energy contributing less than 1% each. The heavy reliance on coal raises concerns about its environmental impact. Over the past two decades, coal has increasingly replaced oil and gas as the primary energy source in the country. Unfortunately, coal power plants emit more carbon per unit of energy produced than oil and gas power plants.

Indonesia will likely need to cease its use of coal, seen mostly in electricity power plants, to meet the NZE targets. CFPPs have had an extensive effect on Indonesia’s electricity sector. As of 2021, about 61% of Indonesia’s electricity (190 terawatt hours) came from CFPPs. In fact, the percentage generated from coal was ranked the seventh highest in any country. In contrast, the combined contribution

of hydroelectricity, wind energy and solar power made up less than 9%, while geothermal energy and bioenergy sources made up about 10% (Basri and Riefky 2023).

Currently, Indonesia has 86 operational CFPPs with a combined capacity of 40.2 gigawatts. The country is also set to generate about 10 gigawatts of capacity from CFPPs under construction. Most of the operational CFPPs are in the Java–Bali and Sumatra regions. As a result, there is a substantial surplus of electrical capacity, surpassing historical levels. Projections indicate that surplus capacity will continue until about 2029–30 (Ministry of Finance 2022a; Basri and Riefky 2023).

Moreover, Indonesia's heavy reliance on coal is closely tied to its economic sector. State revenue in 2022 increased by almost 103% (year-on-year) compared with 2021, mainly owing to tax revenue from coal commodities (Basri and Riefky 2023). This dependency on coal poses challenges for Indonesia's NZE aspirations. Coal power generation is Indonesia's second-largest source of emissions, after deforestation, contributing about 35% of the country's total emissions of 1,262 gigatonnes of carbon dioxide equivalent in 2020 (Nangoy and Suroyo 2021).

In Indonesia, coal has been an economic pillar as well as a primary energy source. The many complexities of an energy transition include the capital needed to transition to renewables, the costs of prematurely closing coal power plants, the loss of jobs and income, the costs of required institutional changes, the possibly increased cost of electricity from renewable energy plants, the risk of stranded assets, and a decrease in tax revenue.

Successful environmental policies have been rare in Indonesia. Among those perceived as successes were the 'clean river' Prokasih program and the Integrated Pest Management program, as highlighted by Resosudarmo and Irhamni (2008) and Resosudarmo (2012). These initiatives were implemented in the early 1990s, before the 1997–98 Asian financial crisis. Despite their initial success, the programs remained localised and could not be easily scaled up to the national level. The effectiveness of the programs soon waned and they faced further setbacks during the financial crisis. Perhaps the most significant climate change policy in the country's history was seen in 2015, when the government reduced energy subsidies from about Rp 276 trillion to Rp 65 trillion (Resosudarmo and Kosadi 2018). Since then, however, the subsidy has gradually increased again.

Resosudarmo (2012) argues that three important lessons arise from past environmental policies in Indonesia. First, the successful implementation of environmentally friendly policies in Indonesia requires unwavering political support from the highest authority; namely, the president and presidential office. Without such support, the influence of conflicting interests within the country can hinder the implementation. Second, a strong knowledge base and strong connections to international research communities are typically necessary to ensure successful implementation. The unique structure and diversity of Indonesia's society and environment demand specific knowledge to make such policies work. Third, when the economy is struggling, environmental concerns tend to take a backseat. In other words, for the implementation of these policies to be successful, the country's economy needs relatively high and stable growth.⁴

4. This contradicts what is known in Indonesia as the *Sadli law*: 'good times make for bad policy, and bad times make for good policy' (Patunru and Rahardja 2015).

ENERGY TRANSITION INITIATIVES

Currently, the government is preparing to introduce or promote several initiatives, including the ETM Country Platform, the JETP-Indonesia, carbon-pricing and market mechanisms, and electric vehicle development. This section aims to provide a comprehensive review of these four initiatives.

Energy Transition Mechanism Country Platform

The ETM Country Platform is a partnership program aimed at improving energy infrastructure and accelerating the transition towards NZEs by 2060 or earlier. The government launched the ETM Country Platform during COP26 in 2021. As part of the ETM Country Platform, two key mechanisms will be used: the early retirement of CFPPs and the facilitation of investment in renewable power plants (IEA 2022c).⁵ The ETM Country Platform is also expected to establish a steering committee, with ministry representatives and the country platform manager. This committee will be responsible for setting objectives, establishing targets and approving financial instruments at the project level.

To implement the platform, as outlined in Ministry of Finance Decree 275/KMK.010/2022, PT Sarana Multi Infrastruktur (PT SMI) will develop and manage a blended finance fund, which includes funds from the state budget and other non-public sources, such as donors, philanthropies, bilateral and multilateral institutions, and private investors. PT SMI will also provide financial de-risking instruments for CFPP early retirement projects. PT SMI will then connect this blended finance fund with PLN and independent power producers to accelerate the retirement of their CFPPs. Additionally, as mandated under the decree, PT SMI will conduct a study on the funding support needed for the platform and will develop the blended finance concept to attract more non-public funds (PT SMI 2022).

Since February 2023, PT SMI has approached many possible partners for the ETM Country Platform in Indonesia (PT SMI 2023). In response, the ADB—in collaboration with the Indonesian government, Islamic Development Bank and the World Bank Group—has launched financial facilities in the form of soft loans (Uly 2022). This partnership is significant as it has produced \$500 million, with the potential to attract up to \$4 billion in soft loans. These funds are intended to accelerate the early retirement and transformation of CFPPs. Additionally, the collaboration is preparing financial facilities to support the upgrade of power plants and electricity networks as a key part of the ETM initiatives (Mawangi 2022).

As per the DEN roadmap for the energy transition, the first CFPP earmarked for early retirement is Cirebon 1. Run by PT Cirebon Electric Power in West Java, this power plant has a capacity of 660 megawatts and began commercial operation in 2012. If agreed upon, Cirebon 1 would be retired by 2042, the end of its power purchase agreement (PPA) with PLN. This would effectively shorten its life by 10–15 years (Lawder 2022). The cost to retire Cirebon 1 early is estimated to be between \$250 million and \$300 million (Nurbaiti 2023). Why the plant cannot retire much earlier than 2042, the year its PPA ends, remains unclear. By that time, the output of Cirebon 1 might already struggle to compete with electricity generated by new renewable power plants. Consequently, PLN would have good reason to stop buying electricity from Cirebon 1. Note that, at the time of writing, no formal

5. See <https://fiskal.kemenkeu.go.id/fiskalpedia/2022/11/10/21-energy-transition-mechanism>.

agreement had been signed between PT Cirebon Electric Power and PLN regarding the retirement of Cirebon 1.

The ETM Country Platform faces several challenges. Chief among them is a lack of grant funding from donors or philanthropists for the program. Investors in particular are generally more interested in the development of renewable power plants, which offer promising future returns. According to the Institute for Essential Services Reform (IESR 2022), investment in renewables in Indonesia has increased significantly compared with other sectors in recent years. From the first quarter of 2022 to the third quarter of 2022, the total investment in renewables was about \$1.35 billion (or about 14% of the total investment during this period).

Conversely, investing in the early retirement of CFPPs does not offer promising returns. Parties involved in CFPP operations are reluctant to give up their expected profits. CFPP operators would be more inclined to participate in early retirement initiatives if they received compensation for the profits they would have earned from operating their CFPPs. Blended finance entities could provide this compensation for the forgone expected profits but would also expect a commercial return on their investment. While some entities, such as multinational development institutions, might be open to offering softer loans with slightly lower returns, it is important to note that this may not be sufficient.

Achieving returns on investment from retiring CFPPs will be challenging for the blended finance institutions unless affirmative policies are implemented, such as tax exemption schemes, policies to lower the cost of capital (Crystallin and Ishikawa 2023) or other government subsidies. Additionally, PLN's electricity prices are regulated. Higher returns could be achieved by letting PLN sell its electricity at the prices set by the global market, which would increase the price of electricity in Indonesia. Any increase in electricity prices, however, could have political implications.

Another challenge for the government is coordinating the efforts of multiple agencies to secure the blended funds and to facilitate the early retirement of CFPPs—a significant and intricate undertaking (Basri and Riefky 2023). Relying solely on PT SMI to manage these complex tasks may not work. The right approach to coordinating private agencies and government entities remains unclear. However, the government may need to establish an institution within the presidential office.

Last, the early retirement initiative for CFPPs has not yet generated any income through the international carbon market. This is mainly because the UNFCCC has set no approved method to verify the scale of emission reductions for this case. Nevertheless, the Indonesian government has been advocating for a carbon verification method for this initiative. In a significant step forward, the government successfully included the sale of carbon credits resulting from CFPP retirement in the revised version of the *ASEAN Taxonomy for Sustainable Finance*, released in March 2023 (Crystallin and Ishikawa 2023). This publication plays a crucial role as a shared foundation that facilitates a smooth transition and encourages the adoption of sustainable finance practices among member states of the ASEAN region. The final decision on this matter rests with the United Nations.

Just Energy Transition Partnership

At the Group of Twenty (G20) Leaders' Summit in Bali in late 2022, the Indonesian government and the International Partners Group (IPG) entered a partnership

supporting ambitious new targets for Indonesia's energy transition. Specifically, the JETP-Indonesia aims to achieve an NZE power sector in Indonesia by 2050 and a 34% renewable energy share in the sector by 2030. To achieve this, the JETP-Indonesia prioritises activities like those of the ETM Country Platform. The partnership advocates for a freeze on plans for on-grid CFPPs, as outlined in the national Electricity Supply Business Plan (RUPTL) for 2021–30, and a moratorium on new on-grid coal power generation as per Presidential Regulation 112/2022. It facilitates the growth of a robust and competitive manufacturing sector for domestic renewable energy. It acknowledges the significance of identifying and supporting vulnerable segments of the population, especially workers in the coal industry and related occupations, with a specific focus on women, youth and other groups disproportionately affected by the transition. Finally, the JETP-Indonesia aims to collaborate with financial institutions to unlock substantial investment opportunities for achieving an NZE economy in Indonesia (European Commission 2022).

To achieve these targets, the JETP-Indonesia secretariat will coordinate the mobilisation and deployment of an initial \$20 billion in public and private financing over three to five years. From this \$20 billion, the IPG members aim to mobilise at least \$10 billion in private funding by working with the Indonesian government and as part of the Glasgow Financial Alliance for Net Zero. This will include funding from the Bank of America, Citi, Deutsche Bank, HSBC, Macquarie, MUFG and Standard Chartered, through commercial loans. The availability of private sector funds will depend on the presence of catalytic public finance and collective ambition from all parties involved, including increased engagement from multilateral development banks. It is expected that the remaining \$10 billion, provided by public sector finance, could attract a significantly larger amount of private finance.

In February 2023, the Indonesian government, along with the co-leads of the IPG, established the secretariat for the JETP-Indonesia. The secretariat, within the Ministry of Energy and Mineral Resources and supported by the ADB, will coordinate the internal and external stakeholders involved in the JETP, including communication, collaboration and activities (US Embassy and Consulates in Indonesia 2023).

However, the strategy for implementing the JETP-Indonesia remains uncertain. Besides facing challenges like those faced by the ETM Country Platform, the JETP-Indonesia has not benefited from clear announcements about the financial contributions of the other IPG members, except for the United Kingdom's \$1 billion through the World Bank's loan programs (GOV.UK. 2022). It is crucial to have transparent and explicit commitments in terms of public funding as it plays a critical role in enabling the refinancing of essential programs, such as the early retirement of CFPPs. Proper sequencing of activities is vital for the effectiveness of JETP-Indonesia. Without initiating the retirement of CFPPs as a first step, it will be challenging for Indonesia to achieve its goal of a NZE power sector by 2050. Public funding also acts as a catalyst for attracting private finance, making it imperative for successful implementation.

Furthermore, the government must overcome the persistent challenge of regulation uncertainty and low institutional quality, which continue to hinder foreign investment in the country. Doing so will trigger greater investment in sectors related to the energy transition and allow the government to implement the JETP-Indonesia programs effectively. At the same time, the government needs to reform key regulations and policies. This should include a revision of the local content

requirement for investment projects in the country, a reduction or elimination of fossil fuel subsidies, and the creation of a competitive market in the electricity sector to enhance its efficiency. The reforms should also include addressing the existing monopoly held by PLN in electricity distribution and the government's control over electricity prices. However, the likelihood and timeline of these essential reforms in the near future remain uncertain. Thus, Indonesia might not receive the necessary investment to achieve its target.

The experience of JETP-South Africa highlights the difficulties that may be encountered by Indonesia during the implementation of JETP-Indonesia. In South Africa, poor transparency and public participation led to tension between civil society and the government (IESR 2022). The likelihood of success for JETP-Indonesia is uncertain without strong partnerships between the government, private sectors and civil society. Note that the energy transition may result in job losses in non-renewable sectors, but it can create new employment opportunities in renewable sectors. This transition could lead to winners and losers, underscoring the significance of collaboration to ensure the program's effective execution.

Carbon Market and Pricing

Indonesia has taken significant steps towards establishing an emissions-trading system (ETS). The process began with the enactment of Law 32/2009 on Environmental Protection and Management. Subsequently, Government Regulation 46/2017 on Environmental Economic Instruments was introduced, which mandates that any party or activities causing pollution or environmental damage must contribute to environmental guarantee funds. These funds are then used by the government to restore the quality of the damaged or polluted environment. Building upon these regulatory foundations, Presidential Regulation 98/2021 on Carbon Economic Value was enacted in 2021. This regulation establishes a national framework for carbon-pricing instruments, including the implementation of an ETS in Indonesia.⁶

The key approach employed within the ETS to reduce emissions is as follows. The government, first, establishes a predetermined level of permissible carbon dioxide emissions for a certain entity, referred to as the baseline. Entities that emit below the baseline are permitted to sell their surplus emission allowances to entities that exceed the baseline. This system is known as a baseline-and-credit ETS. To promote these carbon-trading activities, entities whose emissions surpass the current baseline will be subject to a carbon tax. This carbon tax is regulated under Law 7/2021 on the Harmonisation of Tax Regulations and must be set higher than the highest price of carbon in the ETS. It is imposed on emissions that exceed the established baseline. Therefore, the overall strategy of the ETS can be summarised as 'baseline, trade and tax'. It is important to note that this tax serves as an incentive to enhance energy efficiency.

The government has implemented a step-by-step approach to the ETS and tax system strategy. In 2021, from March until August, a voluntary intensity-based

6. The Minister of Environment and Forestry issued Ministerial Regulation 21/2022 on the Guidelines of Carbon and Economic Value Implementation, which provides specific guidelines for achieving a net emissions reduction in the forestry sector. However, this paper does not cover the developments in the forestry sector.

pilot program was done in the power generation sector. This pilot involved 32 facilities, representing more than 75% of emissions from the power sector, with an average carbon price of \$2 per tonne of carbon dioxide. The objective of the pilot was to familiarise stakeholders with ETS compliance and offset mechanisms, and it provided valuable insights for the development of the mandatory national ETS. During this pilot project, 18 CFPPs participated as sellers, while the remaining 14 CFPPs took on the role of buyers in the emission-trading process (Andriansyah and Hong 2022).

Building on the lessons learned from the pilot project, the Ministry of Energy and Mineral Resources issued Ministerial Regulation 16/2022, which outlines the procedures for setting the economic value of carbon in the power generation sub-sector. Subsequently, in February 2023, the ministry launched the first phase of the ETS in the Indonesian energy sector, which is a mandatory intensity-based emissions-trading system for CFPPs with a capacity of more than 100 megawatts. This initial phase of the ETS covers 99 CFPPs, which generate more than 81% of the country's national power (ICAP 2023). Out of these facilities, 55 belong to the state-owned utility PLN, while the rest are owned by independent power producers. The emissions cap for CFPPs at mining sites is expected to be 1.089 tonnes of carbon dioxide equivalent per megawatt hour. For CFPPs producing between 100 megawatts and 400 megawatts that are not situated at mining sites, the cap is expected to be 1.011 tonnes of carbon dioxide equivalent per megawatt hour. CFPPs with a capacity higher than 400 megawatts are expected to have a cap of 0.911 tonne of carbon dioxide equivalent per megawatt hour (*CNBC Indonesia* 2023).

The second phase is scheduled for launch in 2025, and the third in 2028. These phases aim to incorporate oil and gas-fired power plants, as well as CFPPs not connected to PLN's grid, into the domestic carbon market. Additionally, in January 2023, Law 4/2023 on Financial Sector Development and Strengthening was enacted. This law gives Indonesia's Financial Services Authority (OJK) the responsibility of managing and supervising carbon market trades in Indonesia. The OJK has been tasked with developing regulations to ensure adherence to international carbon-trading practices, which include carbon certification procedures.⁷

If these trades are limited to domestic entities, Indonesia can easily assess its success in reducing emissions and meeting its NDC targets. This reduction, coupled with the subsequent implementation of a carbon tax, will contribute to Indonesia's progress towards achieving NZEs by 2060. However, domestic carbon trades alone might not generate sufficient funding for Indonesia's energy transition. International funding will most likely be needed. Currently, much of the funding associated with the ETM Country Profile and JETP-Indonesia, when received, comes in the form of loans. When the Indonesian carbon market becomes interconnected with the international carbon market, funds could come from the latter. However, selling emission rights abroad might not count towards Indonesia's NDC achievements.

Besides the complexity of determining whether carbon trading can effectively fulfil our commitments for NZE by 2060 and attract foreign capital to fund the energy transition, there are several fundamental challenges in implementing a

7. While this paper was being written, OJK was still preparing the regulation for the carbon market in Indonesia.

carbon market and tax in the country. First, the OJK has not yet developed the necessary regulations to initiate the carbon market in Indonesia. It remains to be seen whether these regulations will effectively facilitate carbon trading and prevent trade manipulation, such as carbon washing or false claims of conducting offset services that appear ecologically friendly but are not truly so.

Second, determining the appropriate size of the carbon baseline per entity for the carbon market and carbon tax has traditionally posed challenges. If the baseline is set too high or too low, CFPP operators may not respond as expected, and the same applies to carbon tax rates. Understanding the true transaction costs for CFPP operators participating in carbon trades is crucial for setting appropriate levels of the carbon baseline and carbon tax. Another important consideration is establishing clear procedures and mechanisms for regularly adjusting the levels of the carbon baseline and carbon tax.

Third, the issue of carbon washing must be effectively addressed. It is imperative to establish stringent regulations that enhance the competence of carbon assessors, enabling them to prevent and detect carbon-washing activities. In a country where monitoring and evaluation processes are not robust, the occurrence of carbon-washing activities could have significant implications. Thus, prioritising the development of strong regulations and robust monitoring systems is essential to ensure the integrity and credibility of the carbon market.

Electrical Vehicles

On the demand side of energy, the Indonesian government is taking steps to establish a comprehensive program for domestic electric vehicles. The program aspires to have 2 million electric cars and 13 million electric motorbikes on the roads by 2030. Meanwhile, PLN aims to establish 7,146 plug-in charging stations and 15,625 battery-swapping stations by 2030 (IESR 2022). By early 2023, about 50,000 electric vehicles were estimated to be in the country. Meanwhile, as of 2022, Indonesia had 439 plug-in charging stations and about 961 battery-swapping stations. About 52% of the charging stations were owned by PLN. These numbers fall well short of the government's targets (Setiawan 2023).

To further stimulate demand for electric vehicles, the government introduced two key policies in 2022. First, Presidential Instruction 7/2022 was issued, aiming to promote the use of electric vehicles for official government vehicles. Second, Ministerial Regulation 15/2022 was enacted, expanding the scope for vehicle conversion into electric vehicles beyond just two-wheelers.

To produce high multiplier effects in the country, the government aims to develop a robust supply chain for electric vehicles, covering various aspects, from mining and processing battery metals to manufacturing electric vehicles and recycling batteries (IEA 2022c).⁸ This target is a key component of the National

8. Regarding electric vehicle batteries, the government has set an ambitious target to produce batteries with an annual capacity of 140 gigawatt hours by 2030. One-third of this capacity will be allocated for export, while the remaining two-thirds will cater to the growing domestic demand. To achieve this goal, the government has established the Indonesia Battery Corporation, which is a joint venture involving four state-owned enterprises: Pertamina, PLN, Mind ID and Antam. Each of these enterprises holds a 25% stake in the corporation, ensuring their active involvement in the battery production sector (IEA 2022b). Recognising Indonesia's position as the largest global producer of nickel, the government

Grand Energy Strategy, which was unveiled during the G20 summit in Bali in 2022. To support this initiative, the government has taken several measures. First, it implemented Presidential Regulation 55/2019, which focuses on battery electric vehicles. This regulation, along with a government roadmap for battery electric vehicles, outlines specific targets for the local production of low-carbon vehicles, including battery electric vehicles, plug-in hybrid vehicles, flex-fuel engines and low-cost green cars. To further incentivise the local production of electric vehicles, the Ministry of Finance introduced Ministerial Regulation 38/2023. From 1 April 2023, this regulation will ensure a reduction of 1%–11% in the value-added tax for sales of electric vehicles made from at least 40% local materials (Rayanti 2023).

Crucially, these regulations to help develop the domestic supply chain for electric vehicles must not discourage local industries from becoming globally competitive. For example, because of the current export ban on nickel, Indonesia could miss an opportunity to increase foreign income, and instead develop uncompetitive nickel-processing industries.⁹

CONCLUSIONS

Among the world's top 10 carbon emitters, Indonesia has a responsibility to help reduce global emissions and limit the increase in the global temperature to a maximum of 1.5 degrees Celsius above pre-industrial levels. To do this, the government has submitted its NDCs to the United Nations, committing to achieve NZEs by 2060. However, as a lower-middle-income country with limited government budgets and ambitious plans to attain high-income status by the early 2040s, Indonesia faces significant challenges in meeting these goals. This paper analyses the prospects and feasibility of the government fulfilling its commitments, considering the complex economic and developmental context of the country. This paper focuses solely on analysing Indonesia's commitment to the energy sector.

The Indonesian economy has shown strong signs of recovery from the shock of the Covid-19 pandemic. Such a recovery would provide a favourable environment for the capital-intensive reform required for an energy transition. There are, however, still threats and challenges that need to be addressed. Geoeconomic fragmentation, if not properly managed, could negatively affect global trade volume and, consequently, the Indonesian economy. An end to the commodity boom could slow the country's GDP growth and reduce fiscal revenue.

Historically, Indonesia has not placed a high priority on developing its renewable energy sector or increasing the share of renewable energy in its total energy supply. Instead, the country has heavily relied on its oil, gas and coal resources to meet its energy needs. As a result, the contribution of renewables to Indonesia's energy supply has remained below 10%. Transitioning to a greener energy system poses significant challenges for Indonesia, owing particularly to its well-established, non-renewable energy industries. Other challenges include the need for substantial

aims to capitalise on the abundance of the resource. The objective is to attract foreign investment in nickel processing, which adds value to the mined nickel ore—a vital component in the majority of electric vehicle batteries today, along with cobalt.

9. For example, see the impact of a log export ban for the development of the plywood industry, in research by Resosudarmo and Yusuf (2006).

capital investment in renewable energy infrastructure, the costs associated with prematurely closing coal power plants, the potential job and income losses, the potential increases in the cost of electricity generated from renewable energy plants, the expenses related to necessary institutional changes, the risk of stranded assets, and the possible decrease in tax revenue.

To address these challenges, the government has implemented several initiatives. On the energy supply side, the government, in collaboration with the international community, has launched Indonesia's ETM Country Platform and the JETP-Indonesia. These initiatives aim to mobilise financial resources to support the phase-out of CFPPs and accelerate the development of renewable energy projects. However, most of these international financial resources come in the form of loans, which require positive returns on investment. The heavily regulated electricity sector, characterised by a monopoly in power distribution, presents challenges in finding additional returns on investments. Moreover, weak institutional quality and regulatory uncertainty in the country may discourage international finance institutions from investing their resources. The availability of sufficient international funds through these initiatives remains uncertain and will depend on various factors.

An ETS, combined with a carbon tax, is another way to gather the international finance needed to transition the country's energy supply. The strategy can be summarised as 'baseline, trade and tax'. Although promising, Indonesia has no experience in organising this activity. Strong regulations and robust monitoring systems are essential to ensure the integrity and credibility of the carbon market.

On the demand side, the Indonesian government has implemented programs to promote electric vehicles. Measures such as the reduction of the value-added tax on electric vehicles made from at least 40% local content have been introduced, along with the development of electric vehicle infrastructure. However, the lack of sufficient infrastructure remains a significant challenge in achieving the country's targets for electric vehicle adoption.

Despite these challenges, the government's determination to launch various energy transition initiatives, and the relative stability of the economy present opportunities for progress. However, meeting ambitious energy transition targets will require addressing long-standing challenges, such as the lack of capital and knowledge, low institutional quality, rigidity in conducting policy reforms and regulatory uncertainty. It is likely that Indonesia could make significant progress in its energy transition, but the probability of achieving the NZE by 2060, at the moment, seems rather low. Maintaining program consistency and monitoring progress, while considering flexibility in target implementation, may be crucial.

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