ENERGY TRANSITION PARTNERSHIP

Study on the Financial Implications of the Early Retirement of Coal-fired Power Plants in Indonesia

Deliverable 4 (e): Supply chain analysis and regional sensitivities

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By:

Hartree NEYEN.IO BREATHE CBS ENGINEERING CONSULTANTS

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Glossary

ADB	Asian Development Bank
BESS	Battery energy storage system
BPP	Electricity generation basic cost (*Biaya Pokok Penyediaan*)
CAPEX	Capital Expenditures
CATA	Coal Asset Transition Accelerator
CCGT	Combined cycle gas turbine
CCS	Carbon Capture & Storage
CCUS	Carbon Capture Use & Storage
CF	Capacity Factor
CFPP	Coal-Fired Power Plant
COD	Commercial Operation Date
COP	UN Climate Change Conference
CRR	Coal Retirement Roadmap
CT	Carbon Tax
DFI	Development Finance Institutions
EBITDA	Earnings Before Interests, Taxes, Dividends and Amortization
ETM	Energy Transition Mechanisms
ETP	Energy Transition Partnership
ETS	Emission Trading Scheme
EU	European Union
EUR	Euros
FCDO	UK Foreign, Commonwealth and Development Office
FIRE	Friends of Indonesian Renewable Energy
GDP	Gross Domestic Products
GHG	Greenhouse Gases
GOI	Government of Indonesia
GW	Gigawatt
IDR	Indonesian Rupiahs
IGCC	Integrated gasification combined cycle
IPP	Independent Power Producer
JTM	Just Transition Mechanism
JTT	Just Transition Transaction

KEN	Indonesia's National Energy Policy
kWh	kilowatt-hour
LCDI	Low Carbon Development Indonesia
LCOE	Levelized Cost of Energy
LTS-LCCR	Long-Term Strategy for Low Carbon and Climate Resilience
MEMR	Ministry of Energy and Mineral Resources
MOEF	Ministry of Environment and Forestry
MOF	Ministry of Finance
MOSOE	Ministry of State-Owned Enterprises
$MtCO_2e$	Megatons of CO_2 equivalent
MW	Megawatt
NDC	National Determined Contribution
NRE	New Renewable Energy
ETP NZE	Net Zero Emissions Scenario
OPEX	Operation Expenditures
PLN	Perusahaan Listrik Negara
PPA	Power Purchase Agreement
PV	Photovoltaic
RE	Renewable Energy
RUEN	National Energy General Plan
RUPTL	National Electricity Supply Plan
SOE	State Owned Enterprise
STEM	Science, Technology, Engineering and Mathematics
US$	US Dollars
VAT	Value-added tax
VRE	Variable Renewable Energy

Executive Summary

This Report E is part of Phase 3 of the Energy Transition Partnership (ETP) funded study, focusing on regional sensitivities in East Kalimantan and South Sumatra from early retiring coal fired power plants (CFPP). The report analyzes the indirect effects of coal plant retirements on supply chains, their impact on short- and long-term fiscal flows, wholesale electricity prices, and PLN's cash flow. In addition, it examines the challenges and opportunities associated with the phase-out of coal power plants, emphasizing the importance of delivering a Just Transition.

This study concludes that the retirement of CFPPs in Indonesia will have significant economic and fiscal impacts on the coal supply chain, including coal mining and transportation sectors. The results suggest that transition to cleaner energy sources presents both challenges and opportunities for the affected regions and the overall energy landscape in Indonesia. It is crucial to carefully manage the implementation of a CFPP early retirement program to avoid unintended consequences.

The early retirement of CFPPs can lead to a suppressed domestic coal demand of 73.4 million tons by 2038, affecting the mining industry and creating development disparities in coal dependent regions in Indonesia. The coal mining sector plays a vital role in the country's economy, contributing significantly to the GDP of provinces such as East Kalimantan, South Sumatra, South Kalimantan, and Central Kalimantan. For instance, in 2017, the coal industry accounted for around 35% and 19-26% of East Kalimantan and South Sumatra's GDP, respectively. This analysis identifies that the coal transport industry will also be impacted, resulting in reduced demand for coal transportation services, decreased revenue, and job losses. Provinces with extensive transport infrastructure, such as South Sumatra and East Kalimantan, will experience the most significant effects.

The early retirement of CFPPs will have contrasting economic and fiscal implications for East Kalimantan and South Sumatra, the two most coal dependent provinces in the country. The model used in this study suggests that CFPP retirement could lead to a potential annual average revenue decrease of 40% in East Kalimantan and 37% in South Sumatra. There may be a decline in VAT

collection as coal is redirected towards international exports, but there is potential for an upsurge in income tax revenue derived from the coal mining sector. Careful monitoring is necessary to assess the short-term economic and fiscal impacts, especially at a sub-regional level.

In the long term, royalties from coal mining companies to local governments are estimated to decline in the scenario where international coal demand decreases after 2028. This study considers a future international coal demand scenario with up to a 75% annual decrease by 2038, from 2028. Additionally, if the government maintains its commitment to stable electricity prices and continues to pursue this objective, there may be a need to increase subsidies to offset potential cost increases resulting from the retirement of coal and the expansion of renewable energy sources. This is supported by the Government's promise to provide funds for electricity supply for low-income communities (Law 30/2009) and to compensate PLN if there is an increase in the cost of generation from RE power plants (Presidential Regulation 112/2022). To ensure the long-term stability of the national and provincial budgets, adopting variable electrical tariffs and establishing a Just Transition Fund are recommended measures. These actions will help mitigate financial challenges associated with the shift away from coal and support a smooth transition towards cleaner and more sustainable energy sources.

The retirement of 32 coal-fired power plants (CFPPs) in Indonesia will have significant implications for employment in the coal mining industry and CFPPs. The provinces of East Kalimantan and South Sumatra, which account for the majority of the country's coal production, will be particularly affected by the transition away from coal-based industries. Therefore, it is essential to give careful consideration and meticulous planning to ensure a Just Transition in these regions. This entails considering the social, economic, and environmental implications, as well as providing support and opportunities for affected workers, communities, and industries to smoothly adapt to alternative sources of livelihood and sustainable development. The principles of a Just Transition, including fairness, inclusivity, and minimizing negative impacts, should guide the planning and implementation processes to ensure a successful and equitable transition away from coal in these provinces. In the coal mining sector, the early retirement of CFPPs poses a significant risk to employment, with an estimation of over 13,000 mining jobs at risk of being lost during the low global coal demand

period starting from 2028. East Kalimantan and South Sumatra face the highest impact, with approximately 6,880 and 4,120 mining jobs at risk, respectively. These provinces heavily rely on coal mining, and the loss of jobs will have a substantial impact on their local economies.

During the high demand period, the CFPP retirement plan is expected to have minimal impact on coal mining employment, as excess coal is expected to be exported to satisfy the high international coal demand. However, in the low demand period characterized by an initial 25% drop in 2028 in international coal demand, equivalent to 5.6 million tons per year of suppressed coal demand not exported, there is a genuine concern for the loss of employment opportunities, particularly in North, East, and South Kalimantan. This poses a threat to the livelihoods of mining workers and their families in these regions.

In addition to the impact on coal mining, the retirement of CFPPs will also have a significant employment impact on CFPP employment. Provinces such as Lampung, Banten, East Java, and West Java will experience the highest job losses in the CFPP sector. The initial impact will be an average of 320 jobs lost per year for three years, followed by a high-impact period of 570 jobs lost per year. After 2031, the impact is expected to decline. Although none of the 32 sampled CFPPs are located in East Kalimantan, approximately 300 jobs in CFPPs in South Sumatra are at risk. It is estimated that around 3,800 jobs will be at risk due to CFPP retirement.

The significant employment impacts on both coal mining and CFPPs highlight the need for careful planning and support for a just transition. Measures should be taken to minimize the negative effects on the 13,000 workers from mining and 3,800 from CFPPs, and their families, estimated by this study to be affected directly and indirectly by the early CFPP retirement particularly in regions heavily reliant on the coal industry. Reskilling and retraining programs, as well as the establishment of a Just Transition Fund, can help mitigate the impacts and support a smooth transition to cleaner and more sustainable energy sources.

The retirement of CFPPs will also have both short-term and long-term economic impacts on the electricity sector. One key aspect is the variation in the Basic Generation Cost (BPP), which is the cost of electricity generation for power plants. The retirement of CFPPs may lead to an increase in the weighted

average generation cost from up to US$ 80/MWh to US$ 92/MWh in the short term, depending on regional factors such as the availability of alternative energy sources, demand patterns, and grid infrastructure. Regions heavily reliant on CFPPs may experience higher prices due to limited interconnection and reliance on more expensive energy sources like diesel power plants.

In the short term, the early retirement of CFPPs is expected to have several effects on PLN's cash flow. Firstly, the model illustrates there will be an increase in electricity costs as PLN will have to purchase electricity from independent power producers (IPPs) at higher prices, and new power purchase agreements (PPAs) may have higher contractual prices (Section 2.2.1). Secondly, PLN's own generation costs will rise as it replaces retired CFPPs with energy from more expensive sources like natural gas or diesel. These factors may negatively impact PLN's short-term cash flow. Furthermore, the decrease in electricity sales is another potential short-term impact. As CFPPs retire and electricity tariffs increase, there is a possibility that the elasticity of electricity demand in Indonesia, estimated to be -0.15 in a given year, could change, leading to a reduction in consumption by consumers in response to higher prices. To mitigate this impact, the government could promote energy efficiency programs and policies while retiring CFPPs. Delays in achieving electrification targets may also occur if rates are postponed due to the increase in electricity prices. To address these impacts, it is recommended to (i) Conduct thorough assessments of power purchase agreement (PPA) termination costs and debt structures to develop replicable business models and identify potential cost-saving opportunities and (ii) Prioritize energy efficiency policies. Further details on these recommendations can be found in Report G of this study.

PLN has the opportunity to increase its cash flow through compensation mechanisms for the early retirement of the 32 CFPPs estimated at US$11.8 billion. This could provide PLN with significant financial resources that can be strategically allocated towards investments in low-carbon technologies and enhance grid infrastructure. This increase in cash flow not only benefits PLN in the short term but also positions the company to proactively prepare for the long-term energy transition. By investing in low-carbon technologies and grid reinforcement, PLN can contribute to a greener and more sustainable future, enabling the integration of renewable energy sources and facilitating a smooth transition to a more sustainable energy system.

The retirement of CFPPs will result in increased investment needs for PLN in the long term. IRENA estimates that an investment of US$80 billion is required to develop Indonesia's grid infrastructure by 2030, while these investments come with a significant price tag, they are expected to yield positive impacts on efficiency and social well-being. Investing in grid strengthening, transmission and distribution systems, and interconnection technologies will be necessary to integrate variable renewable energy sources and enhance system resilience to achieve the government's target of 23% renewable energy in Indonesia's energy mix by 2025. PLN should explore additional solutions like battery energy storage systems, smart grids, and demand response programs to support the transition.

In the long run, the retirement of CFPPs and the adoption of renewable energy sources will lead to reduced operational expenses for PLN. Fuel and maintenance costs currently constitute 44% of PLN's annual operating expenses. However, with the phasing out of CFPPs and the lower operational and maintenance (O&M) costs of renewables, PLN can achieve long-term savings. Renewable energy sources have lower operational expenses and eliminate fuel costs compared to thermal power plants. In 2021, fixed O&M costs for ultra-supercritical coal power plants averaged US$49.5/kW-year. In contrast, wind and solar PV averaged US$27.6/kW-year and US$15.97/kW-year, respectively. This financial benefit allows PLN to allocate resources towards other strategic investments, such as expanding renewable energy capacity, grid infrastructure development, and implementing energy efficiency programs. Ultimately, these long-term savings contribute to the financial sustainability of PLN and support the transition to a cleaner and more cost-effective energy system in Indonesia. The impact of early retirement on PLN's cash flow will depend on the company's ability to manage the transition effectively and maintain a stable financial position throughout the process.

It is essential to address the potential consequences on employment and fiscal conditions while capitalizing on the benefits of transitioning to cleaner energy sources. To address potential consequences on employment and fiscal conditions while capitalizing on the benefits of clean energy transition, key recommendations are proposed.

1. **Comprehensive skills study:** Identify qualifications and assess labor gaps in high-growth industries. Implication: Support targeted training and

upskilling programs for affected workers, ensuring a smooth transition to new sectors.

2. **Low-cost capacity-building program:** Establish a program, backed by official mechanisms and government support, if necessary, to provide workers with skills for high-growth industries. Implication: Enable workers to acquire knowledge and expertise needed in transitioning sectors, facilitating their reintegration into the job market.
3. **Job boards promotion:** Utilize job boards to connect workers with job opportunities and employers. Implication: Assist workers in finding suitable employment, especially in regions with relatively low unemployment rates.
4. **Just Transition Fund:** Establish a fund financed by renewable energy company fees and increased income tax from coal mining. Implication: Ensure stability in national and subnational budgets, supporting social programs and facilitating a just transition for affected workers.

Report Structure

Report E is part of Phase 3 of the Energy Transition Partnership (ETP) funded study, focusing on regional sensitivities in East Kalimantan and South Sumatra from early retiring coal fired power plants (CFPP). The report examines the challenges and opportunities associated with the phase-out of coal power plants, emphasizing the importance of delivering a Just Transition. Additionally, the report analyzes the indirect effects of CFPP retirements on supply chains, and their impact on short- and long-term fiscal flows, wholesale electricity prices, and PLN's cash flow. The findings presented herein aim to inform stakeholders, policymakers, and industry leaders about the implications of these transitions and guide them in implementing effective strategies for a sustainable and equitable energy future.

This report is part of an Energy Transition Partnership (ETP) funded study that analyzes, evaluates, and provides suggestions on the retirement pathways for CFPPs with respect to their financial implications to PLN and the GOI (**Figure 0.1**).

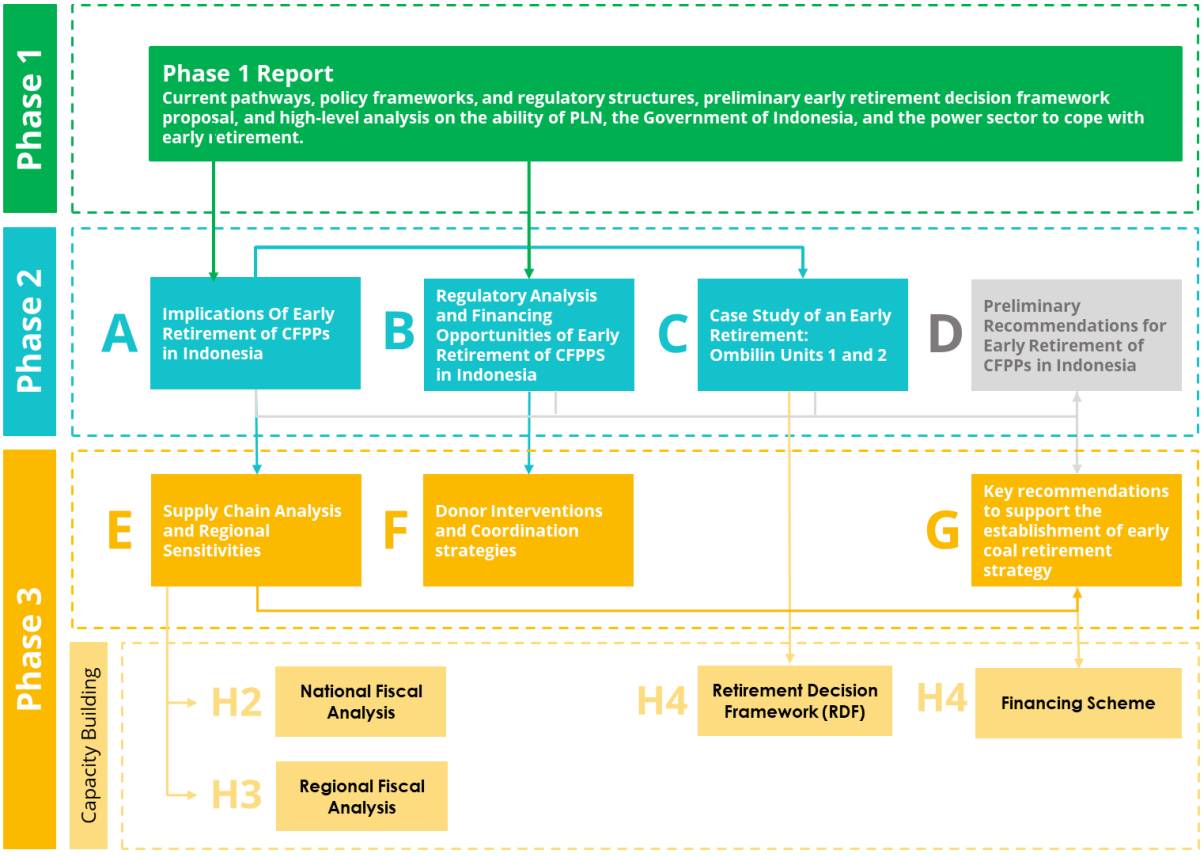
Phase 1 encompassed an examination of current pathways, policy frameworks, and regulatory structures to gain insights into their implications, as well as to identify opportunities and risks. Additionally, Phase 1 proposed a retirement decision framework. Through a high-level analysis, a hypothesis was developed regarding the ability of PLN, the GOI, and the power sector to manage early retirement. Stakeholder consultation validated the hypothesis, which suggests that the GOI, with its interventionist policies, plays a pivotal role in enabling early retirement and has a unique opportunity to transition to a lower carbon power system, particularly due to international interest in unlocking its renewable energy potential. The outcome of Phase 1 is the Phase 1 Report.

Phase 2 of this study goes a level deeper than Phase 1, resulting in Reports A – D. In this phase the study examined the current pathways, policy frameworks, and regulatory structures, providing insights into their implications and identifying opportunities and risks, and provides a retirement decision framework proposal **[Report A]**. In addition, it analyzed the regulatory environment and financing opportunities of early retirement of coal-fired power plants **[Report B]**. This phase also showcased a retirement program using Ombilin units 1 and 2 as a case study to illustrate what early retirement would imply **[Report C]**. Finally, preliminary

recommendations were presented considering the outcomes and findings of the study until the end of Phase 2 **[Report D]**.

Phase 3 evaluated the indirect effects of CFPP retirements on supply chains, examining their implications for short- and long-term including regional sensitivities to examine the impact on East Kalimantan and South Sumatra **[Report E]**. An in-depth analysis on donors and their activities to suggest donor interventions to support early retirement of CFPP was also conducted **[Report F].** In addition, key recommendations for policy makers to support the establishment of early coal phase out strategy were developed refining and substituting recommendations presented in Phase 2 **[Report G].** Finally, a series of capacity building materials designed for relevant ministry staff, focusing on assessment and analysis methodologies on the retirement decision framework, fiscal analysis, and financial proposals were presented **[Report H]**.

Figure 0.1 Study report's structure



1 Economic and Fiscal Impacts of Coal-Fired Power Plant Retirement

The retirement of coal-fired power plants (CFPPs) can have significant economic and fiscal impacts on the coal supply chain, encompassing coal mining and transportation. These effects can extend to the wholesale electricity prices, as well as the cash flow of PLN (Perusahaan Listrik Negara) and the government's fiscal flows (Table 1.1).

These findings highlight the need for careful study and monitoring of each of these aspects to ensure that the implementation of a CFPP early retirement program is carefully managed and does not result in unintended consequences.

Table 1.1 Direct and indirect impacts of early retirement of CFPPs

Direct Impacts	Indirect Impacts
Variations in coal production: The reduction in domestic demand for coal due to CFPP retirement can lead to variations in coal production. The coal mining sector may need to adjust its production levels and capacity to meet changing demands, potentially diverting production to international markets to align with global demand for coal. **Potential job losses:** The decrease in coal mining and transportation resulting from CFPP retirement can lead to potential job losses in these sectors. Workers involved in mining and transportation of coal may face employment challenges as demand might change.	**Variation in mining companies' revenue:** The impacts of early retirement of CFPPs can compound the effects of high and low international coal demand, which will either increase mining sector revenue or decrease mining sector revenue. **Potential decrease in sub-regional revenue:** The reduction in mining activity associated with CFPP retirement can have implications for sub-regional revenue. As mining activity decreases, there is a possibility of a decrease in revenue for sub-regions that rely on the coal industry. This can impact the local economy.

	Increased participation of renewable energy: As CFPPs retire, the role for renewable energy will increase.

1.1 Short- and Long- Term Economic and Fiscal Impacts

The retirement of CFPPs is expected to have significant economic and fiscal impacts on the coal mining sector, which plays a vital role in the country's economy, as well as on PLN, the central play in the electricity sector.

Coal mining is a major contributor to the economies of several provinces, including East Kalimantan, South Sumatra, South Kalimantan, and Central Kalimantan, where most of Indonesia's coal deposits and production are located. For instance, in 2017, the coal industry accounted for up to 35% of East Kalimantan's GDP, while in South Kalimantan, it contributed between 19% and 26% of the local GDP over the past five years. The transition to cleaner energy sources can have political, social, and economic effects in these regions due to the substantial GDP contribution of the coal industry and the development disparity with other sectors[1]. The early retirement of CFPPs, particularly in regions like South Sumatra, one of the largest coal-producing regions in Indonesia and a key province in the CFPP's supply chain, could result in a decline in domestic coal demand, thereby impacting the national coal transport sector.

The retirement of CFPPs will also affect Indonesia's coal transport industry, leading to reduced demand for coal transportation services, decreased revenue, and job losses, especially during periods of low international coal prices. Companies such as PT Pelayaran Nasional Indonesia, PT Kereta Api Indonesia, PT Berlian Jasa Terminal Indonesia, and PT Samudera Indonesia Tbk are likely to be impacted. Provinces with extensive transport infrastructure, including South Sumatra and East Kalimantan, will experience the most significant effects. Regions like Samarinda in East Kalimantan, which rely on large coal mines and utilize major

[1] Aleksandra, I. for ISER (2019) Indonesia's coal dynamics: Toward a just transition, Climate Transparency. Available at: https://www.climate-transparency.org/media/indonesias-coal-dynamics-toward-a-just-transition

transportation routes like the Mahakam River[2], will need to adapt to changes in demand distribution channels.

Fiscal impacts on Indonesia's coal supply chain will primarily stem from the mining activities associated with CFPPs and the CFPPs themselves. While the transport sector has the potential to be affected by the early retirement of CFPPs, the fiscal analysis assumes that coal exports will continue during a predefined period of high international coal demand, gradually declining thereafter. The suppressed domestic coal demand resulting from the retirement of 32 CFPPs is marginal when compared to national coal production (1.32% over a 10-year period). As a result, the contribution of transport activities related to suppressed coal demand to fiscal flows is not significant to the national budget.

In the short term, the early retirement of CFPPs in Indonesia will have contrasting economic and fiscal implications. Firstly, there will likely be a decline in VAT collection as coal, previously traded in the domestic market, is redirected towards international exports. Additionally, the government will be required to provide compensation payments to CFPP owners as part of the retirement process. Conversely, there is potential for an upsurge in income tax revenue derived from the coal mining sector, as companies pivot their sales towards international markets. This projection assumes that international coal demand remains robust in the short term, and that coal mining companies can effectively capitalize on favorable pricing conditions without being constrained by domestic market obligations. The observed increase in coal exports to other markets in 2022 further supports this notion. Therefore, while immediate fiscal challenges are expected, the shift towards international markets may partially offset the impact by generating increased income tax revenue. These dynamics underscore the need for careful monitoring and assessment of the short-term economic and fiscal effects resulting from the early retirement of CFPPs in Indonesia.

In the long term, royalties from coal mining companies to local governments are expected to decline as international coal demand decreases. Moreover, if electricity tariffs will seek to be constant, subsidies will need to be increased to

[2] Samarinda Port (2023) SHIPNEXT.From: https://shipnext.com/port/5828fb946742c90cc0eb7287

compensate for the potential rise in electricity costs resulting from coal retirement and the deployment of new renewable energy sources. These subsidies may put a strain on the national budget. To ensure the long-term stability of the national and provincial budgets, it may be necessary to adopt variable electrical tariffs as widely as possible and establish a Just Transition Fund. These measures can help mitigate the financial challenges associated with the shift away from coal and support a smooth transition towards cleaner and more sustainable energy sources.

1.2 Employment Impact of CFPP Early Retirement Program

1.2.1 Coal Mining

The retirement plan for 32 CFPPs in Indonesia will have substantial implications for employment and fiscal flows in the coal mining industry, especially in East Kalimantan and South Sumatra. Together, they account for 55% of the country's total coal production and over 76% of the coal designated for power generation.

During the low global coal demand period starting from 2028, there is a risk of over 13,000 mining jobs being lost, around 5% of those affected being women. In East Kalimantan and South Sumatra, approximately 6,880 and 4,120 mining jobs are at risk, respectively (Table 1.2). The impact on employment is significant, considering that these provinces heavily rely on coal mining. In 2021, East Kalimantan had a total of 130,564 workers engaged in mining and quarrying, with women comprising 2,815 of the workforce (2.2%)[3]. Similarly, in South Sumatra in 2022, there were 75,036 workers in mining, including 8,376 women (11%)[4].

[3] Statistics Kalimantan Timur. 2023. Kalimantan Timur Province in Figures 2023. https://kaltim.bps.go.id/publication/2023/02/28/7a58231d5aa2f5a7b4d5c36a/provinsi-kalimantan-timur-dalam-angka-2023.html

[4] Statistics Indonesia Sumatera Selatan Province. 2023. Sumatera Selatan Province in Figures 2023. https://sumsel.bps.go.id/publication/2023/02/28/e89a49138ffef974b573bc4c/provinsi-sumatera-selatan-dalam-angka-2023.html

Table 1.2 Jobs at risk in coal mining due to the retirement of the 32 CFPPs

Year	Jobs at risk in coal mining by province	
	East Kalimantan	South Sumatra
2028	1,574	943
2029	1,063	637
2030	941	564
2031	1,527	915
2034	757	454
2036	902	541
2037	23	14
2038	94	56
TOTAL	**6,881**	**4,124**
East Kalimantan and South Sumatra contribution to coal for power generation are 52.37% and 31.39% respectively.		

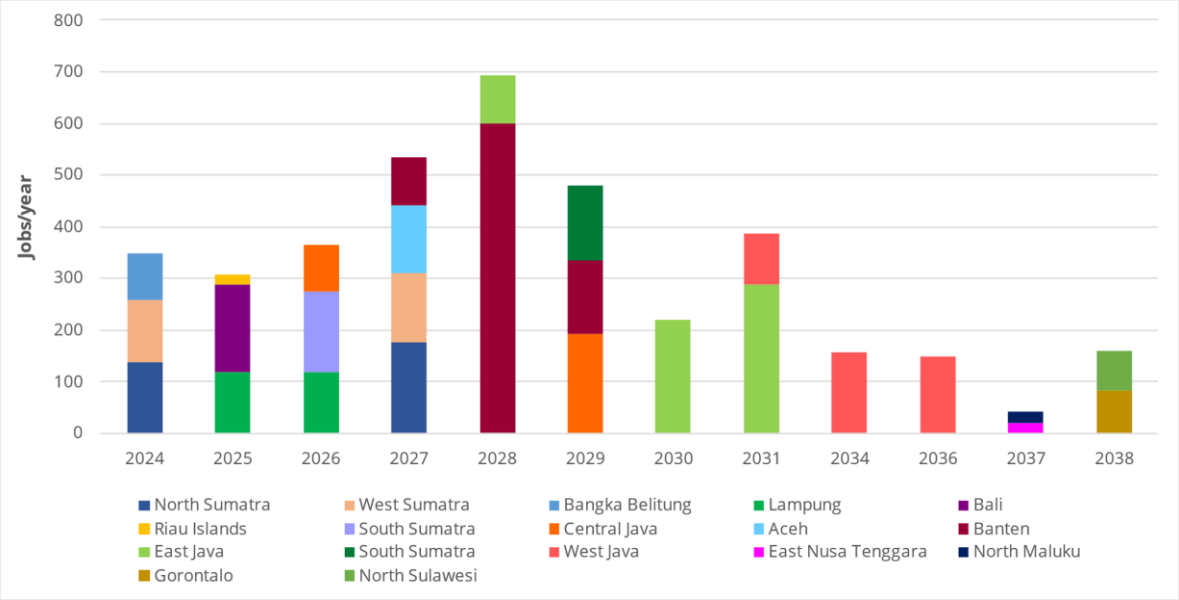
In the short term, during the high demand period, the CFPP retirement plan is expected to have minimal impact on coal mining employment, as excess coal can be exported to the international market. However, in the low demand period characterized by a 25% drop in international coal demand, there is a real concern for the loss of employment opportunities in the mining sector, particularly in North, East, and South Kalimantan, where coal infrastructure is concentrated. This poses a potential threat to the livelihoods of mining workers and their families in these regions.

1.2.2 CFPPs

In addition to the employment impact on coal mining, the retirement plan for CFPPs is expected to have a significant impact on employment at CFPPs, with the highest impact occurring in Lampung, Banten, East Java, and West Java provinces. According to Figure 1.1, the initial impact will begin with a three-year period averaging 320 jobs lost per year, followed by a high-impact period of 570 jobs lost per year for an identical duration. After 2031, the impact on CFPP employment is expected to decline to below 150 jobs lost per year. While none of the 32 sampled CFPPs are in East Kalimantan, about 300 jobs in CFPPs in South Sumatra could be at risk. As most of the workforce in the electricity supply sector are men, it is expected that approximately 3,800 jobs will be at risk due to CFPP retirement, with

approximately 3,400 consisting of men and 400 of women. Figure 1.1 illustrates the jobs at risk due to CFPP closure by province.

Figure 1.1 Jobs at risk due to CFPP closure by province



1.3 Regional Fiscal Impact Sensitivities

The early retirement of CFPPs can have significant consequences for the communities and regions that have long relied on the coal industry for employment and economic growth. Among these regions, East Kalimantan and South Sumatra are particularly affected and require careful consideration and planning for a just transition. It is projected that the retirement plan for the 32 included coal-fired power plants will result in a suppressed coal demand of approximately 73.4 million tons by 2038, predominantly consisting of low-rank coal/medium-rank coal (LRC/MRC) [5] quality coal. Additionally, with the decline in global coal demand, nearly 33% of this coal will not be exported, leading to further impacts on local economies [6]. This section examines the regional sensitivities of East Kalimantan and South Sumatra and highlights initiatives and strategies

[5] 4,200 to 5,000 kcal/kg GAR gross calorific value.

[6] IEA (2022) Coal in Net ZeroTransitions.From:https://iea.blob.core.windows.net/assets/4192696b-6518-4cfc-bb34-acc9312bf4b2/CoalinNetZeroTransitions.pdf

aimed at achieving a just transition for the affected communities. The relevant variables considered are described on **Table 1.3**[7]:

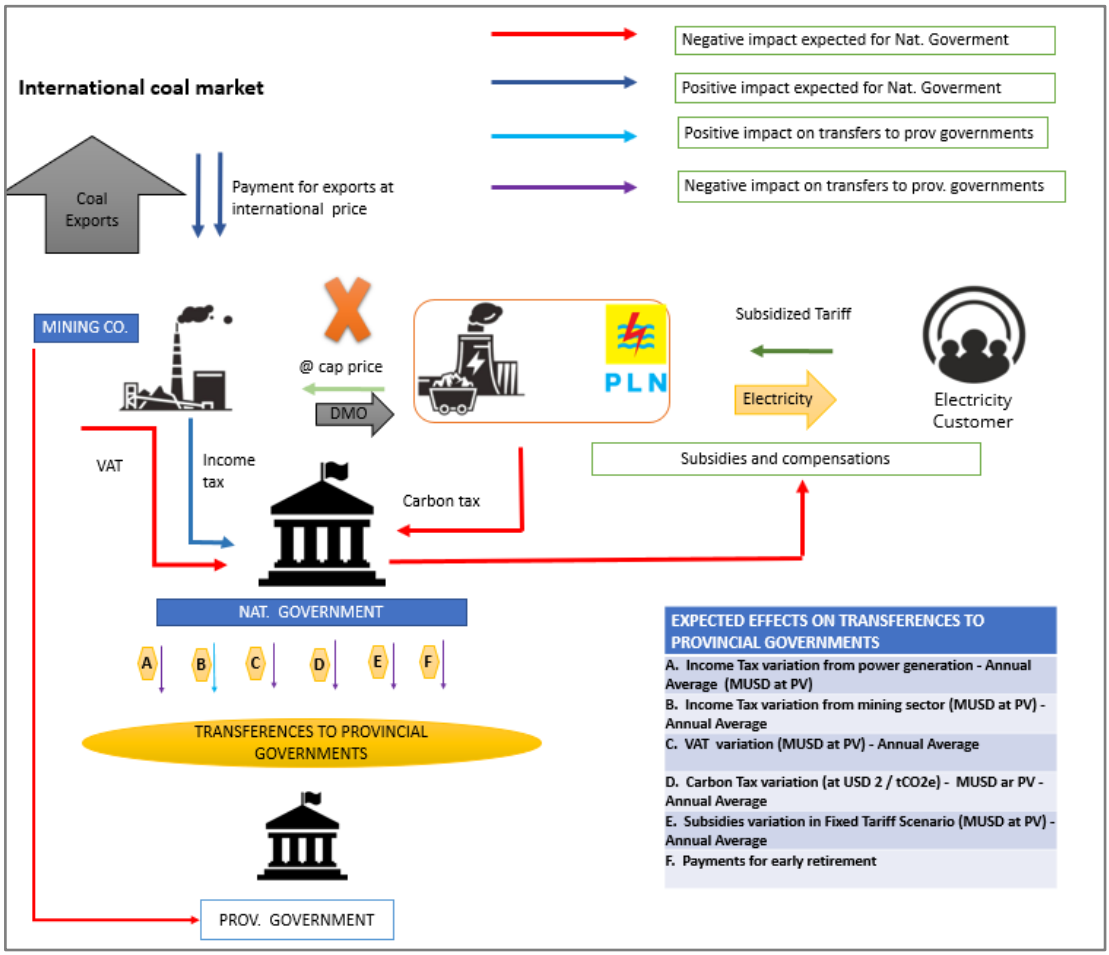
Table 1.3 Variables considered in the analysis

Category	Variable	Supply Chain Sector
Employment	Employment	CFPPs
		Mining
Fiscal Flows	Income Tax	CFPPs
		Coal and Lignite Mining
	VAT	CFPPs
		Coal and Lignite Mining
	Royalties	CFPPs
		Coal and Lignite Mining
NA: Not applicable Coal and lignite mining industries are included in the analysis considering the more than 80% of CFPPs' cost structure are fuel costs i.e. Coal.		

The Figure 1.2below presents a comprehensive overview of the Regional Fiscal Analysis, focusing on the significant impacts of the CFPPs Early Retirement Plan on fiscal flows in East Kalimantan and South Sumatra. This analysis aims to assess the sensitivity of fiscal revenues and expenditures in these provinces to the retirement plan. The diagram illustrates the crucial relationship between national government finances and provincial government finances, highlighting the key aspects of fiscal management in Indonesia that will be explored and elaborated upon in this analysis.

[7] The study acknowledges that CAPEX could have potential economic impacts. However, it has been excluded from the current discussion, which primarily focuses on the supply chain of the CFPPs and their impact on the regional economy. This decision was made because a significant portion of CAPEX components is directly associated with industries located outside the regional economy, particularly in terms of financial costs and direct investments. The banking industry, concentrated in Jakarta and sometimes beyond the country's borders, contributes to the financial costs, while equipment costs predominantly involve external production sources outside the regional and national economy.

Figure 1.2 Fiscal impact analysis scheme for affected provinces



The retirement of CFPPs in Indonesia not only affects employment opportunities in the power sector but also has significant implications for regional government revenues. In periods of high demand, the redirection of unused coal to the international market mitigates the impact on coal mining employment. However, during periods of low demand, the reduced export of LRC/MRC coal due to declining international demand can have a substantial impact on both the mining sector's employment and government revenues in the subsequent years. Provinces with a high concentration of coal infrastructure, such as North, East, and South Kalimantan, are particularly susceptible to these effects.

This Fiscal Impact Analysis was conducted based on a highly stressed scenario for provincial finances, considering several key assumptions:

- Fixed tariff subsidies, which are expected to generate higher subsidies under this retirement plan.
- A period of low international demand for coal (2028 onwards).
- Passive fiscal policies from the national government, directly affecting transfers to subnational governments, thereby negatively impacting their revenues and expenditures because of the Retirement Plan.

1.3.1 East Kalimantan

The fiscal impact on East Kalimantan due to the retirement of CFPPs will result in a 2.24% decrease in the province's annual revenue on average (Table 1.4). The largest share of this annual impact, at 1.95%, will be attributed to the increase in electricity subsidies. However, the total net impact of potential loss over the retirement period would be equivalent to 40.28% of East Kalimantan's total revenues in its annual budget. This impact is mainly due to the subsidy's variation in the Fixed Tariff Scenario, which is estimated to cause an accumulated impact of 35.08% of the annual budget. In addition, the Indonesian government will have to pay for early retirement compensation, which will represent an impact of 3.37% on the province's total revenue.

The royalties' variation would represent a loss for the provincial government of US$ 1,080.49 (15.4 million IDR). Local regencies will also be affected by the decrease in royalties (Table 1.4) because they have a share in these revenues as well.

Table 1.4 Fiscal impacts in East Kalimantan after retirement of the CFPPs (2023 - 2040)

Fiscal Impact Item	National Fund	East Kalimantan	
	Transfers to Local Gov. (US$)	Revenue from Transfers (US$)	Share of Revenues (%)
A. Income Tax variation from power generation - Annual Average (MUSD at PV)	49,106,464	379,593	0.055%
B. Income Tax variation from mining sector (MUSD at PV) - Annual Average	698,041,418	5,395,860	0.780%
C. VAT variation (MUSD at PV) - Annual Average	-2,672,722	-20,660	-0.003%
D. Carbon Tax variation (at USD 2 / tCO2e) - MUSD at PV - Annual Average	-373,310,027	-2,885,687	-0.417%
E. Subsidies variation in Fixed Tariff Scenario (MUSD at PV) - Annual Average	-31,396,753,546	-242,696,905	-35.083%
F. Payments for early retirement	-3,017,882,167	-23,328,229	-3.372%
G. Provincial royalties' variation		-15,480,318	-5.402%
Total impact on provincial Revenues		-278,636,346	-40.28
Royalties' variation on local governments (regencies)		-52,246,074	

1.3.2 South Sumatra

The retirement of CFPPs in South Sumatra would have significant fiscal impacts on the province's revenues. According to Table 1.5, the total net impact would be equivalent to a decrease of 37.65% on the annual provincial revenues, with the highest impact coming from the variation in electricity subsidies, which would represent 33.36% of the annual budget of this province. In addition, payments required to compensate the retirement of the power plants would represent an impact of 3.2% of the local revenue. The other variables, such as income tax variation from power generation, mining sector, and provincial royalties, as well as VAT variation, would have minimal fiscal impact. Therefore, the retirement of CFPPs would result in an annual average decrease of 2.10% on the province's revenues, with 1.85% corresponding to the impact of electricity subsidies. These findings suggest that the retirement of CFPPs in South Sumatra would have significant fiscal implications for the province (as well as for East Kalimantan Province) over the entire period of CFPPs retirement (2023-2040).

Table 1.5 Fiscal impacts in South Sumatra after retirement of the CFPPs (2023 – 2040)

Fiscal Impact Item	National Fund	South Sumatra	
	Transfers to Local Gov. (US$)	Revenue from Transfers (US$)	Share of Revenue (%)
A. Income Tax variation from power generation – Annual Average (MUSD at PV)	49,106,464.24	330,486.50	0.059%
B. Income Tax variation from mining sector (MUSD at PV) - Annual Average	698,041,417.90	4,697,818.74	0.742%
C. VAT variation (MUSD at PV) - Annual Average	-2,672,722	-17,987	-0.003%
D. Carbon Tax variation (at USD 2 / Tco2e) – MUSD at PV – Annual Average	- 373,310,026	-2,512,377	-0.397%
E. Subsidies variation in Fixed Tariff Scenario (MUSD at PV) - Annual Average	-31,396,753,546	-211,300,151	-33.358%
F. Payments for early retirement	-3,017,882,167	-20,310,347	-3.206%
G. Provincial royalties' variation		-9,371,028	-1.48%
Total impact on provincial Revenues		-238,483,585	-37.64%

Fiscal Impact Item	National Fund	South Sumatra	
	Transfers to Local Gov. (US$)	Revenue from Transfers (US$)	Share of Revenue (%)
Royalties' variation on local governments (regencies)		31,627,219	

2 Specific Economic Impact on the Electricity Sector

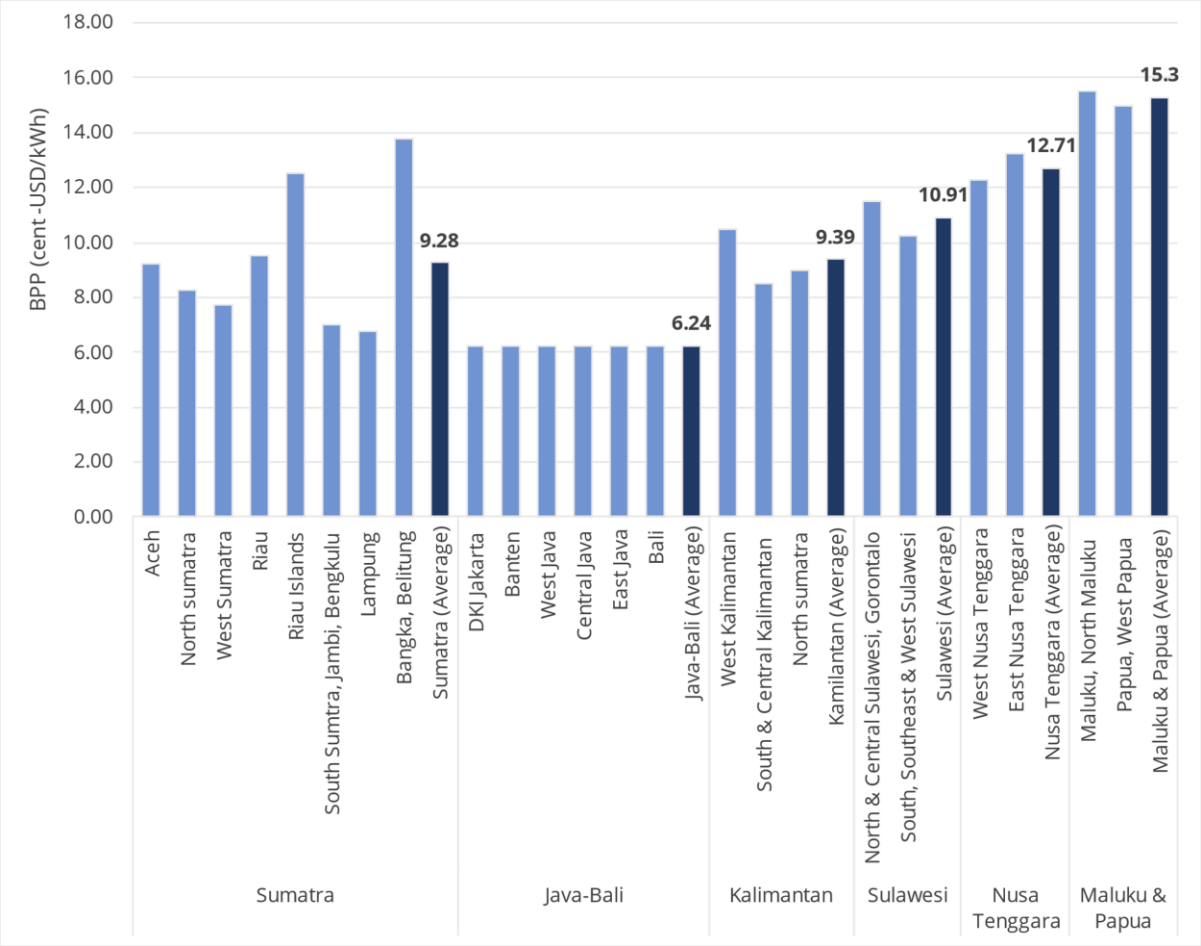
The retirement of CFPPs can have significant implications for the electricity sector, both in the short term and the long term. One key aspect is the variation in the Basic Generation Cost (Biaya Pokok Penyediaan Pembangkitan or BPP), which is the basic cost of electricity generation for a power plant. This cost varies considerably across different regions Figure 2.1, depending on factors such as availability of alternative energy sources, demand patterns, and grid infrastructure.

In the short term, the replacement of CFPPs with other energy sources may lead to an increase in wholesale electricity prices. This is because alternative energy sources may be more expensive to produce. However, the impact on wholesale electricity prices cannot be generalized, as it highly depends on regional factors. For example, Java, which is fully interconnected and relies on CFPPs for 60% of its electricity supply, has a lower BPP compared to other regions. On the other hand, regions like Bangka Belitung and Riau Island in Sumatra have higher BPPs due to limited interconnection and a greater reliance on diesel power plants.

Furthermore, the retirement of CFPPs can have both positive and negative impacts on the state-owned electricity company PT PLN (Persero). In the short term, PLN may experience an increase in electricity costs, which could put financial pressure on the company. This is primarily due to the need to procure electricity from alternative sources that may have higher costs. On the flip side, PLN may also see a decrease in electricity sales due to potential price increases, which could impact on its revenue.

In the long term, the retirement of CFPPs may lead to an increase in investment needs for PLN as it transitions to cleaner energy sources. However, it may also bring benefits in terms of reduced operational expenses associated with coal-fired power plants.

Figure 2.1 Cost of PLN in generating power and in procuring electricity for 2020 (Biaya Penyediaan Pokok - BPP), as stipulated in the MEMR Decree 169/2021



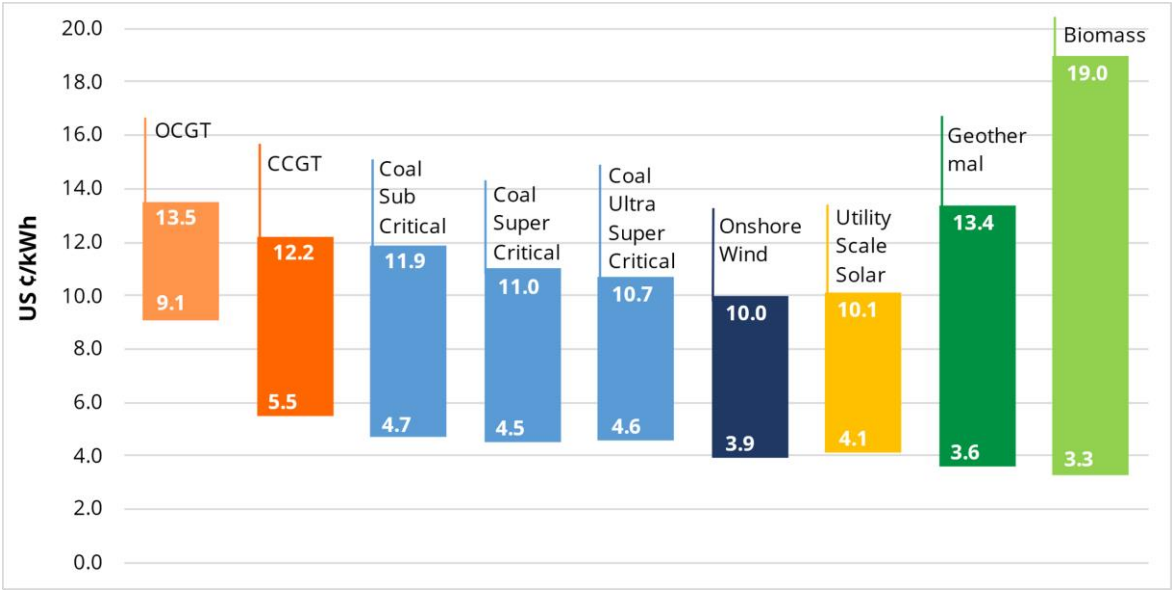
2.1 BPP Variation

The impact of the early retirement of CFPPs on the electricity sector in Indonesia, particularly on the BPP (basic electricity generation cost), is significant and has several implications.

Firstly, replacing the lost power generation from CFPPs with RE sources will require substantial RE capacity. Although RE can have competitive levelized costs of energy (LCOE) in Indonesia (Figure 2.2), CFPPs are still considered the cheapest source of bulk generation in the country, with a generation cost ranging from US$ 66 /MWh to US$95 / MWh (0.98 to 1.4 million IDR/MWh). This cost advantage of coal is primarily due to factors such as coal domestic obligations (DMO), which

limit coal prices locally, and the absence of accounting for externalities like local pollution costs. Consequently, there will be variations in the BPP due to the differences in generation costs between RE and CFPP. Price volume caps can have significant economic implications. From an economic rent perspective, these caps can prevent the market from maximizing its efficiency and hinder the generation of surplus value. By limiting the quantity of goods or services that can be produced or sold, price volume caps distort resource allocation and prevent resources from being allocated to their most productive uses. This can lead to missed opportunities for economic rent to be realized. Ignoring externalities is another key economic implication of price volume caps. Allowing a polluting industry to continue operating without accounting for the negative externalities, such as environmental degradation or health impacts, does not accurately reflect the true economic cost. Ignoring externalities can lead to market inefficiencies and hinder the overall welfare and sustainability of the economy. The implementation of the national Emissions Trading System (ETS) policy for CFPPs presents an opportunity for RE electricity to become more competitive. However, the success of this policy will depend on the complementary policies implemented to support the growth of RE capacity.

Figure 2.2 Levelized cost of renewables and fossil power plants in Indonesia[8]



In the short term, the replacement of CFPPs with RE is expected to result in an increase in the cost of electricity generation. The retirement of coal plants will cause a shift in the supply curve, leading to PLN dispatching more expensive energy sources first (Figure 2.3[9]). This shift will contribute to higher electricity prices.

To illustrate the situation, in the unrealistic situation where 16.9 GW capacity corresponding to the 32 CFPPs considered in the early retirement scenario is retired without immediate replacement by renewables, there would be a significant increase in the electricity generation cost (Figure 2.3a). The cost of generation could rise from US$ 82/MWh (1.2 million IDR/MWh) to as high as US$ 384/MWh (4.2 million IDR/MWh), representing the maximum generation cost (Figure 2.3b). The weighted average generation cost would rise from US$ 80/MWh to US$ 92/MWh, representing ~US$ 3.7 billion in costs for the Indonesian economy. High electricity costs can have significant socioeconomic impacts.

[8] IESR (2023). Making Energy Transition Succeed: A 2023's Update on The Levelized Cost of Electricity and Levelized Cost of Storage in Indonesia. Jakarta: Institute for Essential Services Reform (IESR).

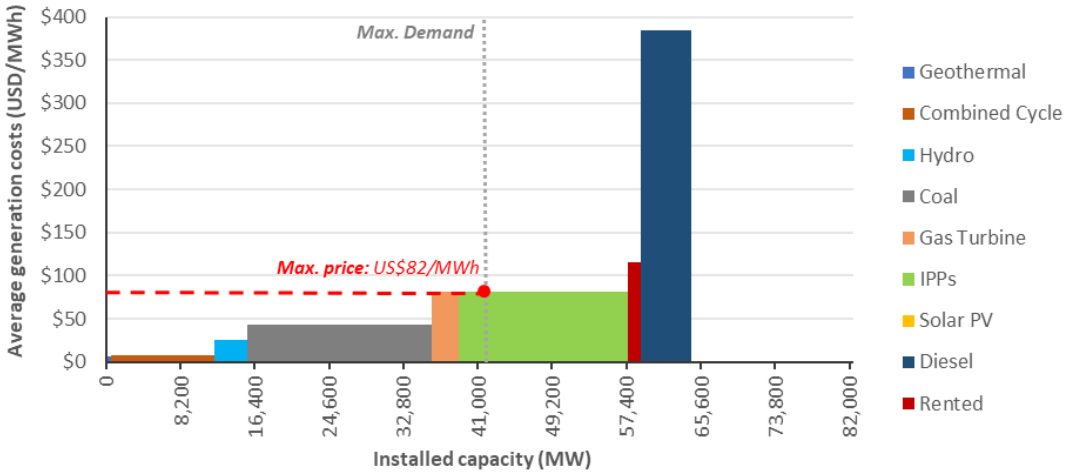
[9] PLN (2022) statistics PLN 2021. https://web.pln.co.id/statics/uploads/2022/08/Statistik-PLN-2021-29-7-22-Final.pdf

Increased electricity prices can disproportionately affect households and lower-income individuals, as they spend a larger portion of their income on energy-related expenses. Higher electricity bills can strain household budgets, leading to reduced discretionary spending on other essential goods and services, such as healthcare, education, or basic needs. Additionally, high electricity costs can affect the cost of living, potentially leading to inflationary pressures and reduced purchasing power. The increased burden on households can exacerbate income inequality, as those with lower incomes may struggle to cope with rising energy expenses.

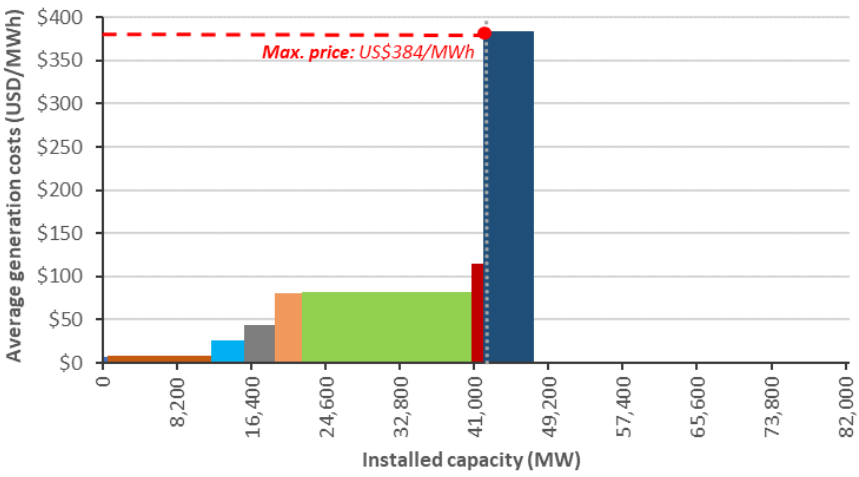
To mitigate this increase in electricity prices, it is crucial to add new renewable energy sources. Figure 2.3c illustrates that if the generation of the retired 32 CFPPs is replaced by a mix of geothermal, hydro, and solar PV (50%, 25%, and 25% respectively), the maximum generation cost would decrease. The weighted average generation cost could decrease up to US$ 76/MWh if this mix of renewables is deployed. PLN can proactively prepare to mitigate the impact and transform this risk into an opportunity to lower generation costs and, consequently, reduce electricity prices for consumers.

Figure 2.3 Merit order curve for PLN's owned, rented and IPP generation, (a) today, (b) after coal retirement and (c) after the retired coal generation has been replaced with renewables.

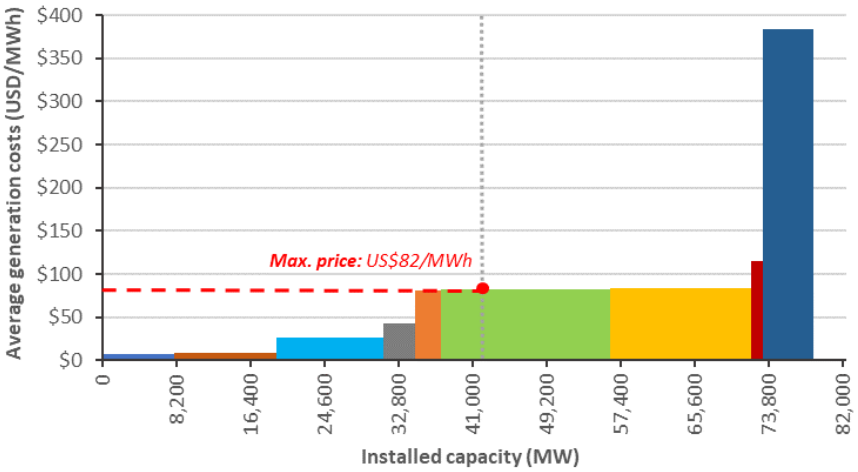
(a)



(b)



(c)



Moreover, the compensation required for early retirement to meet JETP requirements will need to be considered. This compensation cost, estimated at US$ 1 billion per year until 2040[10], is expected to be passed on to the off taker, generally PLN, through the wholesale electricity tariff, potentially impacting the BPP. It should be noted that the consumer electricity tariff in Indonesia is determined by the government, which provides subsidies and compensations to

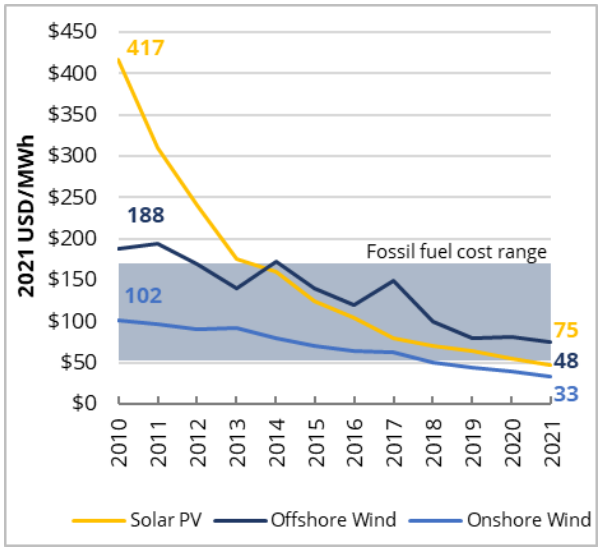
[10] Our estimate is ~US$ 9bn for CFPP retirement by 2040, annualized at 8%.

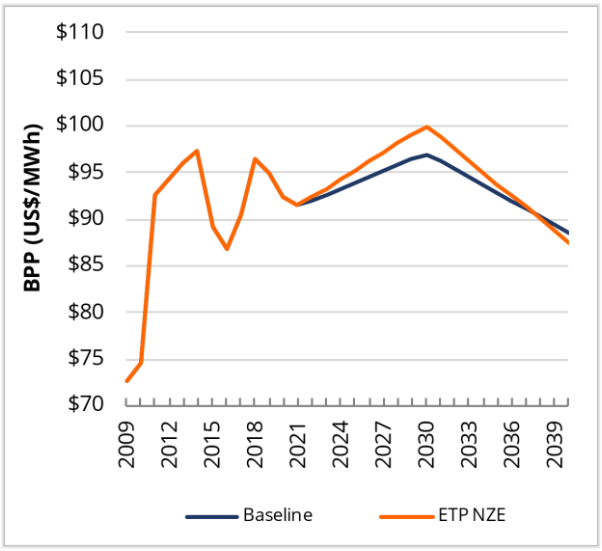
bridge the gap between the electricity generation cost from the power utility company and the consumer. Without adjusting the consumer electricity tariff, imposing the cost of early retirement on the generation costs will increase subsidy needs and add additional burden to the government.

Looking ahead, the retirement of CFPPs and the increased deployment of RE are expected to have a long-term impact on the BPP. As the costs for RE decrease, it is projected to eventually become a cheaper option for electricity generation than CFPPs. In this study, the ETP NZE scenario indicates that the BPP will reach its peak at US$ 100/MWh (1.4 million IDR/MWh) in 2030 due to the accelerated deployment of RE, particularly solar and wind energy, along with other planned developments that require substantial upfront capital investments. By 2030, the investment costs for utility-scale solar PV and onshore wind in Indonesia are expected to decrease to approximately US$ 19/MWh (0.28 million IDR/MWh) and US$ 17/MWh (0.25 million IDR/MWh), respectively. However, by 2040, the BPP is expected to decrease to US$ 88/MWh (1.3 million IDR/MWh) due to lower fuel cost associated with RE[11]. Additionally, the Indonesian government is planning to implement carbon pricing mechanisms that will increase the cost of CFPP electricity generation, thus narrowing the price gap between RE and CFPPs. While the DMO's role can still be relevant, implementing a carbon price mechanism, such as a carbon tax or emissions trading system offers several advantages. A carbon price efficiently targets pollution by incentivizing emission reductions and discriminating against more polluting power plants. In principle. It promotes low-carbon investments by reinvesting revenue into renewable energy subsidies and other measures to transition to a sustainable economy. Carbon pricing adopts a market-based approach, driving innovation and flexibility in emission reduction strategies. These long-term impacts indicate that while the retirement of CFPPs may initially result in an increase in the BPP, the eventual transition to RE is likely to lead to lower costs for electricity generation in the long run.

[11] IEA (2022), *Coal in Net Zero Transitions*, IEA, Paris https://www.iea.org/reports/coal-in-net-zero-transitions, License: CC BY 4.0

Figure 2.4 Global weighted average Levelized Costs of Electricity (LCOE) for utility scale PV and Wind[12] (left); BPP evolution in Baseline and ETP NZE (right)





2.2 Indirect impacts on PLN's cash flow

The early retirement of CFPPs may have a significant impact on PLN's cash flow, particularly in the short term. The reduction in coal supply could lead to an increase in generation costs and a higher cost of electricity from independent power producers (IPPs), which would negatively affect PLN's operating cash flow. Additionally, as PLN invests in new low-carbon technologies to replace the retired CFPPs, the company's investing cash flow may be affected. However, the early retirement of CFPPs, in addition to a lower operating expenditure (OPEX) generation portfolio, may liberate cash for PLN to invest in new technologies and infrastructure, which could positively impact the company's long-term financial position by reducing operational expenses. Overall, the impact of early retirement on PLN's cash flow will depend on the company's ability to manage the transition effectively and maintain a stable financial position throughout the process.

[12] IRENA (2022), *Renewable Power Generation Costs in 2021*, International Renewable Energy Agency, Abu Dhabi.

2.2.1 Short-term impacts on PLN's cashflow

2.2.1.1 Increase in electricity costs

In the short term, the increase in electricity costs will impact PLN's cash flow in two ways. Firstly, as mentioned, PLN will have to pay higher prices to purchase electricity from independent power producers (IPPs). For ongoing power purchase agreements (PPAs), which have specific pricing conditions for a fixed energy volume, IPPs are requested to supply surplus energy to compensate for the retired one. It is most likely that the extra volume of energy is sold at a higher price than at the convenient price at which the PPA was signed first. As well, coal phase-out could also increase the contractual price of new PPAs. PPAs prices are usually defined so that they are more competitive than the utility's generation costs, prioritizing offers from IPPs with lower marginal prices. However, as coal is retired and PLN's overall generation costs increase (Figure 2.3), IPPs may offer PPAs with higher prices than the ones offered in the last decade, meaning PLN would now engage in more expensive contracts. In Indonesia, renewable energy auctions are one of the three procurement mechanisms, alongside direct appointment and direct selection. Although several solar PV and geothermal auctions have been announced in Indonesia, only a few have resulted in awarded bids. The success of auctions in Indonesia has been hindered by overlapping regulations and frequent changes in the legal and regulatory framework for solar PV[13,14] Geothermal auctions are often postponed or canceled due to the need for additional studies or a lack of interest from companies interested in participating in the projects[15].

[13] Hamdi, E. (2019), Indonesia's Solar Policies Designed to Fail? Institute for Energy Economics and Financial Analysis (IEEFA), retrieved from https://ieefa.org/wp-content/uploads/2019/02/Indonesias-Solar-Policies_February-2019.pdf

[14] Hamdi, E. (2020), Racing Towards 23% Renewable Energy, Institute for Energy Economics and Financial Analysis (IEEFA).

[15] PWC (2018), Power In Indonesia: Investment and Taxation Guide November 2018, 6th Edition , PricewaterhouseCoopers, retrieved from https://www.pwc.com/id/en/publications/assets/eumpublications/utilities/power-guide-2018.pdf

Secondly, PLN's own generation costs will also increase as they start to replace the retired CFPPs with energy from existing capacity from natural gas or diesel. The lower than regional average capacity factor (CF) of natural gas and diesel suggests that they can be ramped up as opposed to geothermal where CF is over 80%. (Table 2.1). These alternative sources may be more expensive than subsidized coal, which will increase PLN's costs of goods sold. As a result, PLN's short-term cash flow may be negatively affected due to higher costs of purchased electricity and generation costs.

Table 2.1 Estimated capacity factor by type of generation

Generation Type	Average generation costs[16] (IDR/kWh)	Average generation costs (US$ /MWh)	Indonesia/ Global CF (%)
Diesel	5,906	384	10%/42%[17] *
Solar PV	1,284	84	4%/7%[18]
Gas Turbine	1,248	81	9%/37%[19]
Coal	668	43	64%/57%[20]
Hydro	398	26	38%/39%[21]***
Combined Cycle	126	8	31%/54%[22]**

[16] PLN (2022) statistics PLN 2021. https://web.pln.co.id/statics/uploads/2022/08/Statistik-PLN-2021-29-7-22-Final.pdf

[17] Azizul Mohamad and Nasrul Amri Mohd Amin (no date) Simulation of a diesel generator - battery energy system for domestic for domestic applications at Pulau Tuba, Langkawi, Malaysia. School of Mechatronic Engineering, Universiti Malaysia Perlis, Perlis, Malaysia: https://www.researchgate.net/publication/337684925_Simulation_of_a_diesel_generator_-battery_energy_system_for_domestic_applications_at_Pulau_Tuba_Langkawi_Malaysia

[18] IESR (2019), Levelized Cost of Electricity in Indonesia, Institute for Essential Services Reform (IESR), Jakarta

[19] Idem

[20] Idem

[21] Natanael Bolsona, Pedro Prieto, and Tadeusz Patzek (2022) Capacity factors for electrical power generation from renewable and non-renewable sources. PNAS: https://doi.org/10.1073/pnas.2205429119

[22] Published by Statista Research Department and 25, J. (2023) U.S. energy capacity factors by source 2021, Statista. Available at: https://www.statista.com/statistics/183680/us-average-capacity-factors-by-selected-energy-source-since-1998/

Generation Type	Average generation costs[16] (IDR/kWh)	Average generation costs (US$ /MWh)	Indonesia/ Global CF (%)
Geothermal	107	7	83%/73%[23]

* Average capacity factor for diesel in Malaysia
** Average capacity factor for combined cycle in US
*** Average capacity factor for hydro in Asia

2.2.1.2Decrease in electricity sales

The decrease in electricity sales is a potential short-term impact resulting from the early retirement of CFPPs and the transition to new renewables in Indonesia. Historically, electricity prices have been kept low through subsidies, which have contributed to a relatively inelastic demand for electricity. Studies have estimated the elasticity of electricity demand in Indonesia to be -0.15 in a given year and -0.4 over a four-year period[24], indicating the effectiveness of subsidies in maintaining stable demand.

As CFPPs retire and electricity tariffs increase in the short term, higher subsidies from the government may be necessary to prevent consumers from perceiving a significant rise in tariffs. If the government is unable to meet these subsidy requirements, there is a possibility that the inelasticity of electricity demand could change, leading to a reduction in consumption by consumers in response to higher prices. To mitigate the potential impact of increased electricity prices, the government could actively promote energy efficiency programs and policies while retiring CFPPs, which has a benefit at an end consumer level and at a grid level[25]. Additionally, it is worth noting that the projected electrification targets from PLN

[23] IESR (2019), Levelized Cost of Electricity in Indonesia, Institute for Essential Services Reform (IESR), Jakarta

[24] Burke, P. & Kurniawati, S. Electricity subsidy reform in Indonesia: Demand-side effects on electricity use, Energy Policy, Volume 116, 2018, Pages 410-421, ISSN 0301-4215,https://doi.org/10.1016/j.enpol.2018.02.018

[25] IEA (2014) Multiple Benefits of Energy Efficiency. From: https://www.iea.org/reports/multiple-benefits-of-energy-efficiency/energy-prices

may experience delays if rates are postponed due to the increase in electricity prices.

These implications highlight the importance of carefully managing the retirement of CFPP, and considering the potential effects on electricity demand, consumer behavior and government subsidies. Energy efficiency and adequate support for vulnerable consumers during the transition can mitigate some of these indirect impacts.

2.2.1.3Increase in Cash

PLN has the potential to significantly increase its cash flow through compensation mechanisms for the early retirement of CFPPs. These mechanisms can provide PLN with financial resources to invest in low-carbon technologies and enhance grid infrastructure. Various compensation options, such as grants, zero-cost financing, and pre-financing, are available to compensate CFPP owners for their future cash flow.

Based on similar transactions in the region, the estimated value for the early retirement of CFPPs in Indonesia is up to US$1.6 million per MW (14.8 billion IDR/MW) [26]. Considering this estimate, PLN could receive approximately US$11.8 billion for retiring the selected 32 CFPPs (16.9 GW) included in this study. These funds can then be strategically allocated towards investments in renewable energy, such as around 11 GW of solar PV[27], and strengthening the grid infrastructure to accommodate a larger share of variable energy sources.

This increase in cash flow not only benefits PLN in the short term but also positions the company to proactively prepare for the long-term energy transition. By supporting the development of sustainable and resilient energy infrastructure, PLN can contribute to a greener and more sustainable future. This investment in low-carbon technologies and grid reinforcement will play a crucial role in enabling

[26] Regional: Opportunities to Accelerate Coal to Clean Power Transition in Selected Southeast Asia Developing Member Countries, ADB; October 2021

[27] Based on the IEA estimated cost of construction for utility-scale solar PV of US $1.07 million per MW IEA (2022), Enhancing Indonesia's Power System, IEA, Paris https://www.iea.org/reports/enhancing-indonesias-power-system

the integration of renewable energy sources and facilitating a smooth transition to a more sustainable energy system.

2.2.2 Long-term impacts on PLN's cashflow

2.2.2.1 Increase in investment needs

The early retirement of CFPPs will have a profound long-term impact on PLN's investment and financing cash flow, as the company will need to make substantial investments in new energy sources and the necessary infrastructure to support them. With the government's target of achieving 23% renewable energy in Indonesia's energy mix by 2025, an annual investment of US$8 billion in renewable energy capacity alone will be required[28].

As variable renewable energy sources are integrated into the grid, enhancing system resilience through flexibility becomes crucial[29]. This will necessitate investments in grid infrastructure, including transmission and distribution systems, as well as interconnection technologies. Of particular concern is the Java-Madura-Bali system, which predominantly relies on 150kV transmission lines[30]. Strengthening the grid and establishing interconnections with other nations and islands can significantly enhance flexibility[31]. However, Indonesia's geographical characteristics pose challenges for achieving supply-demand balance across the country, as most islands operate separate power systems.

[28] IISD (2022) Indonesia Must Quadruple its Annual Renewable Investment Target to Reach its Climate Objectives. From: https://www.iisd.org/articles/indonesia-annual-renewable-investment-target

[29] Jasper Donker and Xander van Tilburg (2018). AMBITION TO ACTION: Grid integration in Indonesia, Contribution of variable renewable power sources to energy and climate targets.

[30] International Energy Agency (2022). Enhancing Indonesia's Power System, Pathways to meet the renewables targets in 2025 and beyond.

[31] The ASEAN Power Grid's connections are planned to be expanded to nearby nations and between islands. As a first phase, Java and Sumatra systems are expected to be connected by 2028.

While the early retirement of CFPPs will entail significant investment, estimated at US$80 billion[32], to develop Indonesia's grid infrastructure by 2030, these investments are expected to yield positive impacts on efficiency and social well-being. To support the transition to a more diverse and resilient energy system, PLN should explore additional solutions such as battery energy storage systems, smart grids, and demand response programs. While PLN has already made progress in leveraging digital technology and advanced analytics in dispatching centers, further efforts will be necessary to ensure the successful deployment of renewable energy sources.

In line with this, Presidential Regulation 18/2020 on the 2020-2024 National Medium-Term Development Plan (RPJMN) has directed PLN to design a smart grid program. This program aims to establish five smart distribution networks annually in Java-Bali from 2020 to 2024, aligning with Indonesia's sustainability goals and supporting the transition towards a more sustainable energy future.

2.2.2.2Reduced operational expenses

The retirement of CFPPs and the transition to renewable energy sources will lead to long-term savings in PLN's operational expenses. Currently, fuel and maintenance constitute a significant portion of PLN's annual operating expenses, accounting for 44% in 2020. However, as CFPPs are phased out and replaced with renewables, this share is expected to decrease substantially. Renewable energy sources not only eliminate fuel costs but also have lower operational and maintenance expenses compared to thermal power plants.

According to the US Energy Information Administration (US EIA), the fixed operation and maintenance (O&M) costs for ultra-supercritical coal power plants averaged US$49.5/kW-year in 2021. In contrast, wind and solar PV with tracking had average O&M costs of US$27.6/kW-year and US$15.97/kW-year, respectively[33]. This demonstrates the cost advantage of renewable energy

[32] IRENA (2022). Renewable Pathway More Cost Effective than Fossil Fuels in Indonesia. From: https://www.irena.org/News/pressreleases/2022/Oct/Renewable-Pathway-More-Cost-Effective-than-Fossil-Fuels-in-Indonesia

[33] US EIA (2022), Cost and Performance Characteristics of New Generating Technologies, Annual Energy Outlook 2022. From: https://www.eia.gov/outlooks/aeo/assumptions/pdf/table_8.2.pdf

sources in terms of operational efficiency. Furthermore, as CFPPs age, the frequency and cost of corrective maintenance tend to increase, adding to their operational expenses.

By transitioning to a low-carbon power system, PLN can achieve significant savings in operational expenses over time. These savings arise from reduced fuel costs, lower O&M expenses, and avoiding expensive corrective maintenance as CFPPs age. This financial benefit allows PLN to allocate resources towards other strategic investments, such as expanding renewable energy capacity, grid infrastructure development, and the implementation of energy efficiency programs. Ultimately, these long-term savings contribute to the financial sustainability of PLN and support the transition to a cleaner and more cost-effective energy system in Indonesia.

3 Strategies for Delivering a Just Transition

The phase-out of coal power plants presents both challenges and opportunities for the affected regions and the overall energy landscape in Indonesia. It is crucial to address the potential consequences on employment and fiscal conditions while simultaneously capitalizing on the potential benefits of transitioning to cleaner and more sustainable energy sources.

The recommendations outlined in Table 3.1 aim to minimize the adverse effects on employment and fiscal flows by implementing targeted measures that prioritize the well-being of workers and the stability of the regional and national economies. By diversifying the energy mix and expanding into renewable energy sources, Indonesia can unlock new employment opportunities and stimulate economic growth while reducing its reliance on coal.

Table 3.1 Strategies matrix

Relevant Impact	Strategies	Expected results
Employment		
6,880 jobs at risk in East Kalimantan and 4,120 in South Sumatra within the coal mining industry with a total expected impact of 13,000 jobs over the CFPP retirement period.	Skill audits at mining companies and determination of vulnerable groups such as women, older workers, and foreigners as well as skills compatibility of miners with those required by other industries.	Just transition effectively applied in the coal phase-out in Indonesia, focused on leave no one behind. Solutions suited to socioeconomic baseline in each province.
3,800 jobs at risk in CFPPs over the retirement period (3,400 men, 400 women) with 300 located in South Sumatra.	Skills audit at facility level, upskilling programs with respect to forecasted skills in renewable energy (i.e., solar and wind) and counselling support for skilled workers.	
Fiscal flows		
High likely impact on transferences from national government to	a) Establish a Just Transition Fund to ensure the stability of	Long term stability for national and provincial budget, including East

Relevant Impact	Strategies	Expected results
both East Kalimantan, and South Sumatra. Under a long-term scenario, and under the assumption that national government would maintain passive fiscal policies, the CFPPs Early Retirement Plan would cause a lost would be equivalent to 35% of the total revenue of an annual budget for South Sumatra and 38% for East Kalimantan. More than 90% of this likely negative impact for both provinces are explained by a likely decrease of cash transferences from national government caused by an increase in subsidies for electricity.	the provincial budget for East Kalimantan and South Sumatra, even with the additional expenditures for projects which allow to minimize the Plan impact on Labor Force	Kalimantan and South Sumatra

ETP's Just Coal Transition Forum (JCTF) can support the development of the strategies described in the previous matrix. The JCTF aims to deliver coordination services, facilitate strategies, and transition projects, as well as coordinate technical assistance to build and implement capacities that support coal phase-out in Southeast Asia[34]. Relevant details about recommendations established in the previous matrix and with which JCTF could support are:

- **Conduct a comprehensive study of job qualifications and skills:** To effectively transition workers from the coal mining and CFPPs industries, it

[34] ETP (2022). The Just Coal Transition Forum, Concept Note. From: https://www.energytransitionpartnership.org/resource/concept-note-just-coal-transition-forum/

is important to identify the skills and qualifications of the affected workers. The study should also assess labor gaps with respect to high-growth industries in the same or neighboring provinces. This will help determine the types of training and upskilling programs that will be necessary to support a just transition.

- **Implement a low-cost capacity-building program:** Given the high number of workers who may exit their jobs each year, a capacity-building program backed by official mechanisms and with financial support from the government, if necessary, should be put in place. This program should focus on providing workers with the skills and knowledge required for high-growth industries in the same or neighboring provinces.
- **Promote job boards:** Utilizing job boards to help workers re-enter the labor market is an appropriate mechanism for the local conditions, where provinces exhibit an unemployment rate just above what is considered a situation of full employment (between 4.1% and 4.7%). Job boards can be a useful tool to connect workers with job opportunities and employers seeking skilled workers.
- **Establish a Just Transition Fund:** A Just Transition Fund, fed by the operation fees of new renewable energy companies and the increased income tax coming from the Coal Mining Sector, is a highly recommended policy to ensure stability in national and subnational budgets. This fund can provide enough funding for social programs, such as the proposed re-skilling program for workers from CFPPs and the mining sector and support a just transition for affected workers.

ANNEX

Annex I. Analysis Concept

1. Employment variation

Table 1. Indicators for measuring impact on employment

Indicator Name	Definition	Level of analysis
Employment variation in CFPPs[1]	Jobs lost / MW retired in a year per province. This indicator will be disaggregated by gender and formal sector	Every province, based on data for CFPPs installed in each province.
Employment variation in Mining Industry[2]	Jobs lost / Variation in coal production (tons), in a year per province. This indicator will be disaggregated by Gender and Formal/Informal sectors	Every province identified as one of the coal origins for CFPPs. (Primary analysis at province level, based on mining employment and income data).
Notes: Employment variation in CFPPS is estimated directly, based on employees' number per plant (Annex 5). Employment variation in mining is based on i) the suppressed coal demand (no longer required by retired CFPPs) that will not be exported due to a period of low international coal demand, and ii) average labor productivity figures indicated for the industry.		

2. Government revenue variation

Table 2. Indicators for measuring the impact from government revenue variation

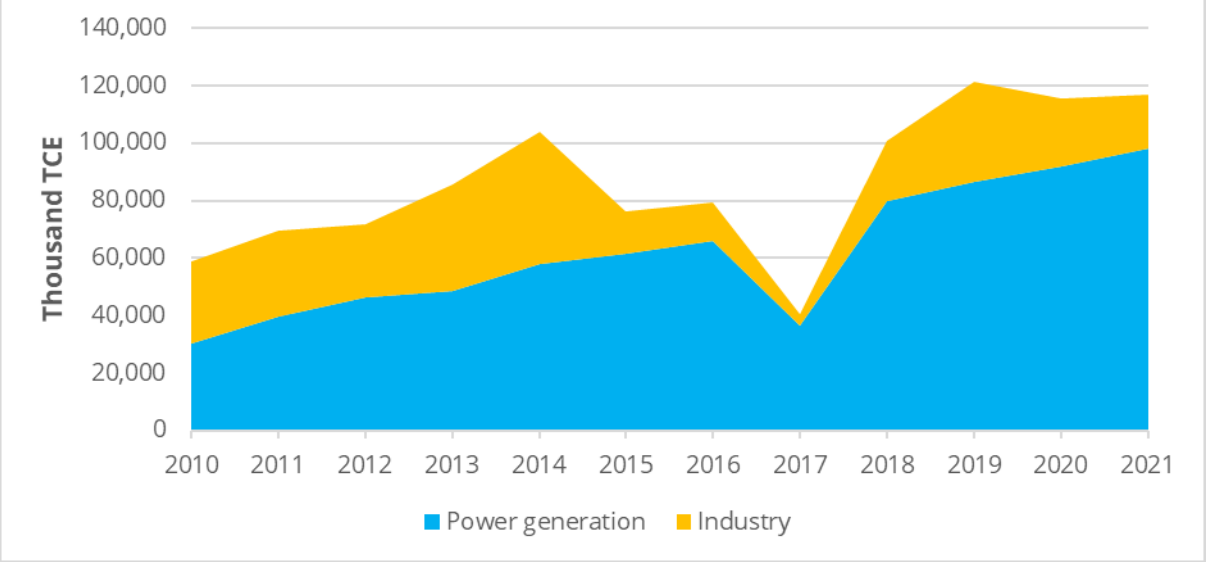
Indicator Name	Definition	Level of analysis
Income Tax variation from CFPPs	USD corporate income tax variation / MWh retired in a year per province.	Every province, based on Retirement Plan .
Corporate Income Tax variation from the mining industry	USD corporate income tax variation / Variation in coal production (tons), in a year per province.	Every province identified as one of the coal origins for CFPPs. (Primary analysis at province level, based on mining employment and income data)
VAT variation from CFPPs	USD corporate VAT variation / MWh retired in a year per province.	Every province, based on CFPPs retired from such province
VAT variation from the mining industry	USD VAT variation / Variation in coal production (tons), in a year per province.	Every province identified as one of the coal origins for CFPPs.
Royalties' Individual variation from the mining industry	USD Royalties variation / Variation in coal production (tons), in a year per province.	Every province identified as one of the coal origins for CFPPs.
Note: VAT does not apply for exports		

In the analysis, the total amount of exportable coal is estimated for every year according to the retirement plan. The difference between the cap price due to DMO and International price should be considered as an additional net income for mining companies, amplifying this way the taxable income base for the government. In terms of value added tax (VAT) on the other hand, since it is not applicable for exported goods, it is foreseeable a variation on this fiscal revenue.

Annex 2. Coal Balance

Coal balance is determinant to quantify the impact on fiscal and employment dimensions since taxes, royalties and jobs at risk are linked to transactions of both coal as commodity and coal-based electricity. Indonesia is a coal net exporter country with broadly 72% of its production being exported and with a share of 81% and 19% of its domestic coal demand coming from power generation and industry, respectively. This means that about 92 million tons of coal are being diverted every year for power generation following an increasing trend in the last years (Figure 1).

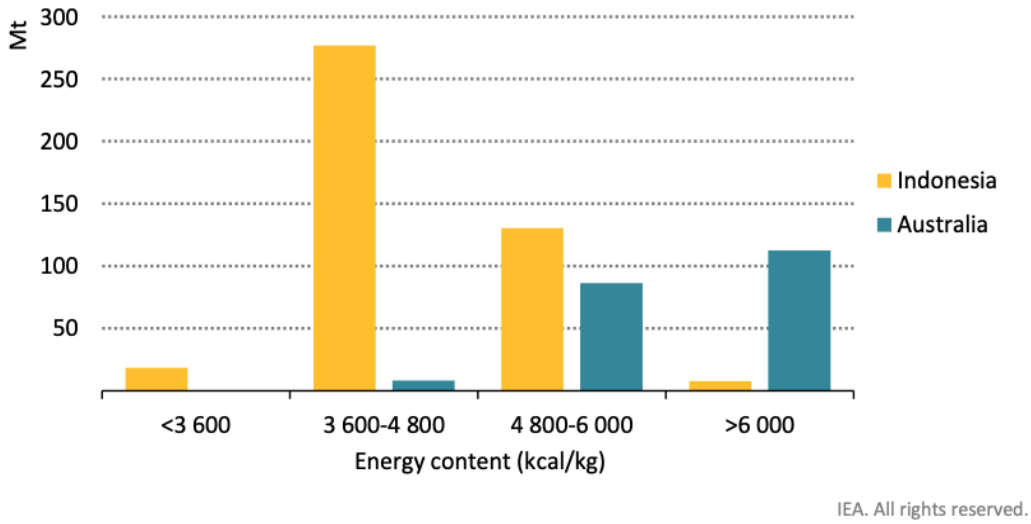
Figure 1. Domestic coal demand in Indonesia (2010-2021)[35]



Most of the Indonesian coal exports are in the lower quality/lower energy content segments of the market.

[35] Indonesia Energy Balance 2010-2021 – Coal. Compiled from Handbook of Energy & Economic Statistics of Indonesia (2010-202).

Figure 2. Coal exports by energy content from Indonesia and Australia[36]



As retirement comes in place, the suppressed coal demand will change at the same time as international coal demand drops.

Table 3. Suppressed coal demand not exportable

Retirement year	International coal demand drop[1] (%)	Suppressed coal demand not exported[2] (ton/year)
2024	0%	0
2025	0%	0
2026	0%	0
2027	0%	0
2028	25%	5,594,554
2029	36%	3,778,104
2030	46%	3,345,092
2031	50%	5,426,223
2034	61%	2,692,330

[36] IEA. 2022. Coal in Net Zero Transitions. Strategies for rapid, secure, and people-centred change. https://iea.blob.core.windows.net/assets/4192696b-6518-4cfc-bb34-acc9312bf4b2/CoalinNetZeroTransitions.pdf

Retirement year	International coal demand drop[1] (%)	Suppressed coal demand not exported[2] (ton/year)
2036	68%	3,207,855
2037	71%	84,255
2038	75%	337,496
TOTAL		24,465,908

Notes:

1. Drop of international coal demand taken for the 32 CFPPs to be retired.
2. Applied as a percentage of the total coal demand for each year.

Annex 3. Fiscal Methodology

To perform a provincial sensitivity analysis for East Kalimantan and South Sumatra, their contribution to the coal demand for power generation has been determined. By concealing the percentage of coal production destined to the domestic market in each province with the national average of coal production used in power generation, it is possible to verify that 49% of the coal produced in South Sumatra and 19% of the coal produced in East Kalimantan have been feeding CFPPs across the country roughly satisfying 31% and 52% of the country's coal demand for power generation respectively[37].

Figure 3 gives a comprehensive introduction to the Regional Fiscal Analysis which allows to identify the most significant impacts of the early retirement to the fiscal flows for both East Kalimantan, and South Sumatra. Therefore, the analysis identifies the sensitivities of retirement in the fiscal flows. This figure presents three aspects of fiscal management in Indonesia that must be included mandatorily to carry out this analysis:

A. Fiscal revenues and expenditures affected by the CFPPs Early Retirement Plan

As it was analyzed in Report A: Implications of Early Retirement of Coal-fired Power Plants in Indonesia, the retirement will impact the revenues and expenditures of the government's budget, as follows:

Revenues likely impacted by the CFPPs Early Retirement Plan

- Income Tax from power generation
- Income Tax variation from mining sector
- VAT variation
- Carbon Tax

Expenditures likely impacted by the CFPPs Early Retirement Plan

- Subsidies and compensations for the electricity companies and consumers

[37] Resulting percentages are obtained by dividing coal destined to power generation (ton) by coal production (ton) for each province.

- Payments for early retirement

B. Connection between national government finances and provincial government finances

National government budget and the sub-national budgets are widely connected by the transferences that the national government delivers regularly to the subnational governments.

Therefore, if the national government suffers negative impact in their revenues and/or in their expenditures it could affect their transferences to the local governments under the steers and limits that the legal framework of the country has established.

Consequently, Figure 3 presents the impact on the subnational budgets through the transferences, when changes in revenues and expenditures, mentioned above, occur.

C. Assumptions

Figure 3 presents the assumptions that have been considered for this analysis are: the highest impact, meaning how big the impact could be on provincial finances if the least favorable scenario takes place at national level for the retirement.

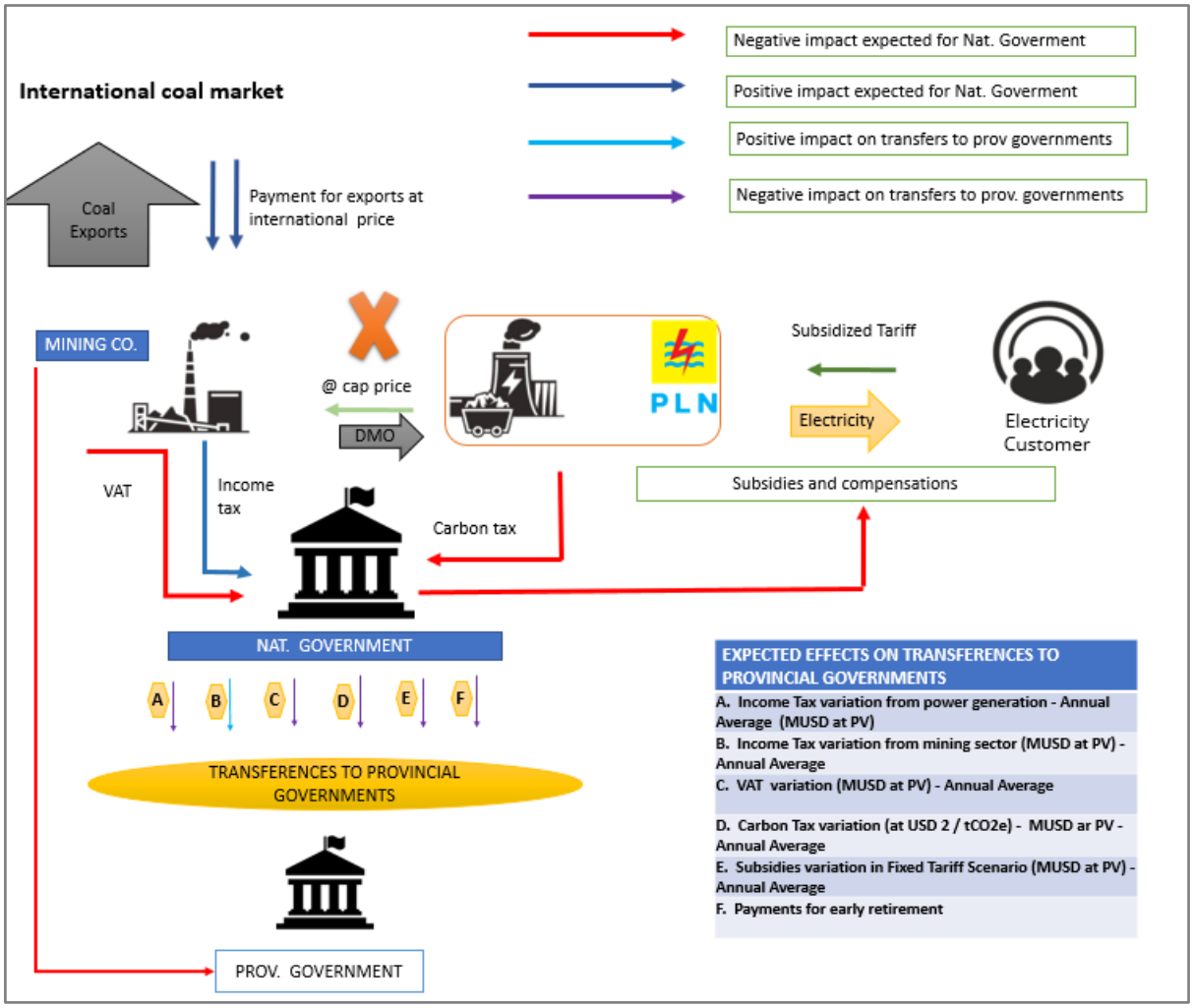
This highest impact implies two assumptions:

- Subsidies with fixed tariffs (the higher likely subsidies generated by this plan)
- A period of low international demand for coal.
- Passive fiscal policies from the national government that cause direct affectation to transferences for subnational governments if its revenues and expenditures will receive negative impacts from the retirement.

The figure also presents the impact of the relevant and clearly identified revenue that the subnational governments receive from the CFPPs value chain: coal royalties.

In conclusion, these scheme presents a comprehensive summary of all impacts that the CFPPs Early Retirement Plan could cause directly and indirectly according to the assumptions presented and the quantifications carried out in this document as wells as in the documents corresponding to the previous phase of this consultancy.

Figure 3. Fiscal impact analysis scheme for affected provinces



Annex 4. Technical data on CFPPs

#	Facility/ Unit Name	Province	City/ Regency	Installed Capacity (MW)	Efficiency (%)	Fuel Type	Age (years)	Number of Worker
1	Celukan Bawang Unit 1, 2, 3	Bali	Buleleng	380	31.5%	MRC	7	167
2	Cilacap Unit 1, 2	Central Java	Cilacap	600	35.5%	MRC	16	90
3	Paiton Unit 5, 6	East Java	Probolinggo	1,220	35.0%	MRC	22	183
4	Cirebon Unit 1	West Java	Cirebon	660	36.0%	MRC	10	99
5	Keban Agung Unit 2	South Sumatra	Lahat	240	36.5%	MRC	7	144
6	Adipala Unit 1	Central Java	Cilacap	660	36.5%	LRC/ MRC	7	99
7	Sebalang Unit 1, 2	Lampung	South Lampung	200	28.5%	LRC/ MRC	7	120
8	Pacitan Unit 1, 2	East Java	Pacitan	630	36.5%	LRC/ MRC	9	95
9	Rembang Unit 1, 2	Central Java	Rembang	630	36.0%	LRC/ MRC	11	95
10	Tarahan Unit 3, 4	Lampung	South Lampung	200	27.5%	MRC	15	120
11	Nagan Raya Unit 1, 2	Aceh	Nagan Raya	220	31.5%	LRC/ MRC	9	132
12	Labuhan Angin Unit 1, 2	North Sumatra	Central Tapanuli	230	31.0%	LRC/ MRC	14	138
13	Teluk Sirih Unit 1, 2	West Sumatra	Padang	224	31.5%	LRC/ MRC	8	134
14	Pangkalan Susu Unit 1, 2	North Sumatra	Langkat	400	36.5%	LRC/ MRC	7	176
15	Lontar Unit 1, 2, 3	Banten	Tangerang	945	36.0%	LRC/ MRC	10	142
16	Pelabuhan Ratu Unit 1, 2, 3	West Java	Sukabumi	1,050	36.5%	LRC/ MRC	8	158
17	Suralaya Unit 8	Banten	Cilegon	625	36.0%	LRC/ MRC	11	94

#	Facility/ Unit Name	Province	City/ Regency	Installed Capacity (MW)	Efficiency (%)	Fuel Type	Age (years)	Number of Worker
18	Bukit Asam Unit 1, 2	South Sumatra	Muara Enim	260	25.5%	MRC	35	156
19	Ombilin Unit 1, 2	West Sumatra	Sawahlunto	200	26.5%	HRC	26	120
20	Suralaya Unit 1, 2, 3, 4	Banten	Cilegon	1,800	33.5%	LRC/ MRC	36	270
21	Suralaya Unit 5, 6, 7	Banten	Cilegon	1,600			25	240
22	Paiton Unit 1, 2	East Java	Probolinggo	800	34.5%	LRC/ MRC	29	120
23	Paiton Unit 9	East Java	Probolinggo	660	36.0%	LRC/ MRC	10	99
24	Indramayu Unit 1, 2, 3	West Java	Indramayu	990	36.0%	LRC/ MRC	11	149
25	Labuan Unit 1, 2	Banten	Pandeglang	600	36.0%	LRC/ MRC	12	90
26	Tanjung Awar-awar Unit 1, 2	East Java	Tuban	700	36.5%	LRC/ MRC	7	105
27	Air Anyir Unit 1, 2	Bangka Belitung	Bangka	60	28.5%	LRC	8	91
28	Tanjung Balai Karimun Unit 1, 2	Riau Islands	Karimun	14	28.5%	LRC	9	21
29	Anggrek Unit 1, 2	Gorontalo	North Gorontalo	55	29.0%	LRC	3	83
30	Amurang Unit 1, 2	North Sulawesi	South Minahasa	50	28.0%	LRC	11	76
31	Ende Unit 1, 2	East Nusa Tenggara	Ende	14	28.5%	LRC	7	21
32	Tidore Unit 1, 2	North Maluku	Tidore Islands	14	28.5%	LRC	7	21