Coal Transition Impacts and the Approach to Inclusive Just Transition Policies in Indonesia

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Executive Summary

Indonesia currently depends on coal-based energy, which represents the main contributor to the country's carbon dioxide (CO_2) emissions. Indonesia's coal-producing regions—East Kalimantan, South Kalimantan, and South Sumatra—emit around 30 million tonnes of CO_2 equivalent ($MtCO_2e$) per year from coal mining methane and coal-fired powerplants (Setyawati & Setiawan, 2024). In this context, the country is committed to playing a proactive role in mitigating its emissions in accordance with its commitment to the Paris Agreement of 2015. Indonesia released its enhanced nationally determined contribution in 2022—pledging to reduce emissions from the energy sector by 358 $MtCO_2e$ by 2030, a target of around 12.5% of the country's emissions reduction goal.

The energy transition will provide access to clean energy, encourage the growth of the green economy, and reduce emissions. However, to ensure the process benefits vulnerable groups (in particular women, youth, and marginalized groups), planning and policies must embed an inclusive approach to a just transition in coal mining communities.

This research presents an economic analysis of the impact of coal mine closures on sectors linked to coal mining. This analysis takes a scenario-based approach to look at potential shocks to economic output and employment. These potential losses are then replaced by new industries within the green economy, and the situation is assessed for potential economic, employment, and other improvements. This endeavour thus provides a picture of what might be expected and how to prepare for it.

Alongside this quantitative analysis, a qualitative study assesses the socio-economic impacts on those employed in the coal mining sector and on communities in coal mining towns.

The findings and recommendations of the study use our scenarios to help policy-makers better plan for a just transition in Indonesia. We also assess the replicability of this research method to benefit just transition efforts in other jurisdictions.

Findings From the Quantitative Study

The disparities uncovered among regencies and among provinces reinforce the need for region-specific just transition strategies, including economic diversification, worker retraining, and investment in sustainable sectors tailored to the local economic structure.

Estimated Economic Impacts of Mine Closures at the Regency Level

The quantitative analysis revealed economic losses associated with coal mine closures in five major coal-producing regencies in Indonesia, with significant variation in regional vulnerability. Among these, East Kutai and Muara Enim emerge as the most economically exposed, whereas Sarolangun appears relatively more resilient. In East Kutai, projected output losses exceed USD 18 billion (IDR 270 trillion), with sectoral income losses estimated at USD 3.8 billion (IDR 57 trillion) and employment losses surpassing 18,000 jobs. Muara Enim, by contrast,

faces an output loss of USD 10 billion (IDR 150 trillion) and income losses of USD 1.26 billion (IDR 18.9 trillion), but experiences even higher job losses—approximately 24,500 positions. Tanah Bumbu records smaller output losses of USD 1.65 billion (IDR 24.75 trillion), yet its employment decline is relatively severe, approaching 28,000 jobs, the second highest across all regions. North Barito exhibits an output loss of USD 0.62 billion (IDR 9.3 trillion), while Sarolangun registers moderate income losses of USD 14.7 million (IDR 220.5 billion) but notable employment reductions of around 5,000 jobs.

Overall, Sarolangun's lower output and income losses across all indicators reflect a more diversified economic structure and less dependence on coal mining as a driver of gross regional domestic product (GRDP), suggesting stronger structural resilience in the face of coal-sector decline.

Estimated Economic Impacts of Mine Closures at the Province Level

Among the five provinces analyzed, East Kalimantan experiences the most severe economic contraction across all key indicators. The province is projected to incur an output loss of IDR 628.35 trillion (USD 41.89 billion) and a sectoral income decline of IDR 82.65 trillion (USD 5.51 billion), both the highest among all regions assessed. In addition, employment losses are particularly pronounced, estimated at over 490,000 jobs, underscoring the province's deep economic dependence on coal mining and related industries. These findings highlight East Kalimantan's heightened vulnerability to the coal phase-out, reflecting both its structural reliance on extractive activities and the urgent need for targeted diversification and just transition policies to mitigate socio-economic disruption.

South Kalimantan would lose IDR 156.45 trillion (USD 10.43 billion) in output and 276,866 jobs. Central Kalimantan, with slightly lower financial losses (USD 3.06 billion in output), has comparably high employment losses IDR 45.90 trillion (315,560 jobs). South Sumatra would experience a significant IDR 346.50 trillion (USD 23.10 billion) output loss, but the employment impact is far lower (24,586 jobs). Jambi's estimated losses are modest relative to the other provinces: IDR 26.55 trillion (USD 1.77 billion), IDR 2.85 trillion (USD 0.19 billion) in income, and about 58,509 jobs. Collectively, these results demonstrate that while the magnitude of financial losses varies across provinces, the employment impact does not always correspond directly with economic output, reflecting structural differences in industrial composition and labour intensity across Indonesia's coal-producing regions.

Scenarios Assessing Coal Mine Closure Impacts and Recovery

Under our three policy scenarios, we see varied but generally positive effects of a coal and lignite mining sector closure in five regencies:

- **Scenario 1:** No recovery policy (baseline contraction)
- **Scenario 2:** Targeting top output multiplier sectors
- **Scenario 3:** Green sector development (10 low-coal-linkage industries)

Regency Level

Across the regencies, Scenario 2 consistently drives the strongest output rebound by channelling stimulus into sectors with the highest output multipliers (food and beverage and the green economy), though it requires the largest fiscal outlays. In contrast, Scenario 3's green sector strategy is the most cost-efficient in achieving output restoration—requiring as little as a IDR 5.025 trillion (USD 335 million) shock in North Barito—while simultaneously maximizing employment gains; for instance, it generates over 143,000 new jobs in Tanah Bumbu without complex input replacement policies. The food and beverage manufacturing sector leads in output gains and consistently ranks as one of the top sectors for output growth across four regencies. Together, these trade-offs underscore the need for a blended policy trajectory.

Province Level

Economic Recovery and Welfare Support

Scenario 2 emerges as the most feasible for maximum economic recovery. Scenario 2 assesses the impact by pumping demand into the sectors with the largest backward–forward linkages. This scenario achieves a GRDP of +4.90% at a USD 16.7 billion (IDR 250.5 trillion) shock in South Sumatra and a +2.67% GRDP boost in East Kalimantan at a USD 35.02 billion (IDR 525.30 trillion) shock. However, these positive results will come at the steepest fiscal stimulus, as no other scenario requires more stimulus funds. Scenario 2's economic stimulus relies on the food and beverage sector in both provinces, signalling the strength of this sector seen in the regency analysis.

Employment Recovery

When the goal shifts from pure output to inclusive recovery, Scenario 3's focus on the green sector emerges as the more feasible. This scenario creates more jobs in four out of five provinces than any other plan—3.14 million in South Sumatra, 2.17 million in South Kalimantan, 470,000 in Jambi, and 2.58 million in East Kalimantan—while requiring less total shock than Scenario 2. Scenario 3 assesses an economic recovery based purely on green priority industries, which provides the closest projections to a transitioned economy without any ties to coal or coal-linked sectors. This is a completely new outlook that paints a picture of a just transition and what can be done to prepare for it.

Energy Transition

In coal-dependent regions such as Muara Enim (South Sumatra) and East Kalimantan, only the intensive, sector-targeted stimulus of Scenario 3 can reverse GRDP contraction and restore growth—highlighting the imperative for robust, focused intervention where mine closures inflict the greatest damage. Conversely, in more economically diversified

provinces like Central Kalimantan and Jambi, equivalent gains in household welfare and employment can be realized through either Scenario 3's green sector pivot or Scenario 2's food and beverage stimulus. This flexibility enables local authorities to achieve both social and environmental objectives with comparatively lower fiscal commitments.

Findings From the Qualitative Study: Informal workers and vulnerable groups

In the qualitative research, 58.8% of respondents were informal workers. Sectors with the highest informal employment include food and beverage services and retail, favoured for their low barriers to entry.

Many young people work in the informal sector, which is easier to access and requires no special skills, especially around coal mines. Formal job opportunities, particularly in mining, are hard to find owing to limited information and the shift toward contracting. Some youth see better employment prospects outside the region, where universities are more reputable.

Women often engage in own-account work, reflecting flexible arrangements around household duties, while male-dominated sectors have fewer women and higher earnings. Several women in the study—particularly those with family ties to mine workers—were found to play dual roles, managing household responsibilities while also earning income. Some respondents run small businesses such as food stalls or catering services, while others sell beverages or pastries. Although a few exceed the regency minimum wage, the median income remains significantly lower. The majority are high school graduates or lower, depend on informal work for family income, and are covered only by basic social protection.

Policy Recommendations

Enable Workforce Reskilling and Diversify Local Economies

Labour reskilling is essential for transitioning both formal mining workers and informal sector actors into new roles. Training should align with the green economy and prioritize women's economic empowerment through access to training, land, markets, and finance.

The transition will need to consider innovative retail practices in the food and beverage sector and opportunities in green energy to absorb the new labour. Additionally, improving governance and pricing mechanisms will be necessary to ensure long-term viability. Intercropping systems, rubber-based product innovation, and sustainability standards will help maintain competitiveness in global markets.

Strengthen Institutional Coordination for Energy Transition

Effective government coordination is essential to advance a just energy transition. Strengthening institutions like the National Energy Council (Dewan Energi Nasional) as central coordination hubs can help. The government should also appoint gender equality, disability, and social inclusion (GEDSI) focal points within relevant agencies to coordinate inclusive energy planning across sectors.

Expand Social Safety Nets for Informal Workers

Coal mine closures will disproportionately impact informal workers and vulnerable groups reliant on coal-related demand. To protect them, the government must expand financial protection mechanisms through a robust social safety net. This can be achieved by adapting existing programs to the context of energy transition. Coordinated planning will be key to targeting support effectively.

Mainstream GEDSI in Energy and Development Policies

Indonesia's energy and development strategies must be updated to explicitly include gender and social inclusion. This includes revising national energy plans, establishing coordination institutions to oversee implementation, and improving interministerial collaboration for gender-responsive energy planning.

Stimulate Economic Sectors With High Potential

To sustain economic performance during and after coal mine closures, local governments should prioritize direct fiscal injections into productive non-coal sectors—particularly agriculture, manufacturing, and services. Stimulating investment in sectors with the highest output multipliers (e.g., construction, food processing, tourism) can generate significant employment and income impacts. Concurrently, green sectors should be promoted through targeted incentives, infrastructure investment, training, and enabling regulations.

Design a Roadmap for a Just Transition

A clear and inclusive roadmap is critical for a successful energy transition. This should be grounded in disaggregated data (by sex, age, and socio-economic status) and integrate GEDSI principles at every stage. Inclusive transition planning must involve women and vulnerable groups in policy discussions and local governance. This requires capacity-building initiatives, access to information, and the development of gender-sensitive planning tools. Participation ensures local needs are reflected in energy and economic policies, and no one is left behind.

Restore Ecosystems With Local Participation

Post-mining land restoration should be linked to community participation, particularly of women and youth. Environmental recovery offers opportunities to improve local livelihoods and quality of life while contributing to broader sustainability goals.

Foster Multistakeholder Collaboration

Government agencies need to work in partnership with local communities, civil society, private investors, and development partners. Effective collaboration will require trust, aligned goals, and resource sharing. Inclusive stakeholder engagement ensures equitable outcomes and enhances the legitimacy of transition policies.

Assessment of the Mixed-Methods Research Approach

Research on the gendered impacts of a just transition on the mining sector in Indonesia is comparatively less established than studies focused on traditional economics and emissions modelling. Our quantitative modelling was able to pull out significant, useful information

related to the potential employment impacts of a coal transition, but was less able to produce gender and social inclusion impacts. As a result, the modelling exercise provided a useful but incomplete picture. Models could be tailored for GEDSI-focused coal transition assessments in Indonesia, but current approaches in the sector lack sufficient detail for comprehensive just transition and GEDSI analysis.

With that said, in our research, the qualitative analysis was able to fill this gap. Focus group discussions, interviews, and other qualitative methods were able to dig into the gender-specific impacts that were missing from the modelling results. Findings on the specific impacts on vulnerable groups in the mining sector, combined with data on employment and broader economic impacts identified by the modelling exercise, show that there is a good case for using mixed-methods approaches in just transition analysis as part of policy design and implementation going forward. The recommendations identified prove the usefulness of the mixed-methods approach as part of this endeavour.

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Abbreviations and Acronyms

BPJS Ketenagakerjaan	Badan Penyelenggara Jaminan Sosial Ketenagakerjaan (Employment Social Security Administration)
BPS	Badan Pusat Statistik (Statistics Indonesia)
CFPP	coal-fired powerplant
CO_2	carbon dioxide
FGD	focus group discussion
GEDSI	gender equality, disability, and social inclusion
GRDP	gross regional domestic product
IDR	Indonesia rupiah
IRIO	interregional input–output
JETP	Just Energy Transition Partnership
Kementerian ESDM	Kementerian Energi dan Sumber Daya Mineral (Ministry of Energy and Mineral Resources)
KEN	Kebijakan Energi Nasional (National Energy Policy)
MSME	micro, small, and medium-sized enterprises
$MtCO_2e$	million tonnes of CO_2 equivalent
RUPTL	Rencana Umum Perencanaan Tenaga Listrik (10-Year Electricity Business Plan 2025–2034)
USD	United States dollar

1.0 Introduction

Indonesia currently depends on coal-based energy, which represents the main contributor to the country's carbon dioxide (CO_2) emissions. Indonesia's coal-producing regions—East Kalimantan, South Kalimantan, and South Sumatra—emit around 30 million tonnes of CO_2 equivalent ($MtCO_2e$) per year from coal mining methane and coal-fired power plants (CFPPs) (Setyawati & Setiawan, 2024). In this context, the country is committed to playing a proactive role in mitigating its emissions in accordance with its commitment to the Paris Agreement of 2015. Indonesia released its enhanced nationally determined contribution in 2022, pledging to reduce emissions from the energy sector by 358 $MtCO_2e$ by 2030, a target of around 12.5% of the country's emissions reduction goal.

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This research presents an economic analysis of the impact of coal mine closures on sectors linked to coal mining. This analysis takes a scenario-based approach to look at potential shocks to economic output and employment. These potential losses are then replaced by new industries within the green economy, and the situation is assessed for potential economic, employment, and other improvements. This endeavour thus provides a picture of what might be expected and how to prepare for it.

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2.0 Methodology

2.1 Research Overview and Objectives

This study applies a mixed-methods approach to analyze the economic and socio-economic impacts of coal mine closures. First, the quantitative study collected data and analyzed it, looking at specific economic sectors to provide scenarios related to the impacts of coal mine closures. It did this by identifying impacted sectors and estimating potential economic losses as well as remedial actions to circumvent these losses. Second, the qualitative study used semi-structured interviews and focus group discussions (FGDs) to capture real-life experiences of coal mine workers, coal mining communities, and vulnerable groups. This study also assessed the situation regarding gender equality, disability, and social inclusion (GEDSI) within the coal mining sector, providing data on the potential impacts of the transition on the studied groups.

Figure 1. The data collection process
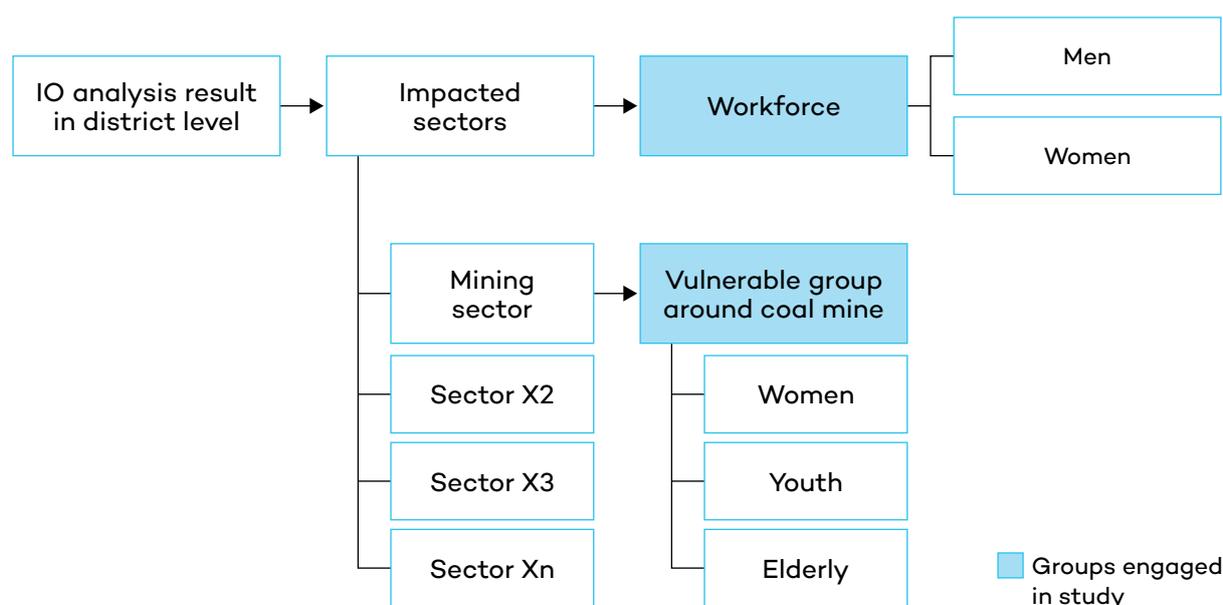
Source: Author diagram.

Figure 1 illustrates how the study stratified its qualitative inquiry: starting from the input–output (IO) analysis results of impacted sectors (left), two main groups were engaged: workers ("Workforce") in the affected sectors, and "Vulnerable Groups Around the Coal Mine" (community members). For each impacted sector, both women and men employees were interviewed (as indicated by separate branches under the "Workforce" category) to capture gender-specific impacts. Likewise, community FGDs and interviews focused on local women, youth, and elderly populations around the mine, to document their perspectives and needs in the transition. This approach ensured that the voices of marginalized groups were included in assessing the closure's social impacts.

These methods combined offer a comprehensive view of coal mining's benefits and help inform inclusive policy for all affected groups. Together, they can help in shaping and planning for a just transition in Indonesia at the national, provincial, and regency level.

The overall objectives of the study were as follows:

- Analyze key sectors in the coal value chain to assess the potential impacts of coal mine closures and present scenarios that quantify these economic impacts;

- Deploy a qualitative study in coal mining communities to assess potential just transition impacts;

- Consider the effectiveness of the deployed research methods with regard to collecting just transition-related data to assist in developing inclusive and procedurally just processes when designing just transition policies for coal-dependent regions.

2.2 Quantitative Study Methodology

Interregional input–output (IRIO) is a powerful analytic tool used to understand economic interdependencies among regions (Widodo, 2022). Developed from the foundational work of Walter Isard (1951), the IRIO framework allows for the quantification of both intraregional and interregional economic flows and multipliers. This capacity makes it particularly valuable in evaluating policy impacts and regional development planning in a spatially diverse country like Indonesia (Miller & Blair, 2009).

The IRIO method was applied to analyze provincial and regency data from the 2016 Indonesian Input-Output Table (producer prices) published by Badan Pusat Statistik (BPS: Statistics Indonesia) in 2021. The analysis quantified interregional impacts generated by sectors within the coal value chain across various provinces, whereby an impact in one province may affect the economic input or the output of that specific sector in a different province. Specifically, the analysis is centred around economic outputs and employment at the provincial and regency levels.

The IRIO analysis (Figure 2) maps how coal production in one province influences and depends on others, highlighting economic interdependencies across regions. At the provincial level, coal functions as the "active sector," supported by input suppliers (e.g., machinery, labour), and serves direct users like power plants, as well as downstream sectors and external buyers. The model captures cross-provincial flows—e.g., how coal from Province A powers industries in Provinces B, C, and D—illustrating how disruptions in one location cascade through the economy. It also integrates the roles of households (through wages), governments (via taxes and royalties), and companies (through investment decisions), revealing how shifts in coal activity affect income, budgets, and profits. Ultimately, IRIO analysis provides a systemic view of both direct and indirect linkages, showing how economic ripple effects, positive or negative, spread through production chains and across regional borders.

Figure 2. The IRIO analysis process
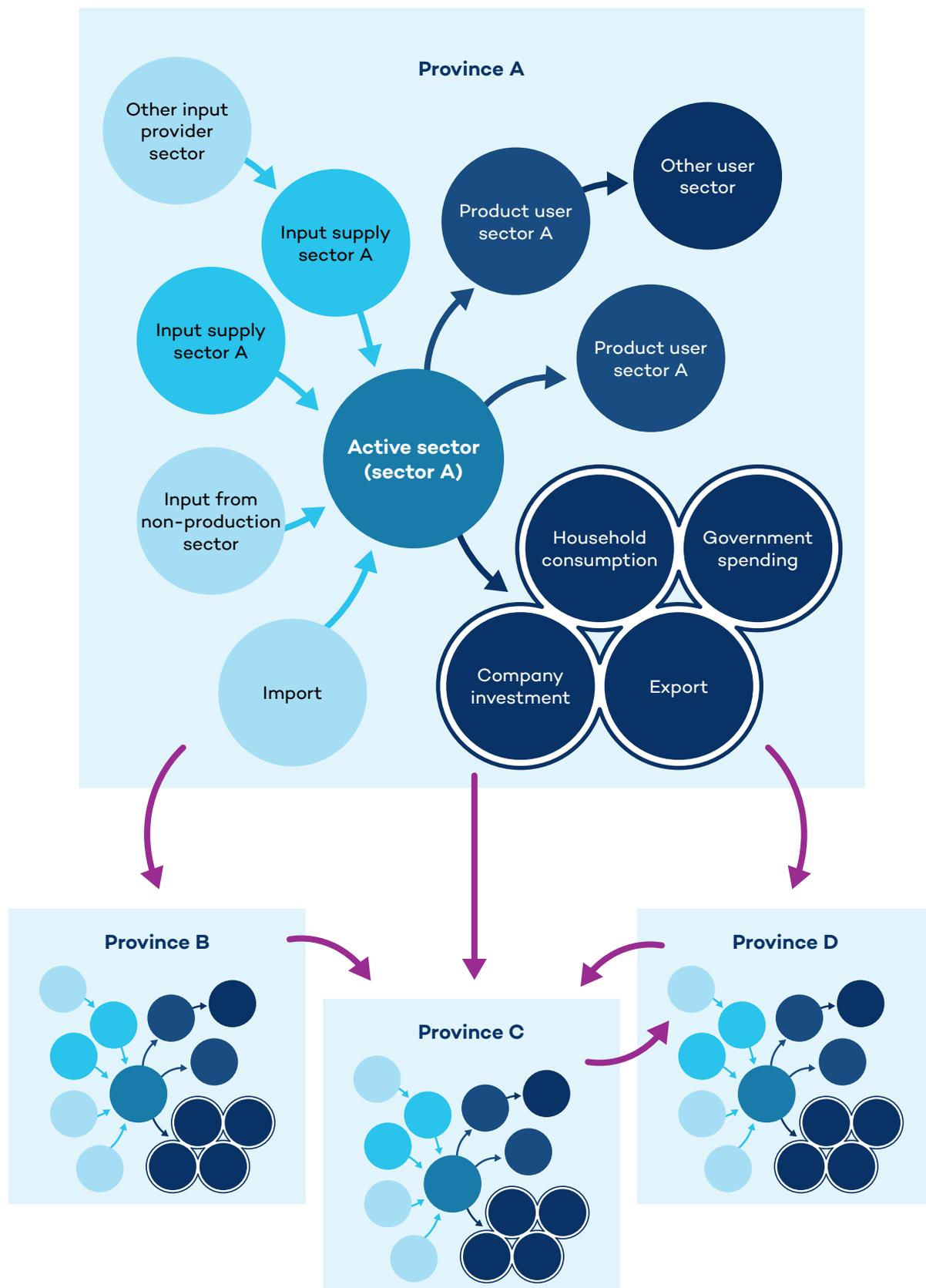
Source: Authors' diagram.

The second method used IO (Figure 3), a data modelling technique that divides the economy into final demand and production and accounts for the direct and indirect interdependencies among different sectors (Mair & Druckman, 2023). IO was used to analyze regency-level data by disaggregating each regency's economy into final demand and producing sectors, charting both direct dependencies and higher-order linkages among industries. Employing the same baseline data, the analysis applies three policy scenarios—unmitigated closure, broad-based demand stimulus, and targeted support for high-multiplier green economy sectors to estimate changes in output, household income, and labour demand at the sub-provincial scale. This granular analysis identifies which alternative industries are best positioned to absorb displaced economic activity following coal mine retirements.

Figure 3. The IO analysis process
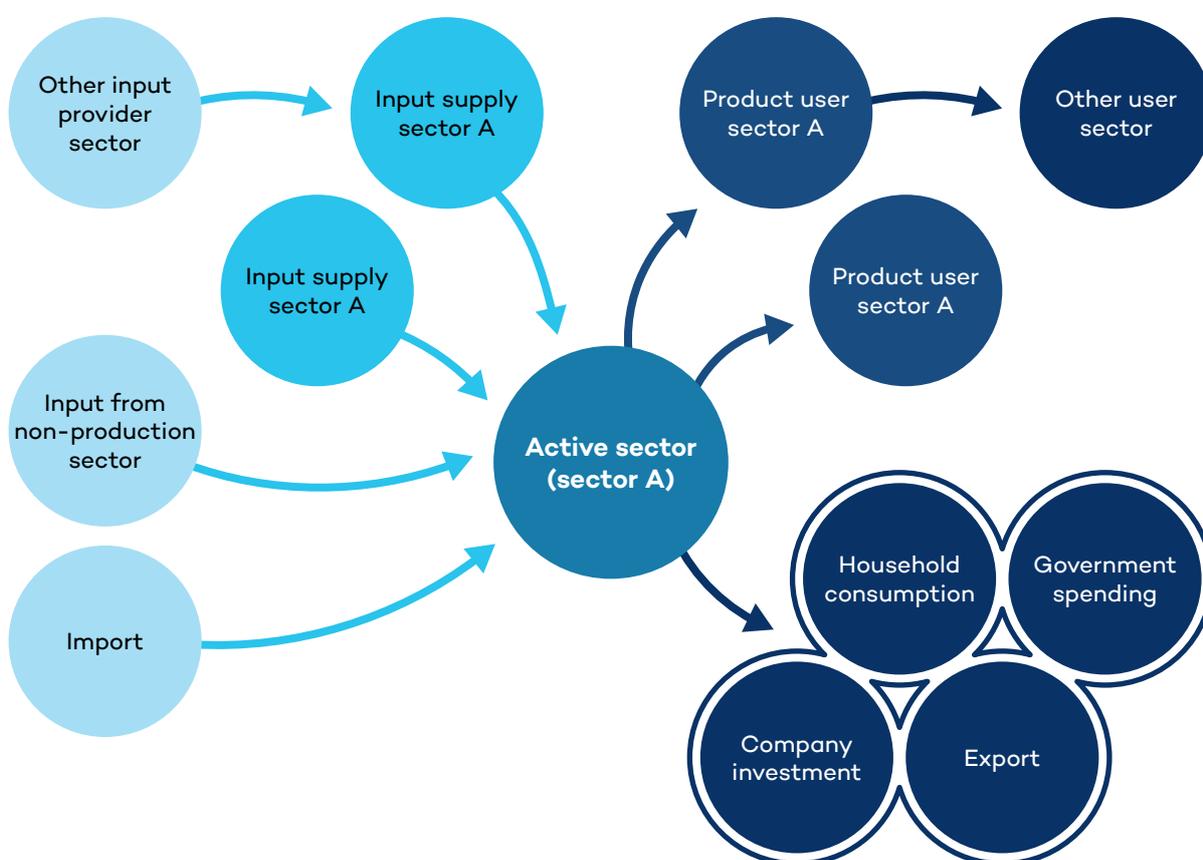
Source: Authors' diagram.

The IO process looks at the coal sector as the "Active Sector," which draws in a wide range of inputs and pushes out critical outputs, making it the engine that drives multiple layers of economic activity. It depends on a network of input supply sectors, such as equipment manufacturers, energy providers, transportation services, and labour markets. Coal exports, both to other regions and internationally, extend coal's economic footprint beyond district boundaries. Households benefit through employment and wages tied to mining and related services. Governments derive revenue through royalties, taxes, and fees from coal activities.

All together, the model forms a closed-loop economic system: inputs fuel coal production; coal generates outputs; outputs support industrial activity and revenue streams; and these revenues circulate back through household spending, public finance, and private investment. The analysis shows how the direct connections (e.g., coal to power plants, coal to employment) and indirect dependencies (e.g., coal → steel → manufacturing → exports) are interconnected, and how a disruption in one facet can trigger a multi-sectoral and socio-economic cascade.

2.3 Qualitative Study Methodology

The qualitative component of the study employed focus group discussions (FGDs) and semi-structured interviews to capture community-level perspectives and institutional insights on the just transition. These engagements were conducted with workers, vulnerable groups, provincial and local government officials, and other policy stakeholders in East Kutai Regency. Fieldwork took place between June and July 2024, comprising a district-level FGD with local government representatives, a village-level FGD in Swarga Bara, and several in-depth interviews with community members, workers, and municipal officials. To ensure the integration of local experiences with policy-level understanding, a second expert FGD was convened in October 2024, bringing together national stakeholders to review and validate both the quantitative findings and qualitative GEDSI insights. This mixed qualitative approach provided a robust and contextually grounded basis for developing just transition scenarios for East Kutai, reflecting both socio-economic realities and policy considerations.

The study engaged a range of national stakeholders through the expert FGDs. Key participants included Indonesia's Ministry of Energy and Mineral Resources (especially the Directorate of Mineral and Coal), the Ministry of Investment—notably its Mineral and Coal Downstream Directorate, the Ministry of Manpower (industrial relations and social security division), the Ministry of Finance (financing and risk management division), and the Ministry of Social Affairs (vulnerable groups empowerment directorate). Representatives from the Ministry of Home Affairs and the Ministry of Women's Empowerment and Child Protection were also invited to contribute perspectives on regional governance and gender policy. In addition, the Coordinating Ministry for Maritime Affairs and Investment (which oversees mining affairs) and the National Development Planning Agency (Bappenas) participated, reflecting the broader economic planning and policy context. Aside from government, a few research organizations (e.g., Institute for Essential Services Reform [IESR] and Yayasan CERAH Indonesia) were present in these FGDs to provide expert input.

2.3.1 Local Government (East Kutai) Departments

The East Kutai District government and East Kalimantan Provincial authorities were heavily involved during the field FGD. Participants included the East Kalimantan Provincial Planning and Development Agency (Bappeda) and the East Kutai District Bappeda, which are central to regional economic planning. Various East Kutai line offices took part, such as the Transmigration and Manpower Office, the Community Empowerment and Village Government Office, the District Secretariat's Natural Resources Section, and the District Health Office. Administrative leaders from the local area were present as well, notably the sub-district heads of North Sangatta and South Sangatta, and the Head of Swarga Bara

Village, representing the community at the village level. These local officials provided insights into district-level readiness, labour conditions, and community development in the face of a potential coal mine closure.

The FGDs assessed the gender, educational level, and age distribution demographics of the coal mining sector workforce in the mining community. Participants included women married to or living with male mine workers who shouldered household responsibilities and shared in the risks of mining; male and female young jobseekers; students; older adults who remained active in the workforce; and male coal mining retirees.

This approach sought to complement the quantitative methods by assessing the social impact that the quantitative data would not be able to reveal on the real-life experiences of coal mine operations in these communities, from households with direct and indirect links to the coal value chain.

2.4 Study Area

The quantitative analysis focused on five provinces in Indonesia, in one regency in each province. The provinces were East Kalimantan, Jambi, Central Kalimantan, South Kalimantan, and South Sumatera.

The fieldwork in the qualitative data collection was undertaken in East Kutai regency (East Kalimantan Province), capital city Sangatta, with an area of ~31,200 km², or 24.5% of the total area of East Kalimantan Province (Widianingsih & Achmadi, 2021). The regency has a population of 429,640 (2023), with a density of 13.75 people per km² (BPS East Kutai, 2024).

Figure 4. Location of East Kutai regency

East Kutai Regency
East Kalimantan, Indonesia

Source: Google Maps, 2024.

East Kutai was chosen as the study area for several reasons. First, East Kalimantan Province contains 38.27 billion tons of coal—41.5% of Indonesia's reserves (Kementerian Energi dan Sumber Daya Mineral [ESDM], 2023). Second, it is home to PT Kaltim Prima Coal, one of

the world's largest open-pit mines, operating on 61,543 hectares in Sangatta and employing 30,575 workers. Third, mining and quarrying dominate the province's economy, contributing 43.19% to its GDP, with East Kutai ranking second among districts at 19.93% in 2023. Within the regency, mining alone accounts for 82.69% of GDP (BPS, 2023).

The coal sector plays a dominant economic role in East Kutai. In 2023, coal and lignite mining contributed IDR 251.09 trillion—75.23% of the regency's total output. It also led in total wages, paying IDR 37.04 trillion, 69.06% of all coal mining-related labour compensation. The sector ranked second in tax contribution, generating IDR 1.76 trillion, 24.84% of local net tax revenue. While not the top employer, it still absorbed 16,279 workers—8.56% of the local workforce (BPS, 2023).

East Kutai regency is also projected to experience more severe economic losses from coal mining phaseouts, as indicated by our IRIO analysis. This is where coal phase-out planning needs to be focused to minimize significant shocks in the economy while also testing the transition from coal, looking at substitute sectors or new economic sectors within the green economy.

3.0 Context

3.1 The Coal Mining Industry in Indonesia

Indonesia produces coal in 13 provinces, but the coal value chain stretches across various provinces and includes lignite mining, mining services, transport, and business services. The coal sector contributed approximately 3.6% of Indonesia's GDP in 2022 (Beutel et al., 2025). In provincial terms, East Kalimantan has the highest coal production (61.65%), followed by South Kalimantan (17.37%) and South Sumatera (11.11%), as Figure 5 shows. Thus, East Kalimantan has the highest coal production among the five provinces, while the rest of the provinces have employment spread across mining and quarrying, agriculture, trade, and manufacturing, account for employment in other provinces.

Figure 5. Indonesian coal production by province
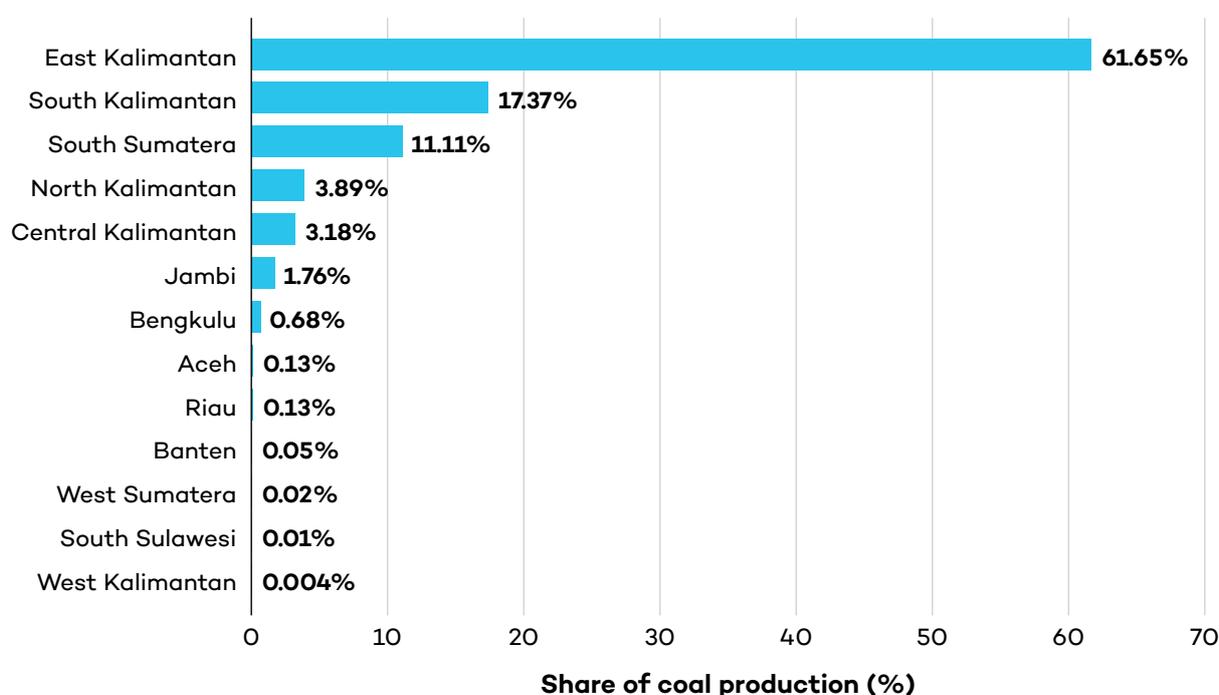
Source: Statistics Indonesia, 2021.

The coal mining sector generates opportunities for micro, small, and medium-sized enterprises (MSMEs), and supports social initiatives—such as religious, educational, health-care, and security services—through infrastructure development (Setyadi, 2024). Coal mining has also led to adverse impacts on public health, changes in local community dynamics, and disruptions to social structures as a result of workforce influx and population displacement (Fitriyanti, 2018). Environmentally, the sector is responsible for significant landscape alteration, reduced soil fertility, biodiversity loss, increased greenhouse gas emissions, and declining air and water quality (Beutel et al., 2025; Kodir et al., 2017).

3.2 The Energy Sector and the Just Transition

Indonesia's energy sector is currently dominated by coal, with gradual progress being shown in integrating renewables into the energy mix. Policy and regulation are directed by the National Energy Policy (Kebijakan Energi Nasional: KEN) as stipulated in Government Regulation No. 79 of 2014. The country has committed to phasing out CFPPs and expanding its renewable energy capacity to achieve net-zero emissions by 2050 (Shofa, 2024). In 2021, the government targeted a renewable energy mix of 51.6% by 2030 and a reduction in the portion of coal from 43% to 34%. To support these developments, Indonesia developed a Just Energy Transition Plan, which was adopted in 2022 at the G20 summit in Bali.

Presidential Regulation No. 112 of 2022 implemented a moratorium on new CFPPs (Climate Action Tracker, 2024). Article 3 strictly prohibits any additions to the country's coal fleet (Fitrianggraeni & Saputra, 2024), signifying a strong commitment to reducing carbon emissions. The 2021–2023 electricity master plan forecasts Indonesia's total coal capacity to hit 76.5 GW by 2031, adding 26.8 GW of new coal power (Setiawan, 2025). This includes 6.6 GW of grid-connected coal plants and over 20 GW of captive coal capacity, mainly to fuel the expanding mineral processing sector. If fully built, Indonesia's captive coal capacity alone would match Poland's total coal capacity of 31.54 GW (Setiawan, 2025). As of Rencana Umum Penyediaan Tenaga Listrik (RUPTL) 2025–2034, there are ~13.8–14 GW of planned coal-fired power plant capacity under consideration in the pipeline by 2030, and while many new coal plants are generally prohibited under the new policy, certain exemptions in RUPTL allow some plants (for example those already in the RUPTL or strategic/captive projects) to continue operating under specific conditions (Energy Transition Partnerships, 2023). These exceptions potentially undermine the regulation's primary goal of halting coal expansion, particularly within the mining and heavy industry sectors, which continue to plan and build their own captive plants.

The Draft Government Regulation on KEN has revised Indonesia's 2025 renewable energy target from 23% to 17%–19%, effectively shifting the original goal to 2030 (Simanjuntak, 2024). It sets more modest benchmarks of 19%–21% by 2030, 36%–40% by 2040, and 70%–72% by 2060 (Simanjuntak, 2024). Citing macroeconomic pressures and slower post-COVID growth, the Ministry of Energy and Mineral Resources (Kementerian ESDM: Kementerian Energi dan Sumber Daya Mineral) justifies the downshift, but the revised trajectory clashes with the JETP's[1] aim of 44% non-fossil energy by 2030, casting doubt on Indonesia's readiness to meet its global climate commitments.

Robins and Rydge (2019) highlight that neglecting the social and economic consequences of an energy transition has hindered progress, particularly for the groups that are most affected—such as workers, communities, consumers, and citizens. As Figure 6 shows, ensuring justice in the transition process is key to overcoming these challenges and

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[1] The Indonesia JETP is a agreement to mobilize USD 20 billion in public and private financing to support a just energy transition in Indonesia. It was signed on November 15, 2022, at the G20 Leaders' Summit in Bali between the President of Indonesia and the International Partners Group led by the United States and Japan. The Indonesian JETP targets by 2030 to cap total power sector emissions at 290-million-ton CO_2eq, accelerate deployment of renewable energy to contribute at least 34% of all power generation, and to establish a goal to reach net-zero emissions in the power sector by 2050 (United Nations Development Programme Indonesia, n.d.).

achieving equitable outcomes. The joint statement on the JETP also outlines social protections, such as stakeholder engagement, compensation, retraining, and support for alternative livelihoods; these remain largely conceptual, with specific action plans yet to be developed (JETP Joint Statement, 2022).

Figure 6. A just transition process

Developing strategies for a just transition
- Identifying various actions and projects that can support the transition
- Monitoring, evaluating, and adapting strategies

Paving the way for new sustainable business opportunities
- Economic diversification
- Support for workers
- Need for skills and workforce skill enhancement

Designing an effective governance model
- Involvement of policy-makers
- Social dialogue
- Participation of people

Decarbonizing energy-intensive industries
- Challenges and opportunities for the industry
- Various technological options and developments

Source: Tari & Balgis, 2023.

3.3 The Socio-Economic Impacts of Phasing Out Coal

Globally, the impacts of the cessation of coal extraction and coal-based electricity generation will be most significant in the extraction and electricity sectors, but it will also be felt in other industries, such as trade, land transport, financial services, administration, and consulting (Departamento Intersindical de Estatística e Estudos Socioeconômicos [Inter-Union Department of Statistics and Socioeconomic Studies], 2022). The effects will be more pronounced in sectors related to electricity generation and in coal extraction. Meanwhile, regulatory gaps remain in Indonesia around the social and economic impacts of coal mine closures linked to the early retirement of CFPPs (Sharpe & Martinez-Fernandez, 2021).

Despite global decarbonization efforts, coal remains the main source of energy in countries such as China, India, and Indonesia. Hanyi et al. (2022) and Kurniawan and Managi (2018) show a positive relationship between coal consumption and economic growth, underscoring the importance of a sustainable coal economy. In countries like Japan and Spain, the energy transition has been navigated through a comprehensive policy, incorporating both local and centralized approaches (Garha, 2022). In Germany, coal mine closures have led to reduced

production, income, and population in lignite coal regions. However, accelerating the coal phase-out could accelerate recovery, with federal policy support essential to enable structural adjustment (Oei et al., 2020). To meet decarbonization goals and ensure sustainability, countries that closed coal mines have adopted procedural, distributive, and restorative justice in their policies.

Indonesia has been able to develop worker support programs to support coal mining employees likely to be affected by the transition, such as Kartu Prakeja, which was originally launched as a productivity and social protection tool during the COVID-19 crisis and has functioned primarily as a digital voucher scheme for reskilling and income support (Purbasari et al., 2023). Despite its impressive reach, though, this was not designed with green jobs or climate-oriented training in mind (Rozikin & Muhyiddin, 2025).

Indonesia's national employment insurance system, the BPJS Ketenagakerjaan (Badan Penyelenggara Jaminan Sosial Ketenagakerjaan [Employment Social Security Administration]), has introduced the Job Loss Protection (Jaminan Kehilangan Pekerjaan) benefit, which offers 6 months of wage replacement and includes a job-matching and reskilling service (Carter & Tsuruga, 2023). However, this currently has limitations based on its eligibility requirements, which exclude many informal or precarious workers, making it an inadequate—even if helpful—measure in supporting loss of income during the transition.

While these programs can be cited as "transition supporting," they still mainly represent foundational work toward preparing for the transition. This is especially true for employee programs.

> Indonesia has fragments of infrastructure for worker protection and training, but not yet a system built for a just, green transition. Recognizing this gap is critical so that policy-makers and stakeholders do not assume the groundwork is already laid but instead invest in building the institutional strength needed to make a just transition truly inclusive. (Taufik, 2022)

4.0 Research Results

4.1 Findings From the Quantitative Study

This subsection summarizes the findings from the IRIO and IO analyses regarding the impacts of coal mine closures in five regencies across five provinces with significant coal mining activities. It first estimates the overall impact at the regency and province levels using estimated economic shock figures. The information is then presented, looking at the impact on economic output, sectoral income, and employment.

4.1.1 Estimated Overall Economic Impacts of Mine Closure

Regency Level

Figure 7a presents estimated economic losses at the regency level resulting from coal mine closures in five major coal-producing regencies in Indonesia. The impacts are shown across three key indicators: output (IDR trillion), sectoral income (IDR trillion), and employment (in 100,000 jobs lost).

Figure 7a. Economic impacts of coal mine closures by regency
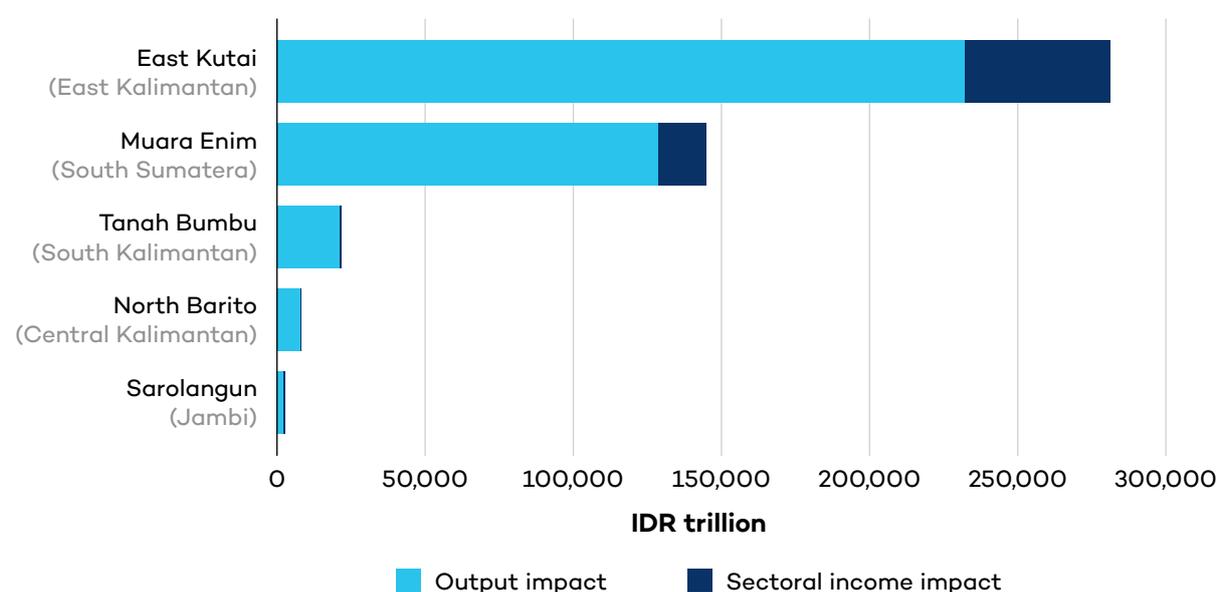
Source: Authors' analysis with data from Statistics Indonesia, 2021, 2023.

East Kutai stands out with the highest output loss, exceeding IDR ~259 trillion (USD 17.27 billion),[2] highlighting its extreme reliance on coal mining for regional

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[2] Note on currency conversion: All monetary figures have been converted from IDR to USD using an exchange rate of USD 1 = IDR 15,000.
  • USD 1 billion (B USD) ≈ IDR 15 trillion (T IDR)
  • USD 1 million (M USD) ≈ IDR 15 billion (B IDR)

economic output. Sectoral income losses are also substantial, at nearly IDR ~38 trillion (USD 2.53 billion), and job losses exceed ~18,000 (Figure 7b), suggesting strong financial dependence but with relatively less labour intensity compared to other regencies.

This is followed by Muara Enim, which experiences a broad-based economic hit, with an output loss of IDR 150 trillion (USD 10 billion) and a sectoral income loss of IDR 18.9 trillion (USD 1.26 billion). Muara Enim shows significantly higher employment losses than East Kutai, at around 24,500 jobs (Figure 7b), indicating a more labour-dependent coal economy. This area is thus likely to face both financial and social disruption.

Tanah Bumbu faces a significant labour shock. Output losses are lower at IDR 24.75 trillion (USD 1.65 billion), but employment losses are relatively high—at nearly 28,000 jobs (Figure 7b)—the second highest across the regencies. This suggests coal-related sectors are key employers, despite not being the top revenue generators.

Figure 7b. Economic impacts of coal mine closures by regency
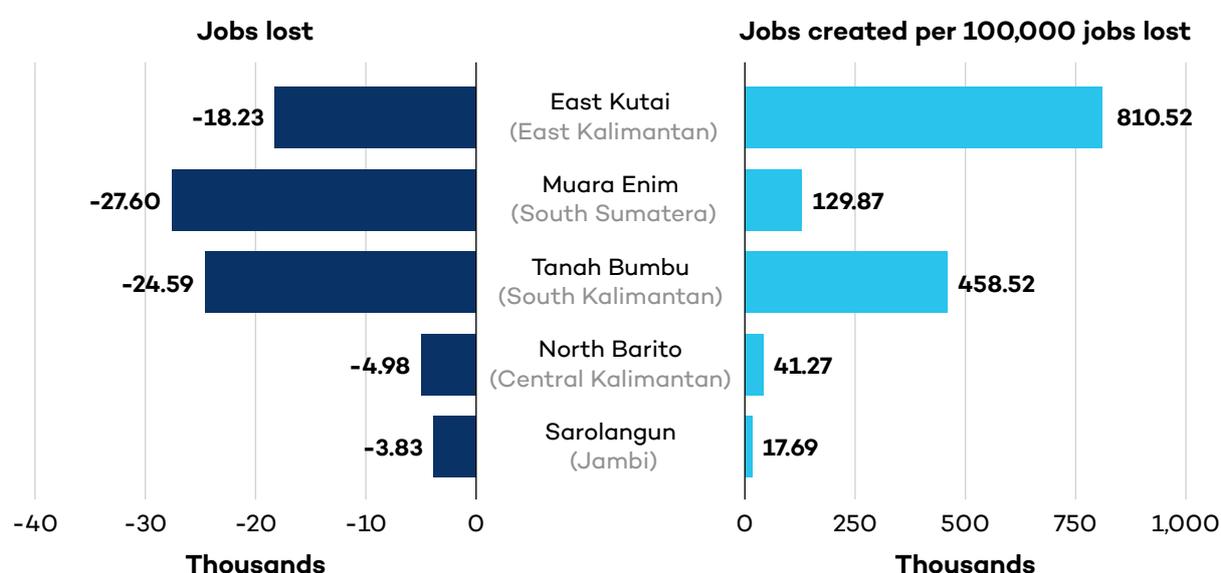
Source: Authors' analysis with data from Statistics Indonesia, 2021, 2023.

North Barito registers an output loss of IDR 9.30 trillion (USD 0.62 billion) (Figure 7a) and registers moderate income losses of IDR 0.22 trillion (USD 14.7 million), but a notable employment impact of nearly ~5,000 jobs (Figure 7b). Sarolangun, by contrast, has the smallest overall losses across all metrics, reflecting a more diversified economy or a lower reliance on coal mining as a driver of gross regional domestic product (GRDP).

These results highlight stark differences in how coal mine closures will impact various regencies. East Kutai and Muara Enim emerge as the most economically vulnerable, while Sarolangun appears more resilient. This disparity reinforces the need for region-specific just transition strategies, including related to economic diversification, worker retraining, and investment in sustainable sectors tailored to each regency's economic structure.

Province Level

Figure 8a. Provincial output loss

East Kalimantan — 628.35
South Sumatra — 346.50
South Kalimantan — 156.45
Central Kalimantan — 45.90
Jambi — 26.55

(x-axis: 0, 100, 200, 300, 400, 500, 600, 700, 800 — IDR trillions)
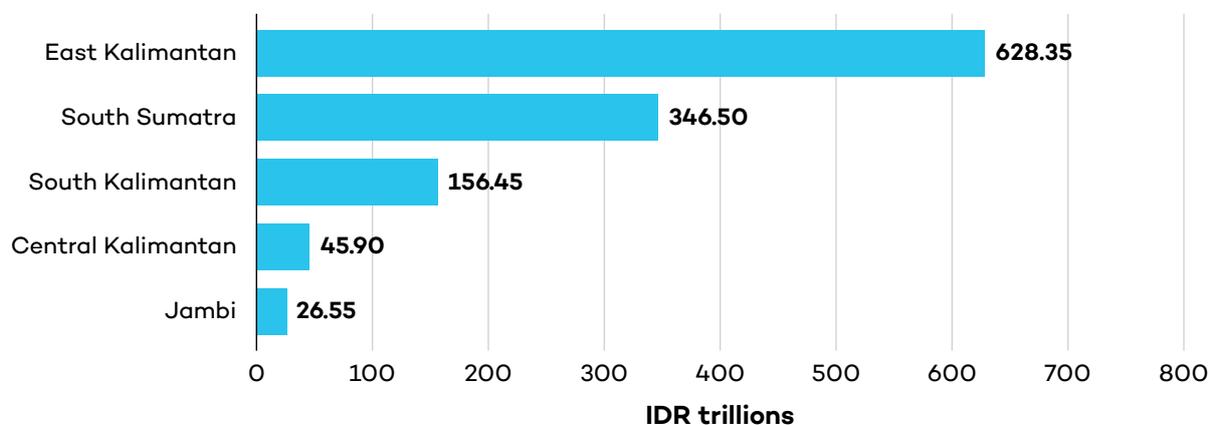
Note: This conversion rate is used as a modest figure in making.
Source: Authors' analysis with data from Statistics Indonesia, 2021, 2023.

East Kalimantan shows the most severe contraction across all three indicators. The province would lose IDR 628.35 trillion (USD 41.89 billion) in output (Figure 8a) and IDR 82.65 trillion (USD 5.51 billion) in sectoral income—the highest among all provinces. Job losses are also the most significant, reaching over 490,000 workers. This reflects East Kalimantan's extreme economic dependency on coal mining: the sector contributes nearly 80% to its GRDP.

South Kalimantan would lose IDR 156.45 trillion (USD 10.43 billion) in output and 276,866 jobs. Central Kalimantan, while showing slightly lower financial losses at IDR 45.90 trillion (USD 3.06 billion) in output, has comparably high employment losses (315,560 jobs), indicating a labour-intensive dependency on coal-related activities, particularly in transport sectors linked to mining.

Figure 8b. Provincial-level employment impacts

-315.560 — Central Kalimantan
-276.866 — South Kalimantan
-100.000 — Jambi
-58.509 — East Kalimantan
-24.586 — South Sumatra

(x-axis: 350, 300, 250, 200, 150, 100, 50, 0 — Jobs lost per 100,000, in thousands)
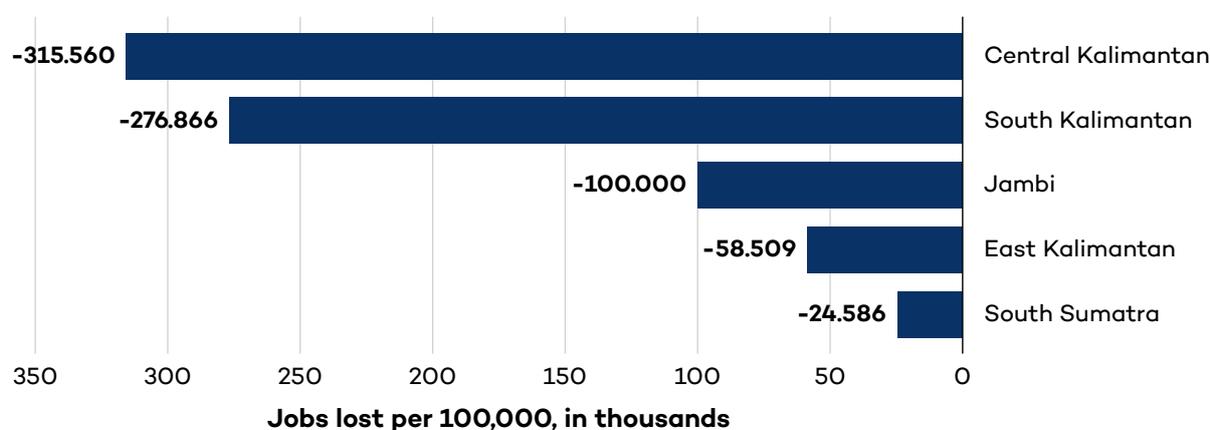
Source: Authors' analysis with data from Statistics Indonesia, 2021, 2023.

South Sumatra would experience a significant IDR 346.50 trillion (USD 23.10 billion) output loss. However, the employment impact is far lower (24,586 jobs). This suggests that, while the province's economy is financially exposed to coal mining, the sector is likely more capital-intensive or less integrated with labour-heavy downstream industries compared to other provinces.

Jambi's estimated losses are modest relative to the other provinces: IDR 26.55 trillion (USD 1.77 billion) in output, IDR 2.85 trillion (USD 0.19 billion) in income, and about 58,509 jobs. The lower exposure is consistent with Jambi's more diversified economic base, particularly its stronger agriculture sector, which may provide a buffer against coal phase-out shocks.

This analysis underscores the regional disparities in vulnerability to coal mine closures. While some provinces, like Jambi, may be better positioned for a transition, provinces such as East and South Kalimantan will face massive economic and social disruptions. These findings again point to the need for targeted transition policies tailored to the specific dependency profile of each province.

4.1.2 Three Scenarios to Mitigate Negative Impacts of Coal Mine Closures

We model the closure of coal mines by introducing an economic shock and report the impact by regency and then province. The stimulus is made against set economic growth targets for each regency and province and considers reallocating the fiscal stimulus to high-potential sectors outside of coal mining. Three policy scenarios are considered. Scenario 1 evaluates the effects of coal mine closure at all levels (regency and provincial) when there is no recovery policy in place (baseline contraction). Scenario 2 assesses top output multiplier sectors. Scenario 3 examines economic recovery projections using sectors that could potentially replace coal, including the green economy[3] (renewables sector development).

- **Scenario 1:** No recovery policy (baseline contraction)
- **Scenario 2:** Targeting top output-multiplier sectors
- **Scenario 3:** Green sector development (10 low-coal linkage industries)

We compare outcomes across three key metrics: GRDP/output, sectoral income (welfare), and employment.[4]

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[3] The United Nations Environment Programme defines a green economy as "one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" (Kasztelan, 2017). A green economy focuses not only on environmental protection but also on economic transformation, promoting sectors such as renewable energy, sustainable agriculture, green buildings, and clean transportation (Georgeson & Maslin, 2017).

[4] Note on currency conversion: All monetary figures have been converted from IDR to USD using an exchange rate of USD 1 = IDR 15,000.
  • USD 1 billion (B USD) ≈ IDR 15 trillion (T IDR)
  • USD 1 million (M USD) ≈ IDR 15 billion (B IDR)

Regency Level

Results from the five regencies indicate varied but generally positive effects of a coal and lignite mining sector closure in five regencies

The information is provided in Table 1, with each scenario detailed for every regency. Presenting the data in this manner facilitates straightforward comparison of the three scenarios across the five regencies, thereby supporting a comprehensive IO analysis. These numbers represent a projection under each scenario, depending on whether the economic demand shock is met.

The types of jobs created will depend on further job analysis studies, which would need to identify all possible employment opportunities under each economic sector (permanent/temporary, long-/short-term, skilled/non-skilled, formal/informal, etc.). These are simply guiding figures to provide an idea of how the coal transition recovery can be prepared for from an economic recovery perspective.

Table 1. Regency IRO analysis

Metric	Scenario 1	Scenario 2	Scenario 3
1. Muara Enim Regency			
Final demand shock (USD)	9.37 billion	8.49 billion	9.29 billion
GRDP ⇕[5]	−63.41%	+8.00%	+8.00%
Sectoral income (USD) ⇕	−1.40 billion	+2.74 billion	+2.42 billion
Employment ⇕	−24,586 jobs	+458,518 jobs	+ 727,572 jobs
Top impact sector	Coal mining	Food & beverage	Food & beverage
2. Tanah Bumbu regency			
Shock (USD)	1.63 billion	1.92 billion	1.96 billion
GRDP ⇕	−53.07%	+4.06%	+4.06%
Income (USD) ⇕	−43.3 million	+618.0 million	+385.3 million
Employment ⇕	−27,599 jobs	+129,874 jobs	+142,986 jobs
Top sector	Coal mining	Food & beverage	Food & beverage
3. North Barito regency			
Shock (USD)	578 million	732 million	335 million
GRDP ⇕	−44.39%	+5.07%	+5.07%
Income (USD) ⇕	−16.7 million	+300.7 million	+256.7 million

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[5] ⇕ indicates the percentage change relative to the baseline (Scenario 1), e.g., +8.00% means an 8% increase in GRDP compared to the scenario of no policy intervention.

Metric	Scenario 1	Scenario 2	Scenario 3
Employment ↕	−4,976 jobs	+41,270 jobs	+67.543 jobs
Top sector	Coal mining	Food & beverage	Food & beverage
4. Sarolangun regency			
Shock (USD)	173 million	266 million	269 million
GRDP ↕	−9.06%	+5.40%	+5.40%
Income (USD) ↕	−26.7 million	+111.0 million	+120.0 million
Employment ↕	−3,824 jobs	+17,685 jobs	+10,247 jobs
Top sector	Coal mining	Petroleum & gas	Construction
5. East Kutai regency			
Shock (USD)	18.15 billion	20.65 billion	23.66 billion
GRDP ↕	−86.72%	+4.63%	+4.63%
Income (USD) ↕	−4.25 billion	+3.68 billion	+2.69 billion
Employment ↕	−18,234 jobs	+810,518 jobs	+819,763 jobs
Top sector	Coal mining	Food & beverage	Food & beverage

Source: Authors' analysis with data from Statistics Indonesia, 2021, 2023.

Across the regencies, Scenario 2 consistently drives the strongest GRDP rebound by channelling stimulus into sectors with the highest output multipliers, though this requires the largest fiscal outlays. In contrast, Scenario 3's green sector strategy is the most cost-efficient in achieving output restoration—requiring as little as a USD 335 million (IDR 5.025 trillion) shock in North Barito—while simultaneously maximizing employment gains; for instance, it generates over 143,000 new jobs in Tanah Bumbu without complex input replacement policies. Scenario 2, focused on food and beverage expansion, strikes the best balance for boosting household welfare—delivering welfare uplifts of up to USD 618 million (≈ IDR 9.27 trillion) in Tanah Bumbu and USD 300.7 million (≈ IDR 4.51 trillion) in North Barito—at moderate funding levels. Moreover, in regencies such as Sarolangun, Scenario 2's emphasis on construction not only lifts GRDP but also augments welfare, whereas Scenario 3's green food and beverage initiatives more than triple job creation.

The food and beverage manufacturing sector leads in output gains and consistently ranks as one of the top sectors for output growth across four regencies. This shows high responsiveness to economic stimulus and the ability to absorb redirected economic activity following coal mine closures, positioning it as a key driver in the transition.

Together, these trade-offs underscore the need for a blended policy trajectory: prioritize Scenarios 2 and 3 for immediate income support, to restore output in high-coal regions, and secure broad-based employment and sustainable growth.

Province Level

The information provided at the province level in Table 2 focuses on the same three scenarios as in the regency simulation. However, this section looks at the IRIO analysis for affected provinces.

Table 2. Provincial IRIO analysis

Metric	Scenario 1	Scenario 2	Scenario 3
South Sumatra province			
Final demand shock (USD)	17.97 billion	16.70 billion	15.52 billion
GRDP ⥮	–26.42%	+4.90%	+4.90%
Sectoral income (USD) ⥮	–2.60 billion	+2.59 billion	+2.31 billion
Employment ⥮	–474 702 jobs	+1,744,410 jobs	+ 3,140,404 jobs
South Kalimantan province			
Shock (USD)	8.79 billion	8.85 billion	9.51 billion
GRDP ⥮	–37.63 %	+4.42%	+4.42 %
Income (USD) ⥮	–0.43 billion	+ 2.01 billion	+1.50 billion
Employment ⥮	–276 866 jobs	+ 1,611,550 jobs	+2,170,297 jobs
Central Kalimantan province			
Shock (USD)	2.50 billion	3.64 billion	3.37 billion
GRDP ⥮	–13.23%	+5.54 %	+5.54 %
Income (USD) ⥮	–0.19 billion	+ 0.85 billion	+0.66 billion
Employment ⥮	–315 560 jobs	+ 105 056 jobs	+97 026 jobs
Jambi province			
Shock (USD)	1.64 billion	2.73 billion	2.73 billion
GRDP ⥮	–6.02%	+4.94%	+4.94 %
Income (USD) ⥮	–0.20 billion	+0.71 billion	+0.73 billion
Employment ⥮	–58 510 jobs	+316 518 jobs	+470 547 jobs
East Kalimantan province			
Shock (USD)	34.39 billion	35.02 billion	32.41 billion
GRDP ⥮	–45.79%	+2.67 %	+2.67 %
Income (USD) ⥮	–6.15 billion	+2.39 billion	+3.17 billion
Employment ⥮	–490 251 jobs	+1,484,877 jobs	+2,581,769 jobs

Source: Authors' analysis with data from Statistics Indonesia, 2021, 2023.

Economic Recovery and Welfare Support

Scenario 2 emerges as the most feasible for maximum economic recovery. Scenario 2 assesses the impact by pumping demand into the sectors with the largest backward–forward linkages. This scenario achieves a GRDP of +4.90% at a USD 16.7 billion (IDR 250.5 trillion) shock in South Sumatra and a +2.67% GRDP boost in East Kalimantan at a USD 35.02 billion (IDR 525.30 trillion) shock. However, these positive results will come at the steepest fiscal stimulus, as no other scenario requires more stimulus funds. Scenario 2's economic stimulus relies on the food and beverage sector in both provinces, signalling the strength of this sector seen in the regency analysis.

Employment Recovery

When the goal shifts from pure output to inclusive recovery, Scenario 3's focus on the green sector emerges as more feasible. This scenario creates more jobs in four out of five provinces than any other plan—3.14 million in South Sumatra, 2.17 million in South Kalimantan, 470,000 in Jambi, and 2.58 million in East Kalimantan—while requiring less total shock than Scenario 2. Scenario 3 assesses an economic recovery based purely on green priority industries, which provides the closest projections to a transitioned economy without any ties to coal or coal-linked sectors. This is a completely new outlook that paints a picture of a just transition and what can be done to prepare for it.

Energy Transition

In coal-dependent regions such as Muara Enim (South Sumatra) and East Kalimantan, only the intensive, sector-targeted stimulus of Scenario 3 can reverse GRDP contraction and restore growth—highlighting the imperative for robust, focused intervention where mine closures inflict the greatest damage. Conversely, in more economically diversified provinces like Central Kalimantan and Jambi, equivalent gains in household welfare and employment can be realized through either Scenario 3's green sector pivot or Scenario 2's food and beverage stimulus. This flexibility enables local authorities to achieve both social and environmental objectives with comparatively lower fiscal commitments.

4.1.3 Conclusion

A strategically coordinated, state-led energy transition will enable Indonesia to sustain growth while phasing out coal. By integrating provincial policies, reallocating budgets, and advancing green industrialization, the government can cushion the socio-economic impacts of mine closures. Shifts in final demand will redistribute growth across sectors: while fossil fuel-linked industries may contract, cleaner and more labour-intensive sectors benefit, balancing the economy and preserving stability.

The Public Pathway approach, outlined in the 2025 Trade Union Initiative's position paper (International Labour Organization, 2025), reinforces this vision through state planning, democratic control of finance, and worker-centred policies—principles aligned with Article 33's mandate that natural resources serve collective welfare. Provincial governments, like regency governments, can tailor and integrate policy options to local needs, operationalized through reallocation of national and local budgets.

4.2 Findings From the Qualitative Study

4.1.1 Informal Work and Vulnerable Groups

This section presents the circumstances of vulnerable community groups in Swarga Bara village, located near a coal mining site in East Kutai regency, East Kalimantan Province. These groups include youth (aged 16–30), both those still in school and those actively seeking employment; retirees over 55, including both former mine workers and general retirees; and adult men and women over 30, such as mine workers' spouses, MSME owners, and casual labourers. These groups face distinct economic and social challenges and are likely to be disproportionately affected by the closure of coal mines. The findings provide insight into their livelihoods, resilience, and exposure to risk in the context of East Kalimantan's economic transition.

The informal sector forms part of the local economy directly tied to the presence of coal mines. The study found that 58.8% of respondents (20 out of 34) were informal workers, spread evenly between men and women (Figure 9). Most were of productive age (<56), with notable representation among vulnerable groups such as MSME owners in informal trade. The food and beverage service sector had the highest number of informal workers (six respondents), followed by wholesale and retail trade (four respondents). Both sectors are accessible owing to their low capital and skill requirements.

Informal workers held diverse jobs and incomes, with some taking on secondary work in sectors like construction, plantations, and coal mining. Own-account work—the most common category, especially for women—offers flexible arrangements aligned with domestic responsibilities. Male-dominated sectors like construction and logistics showed low female representation, mirroring national trends. A gender income gap was evident: men earned IDR 1 million–10 million (~USD 66.67–USD 666.67)[6] per month and women IDR 5 million–60 million (~USD 333.33–USD 4,000), reflecting unequal access to high-paying sectors. While 65% had some form of social protection, including BPJS Kesehatan, 35% lacked any coverage, highlighting gaps in the safety net for informal workers.

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[6] Values use the conversion rate of USD 1 = IDR 15 000.

Figure 9. Number of male and female informal workers in each sector
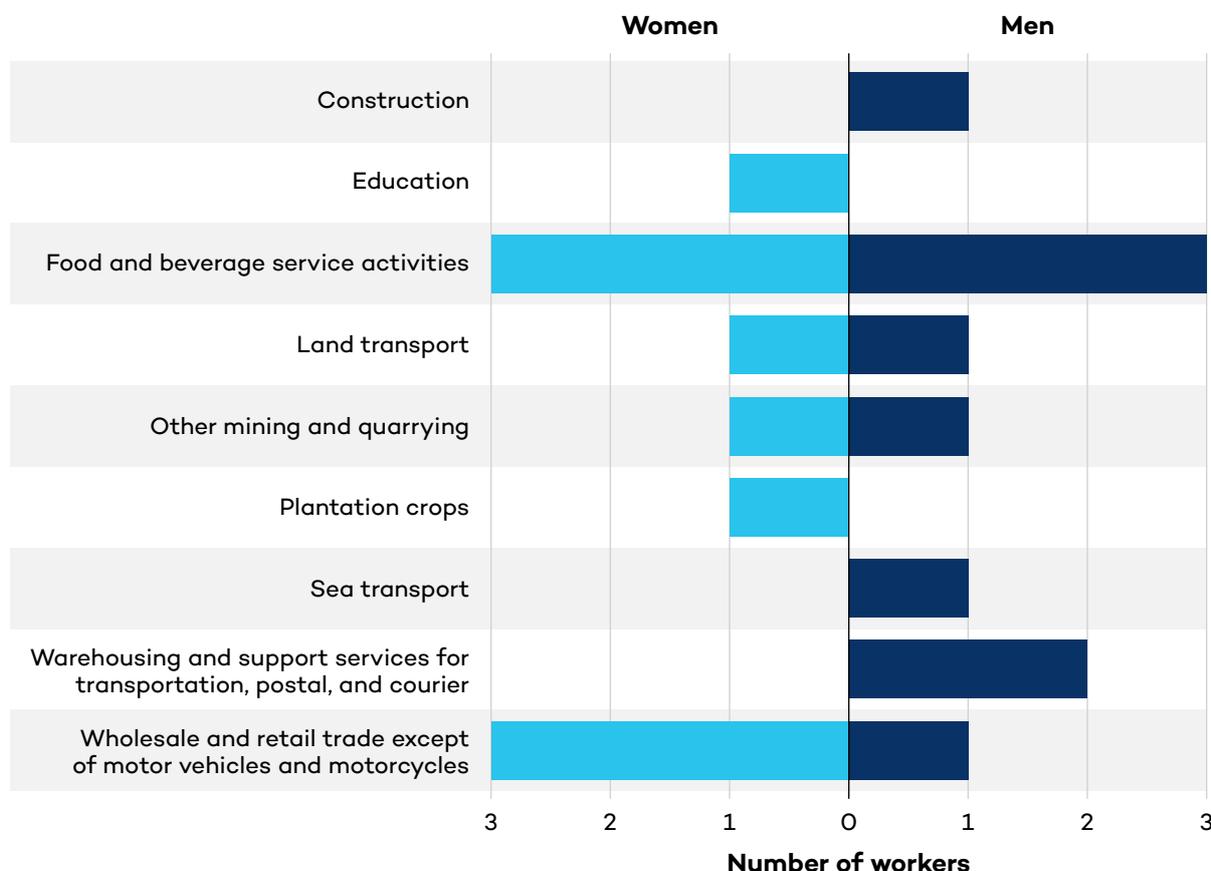
Source: Authors' diagram.

Many youths were involved in informal work, which is easier to obtain. Youth near mining areas in East Kutai regency face challenges in accessing formal employment. A male respondent who was looking for work said that information on formal employment—especially in the mining sector—was difficult to obtain and often restricted to insiders. A female student working part-time in a bookstore highlighted the accessibility of informal jobs, which require no special skills and cater to the needs of mining workers. Another respondent in higher education spoke of better job prospects in Java or the new capital city, owing to the presence of more reputable universities.

Several women in Swarga Bara village—particularly those with family ties to mine workers— were found to play dual roles, managing household responsibilities while also earning income. Some respondents ran small businesses, such as food stalls or catering services, while others sold beverages or pastries. Their earnings range from IDR 1 million (USD 66.67) to IDR 4 million (USD 266.67) per month. Although a few exceeded the East Kutai regency minimum wage of IDR 3.74 million (USD 249.33), the median income remains significantly lower at just IDR 1.25 million (USD 83.33).

One notable exception was a university-educated respondent in her early 30s, whose use of social media to expand her business beyond the village had allowed her to surpass the minimum wage. Her case highlights the potential of the digital economy to support women's

dual roles, provided there is adequate access to digital infrastructure and literacy (Sowmya & Pai, 2024). However, most respondents lack these resources. The majority were high school graduates or lower, depended on informal work for family income, and were covered only by basic social protection (e.g., BPJS Kesehatan).

FGDs With Government Officials

The findings are presented based on recurring themes. These range from economic dependence on coal, policy readiness, transition strategy, employment and social protection, education and community development, vulnerable groups, GESI, and cross-cutting issues.

Table 3. FGD data analysis

Theme	Local government (East Kutai)	National government (ministries/agencies)	Community voices (workers & villagers)
Economic dependence on coal	Coal underpins >80% of GRDP; officials fear collapse if mines close.	Coal royalties = ~80% of non-tax revenue; closure seen as a fiscal risk.	Residents worry about collapse of local economy; fear loss of small businesses tied to mining.
Policy readiness	Waiting for clear direction from Jakarta; no mandate locally.	No immediate mine phase-out policies; roadmap vague; no reskilling yet.	Villagers sense a lack of planning; feel excluded from decisions; uncertain about their future.
Transition strategy	Drafting diversification strategies; piloting renewables (solar, micro-hydro, biogas); agriculture programs.	Focus on coal "downstreaming" (high-value coal products); prioritize power plant retirement over mine closures.	Communities skeptical: small renewables exist but jobs/income from them are minimal compared to mining.
Employment & social protection	Developing labour database; plantation programs; negotiating social protection for casual workers.	No reskilling programs yet; welfare measures only planned in later transition phases.	Workers fear unemployment; day labourers and informal workers highlight lack of safety nets; women fear exclusion from formal jobs.
Education & community development	Scholarships and infrastructure tied to coal revenues and CSR; closure would cut these off.	Focus on state revenue loss, not community-level education/services.	Parents fear loss of scholarships for children; villagers cite CSR-built infrastructure (e.g., roads) that would not be maintained post-closure.

Theme	Local government (East Kutai)	National government (ministries/agencies)	Community voices (workers & villagers)
Vulnerable groups & GESI	Aware women, youth, and the elderly are most exposed; pushing CSR to support vulnerable workers.	Some acknowledgement (e.g., women's empowerment ministry), but not integrated into mainstream policy.	Women report lower access to reemployment; youth worry about lost scholarships and jobs; the elderly fear reduced welfare support.
Overall outlook	Defensive; survival concerns dominate; diversification attempts limited in scale.	Strategic but cautious; long-term staged transition with reliance on coal revenue in the short term.	Fearful and uncertain; communities want inclusion in planning and assurance of livelihoods beyond coal.

Source: Primary data from focus group discussions.

The findings reveal a layered set of perspectives on coal transition in East Kutai. At the local government level, authorities are deeply aware of the district's heavy dependence on coal but are also cautiously experimenting with diversification strategies such as small renewable projects and agricultural initiatives. At the national government level, ministries are aware of the fiscal challenges, emphasizing coal's critical contribution to state revenues and preferring a gradual, long-term transition framed around staged policies and power sector retirement, rather than abrupt mine closures. Meanwhile, communities emerge as the most vulnerable actors: workers and villagers express strong fears about losing jobs, scholarships, and social services, while also **voicing frustration at being excluded from transition planning**. Together, these perspectives highlight concerns between local survival, national fiscal caution, and community vulnerability, underscoring the urgent need for inclusive and coordinated just transition strategies.

5.0 Conclusions, Recommendations, and Assessment of the Mixed-Methods Approach

5.1 Conclusions

The closure of Indonesia's coal mining sector without targeted economic interventions will trigger significant economic and social disruptions. Using IO and GEDSI approaches, this study has identified key impacts, challenges, and opportunities across affected regions. These have related to structural economic shifts; employment losses; the rise of informal work among youth, adults, and the elderly; increased burdens on women; and the potential for clean energy development and environmental recovery. Local governments face major constraints in managing these transitions owing to limited authority in relation to energy policy, weak coordination with the centre, and insufficient technical or financial support.

To address these challenges, the study has modelled three transition scenarios to identify viable sectoral alternatives to coal. Results highlight the manufacturing of food and beverages as a consistently strong replacement sector across regions. Local governments are encouraged to adopt mixed strategies from these scenarios, and to pair these with policies to reduce environmental damage and actively involve workers and vulnerable groups in transition planning.

The IO analysis shows that sectors most affected by mine closures include coal and lignite mining, other mining and quarrying, land transport, retail trade, and construction. Formal workers in these sectors may shift to informal jobs that are easier to access but offer lower wages and fewer benefits, weakening social protection coverage for families. Informal workers dependent on coal—especially those in food services and retail—also face a loss of income. In East Kutai and other coal-reliant regencies (Muara Enim, Tanah Bumbu, Sarolangun, North Barito), these sectors are particularly vulnerable.

Skills data from East Kutai show that older respondents often possess agricultural experience, making agriculture a potential fallback sector. Importantly, agriculture has low linkages to coal and still absorbs high labour numbers. Youth respondents tend to have digital economy skills, such as videography and editing, though this sector is less labour-intensive and more coal-dependent than others. Among sectors analyzed, food and beverage manufacturing shows the lowest linkages to coal and high potential for absorbing informal workers across age and gender groups.

A just energy transition will require targeted policies for informal workers, including retraining for green sectors, support for eco-friendly MSMEs, and robust social protection. Such measures are essential to ensure the transition not only mitigates environmental risks but also promotes equitable outcomes for communities most at risk.

5.2 Recommendations

This section outlines strategic recommendations to guide coal-producing regions through mine closures and toward a just, inclusive energy transition. The recommendations aim to support economic stability, workforce transitions, strengthen institutional coordination, and protect vulnerable populations, particularly informal workers and women.

5.2.1 Policy Recommendations

Enable Workforce Reskilling and Diversify Local Economies

Labour reskilling is essential for transitioning both formal mining workers and informal sector actors into new economic roles. Skills training should align with the green economy, including sustainable agriculture, digital enterprise, and renewable energy. Women's economic empowerment must be prioritized through targeted support: access to training, land, markets, and finance.

Food and beverage manufacturing, identified as a high-potential sector across multiple provinces, can serve as a replacement for coal-related employment. Rubber plantations, particularly in Sarolangun regency, represent another diversification opportunity. Strategies will need to include ways to accommodate the higher number of job losses in the coal mining sector, looking at areas where these can be absorbed either through innovative retail practices in the food and beverage sector or opportunities in the green energy sector. Additionally, improving governance and pricing mechanisms will be necessary to ensure long-term viability. Intercropping systems, rubber-based product innovation, and sustainability standards will help maintain competitiveness in global markets.

Strengthen Institutional Coordination for the Energy Transition

Effective coordination between ministries and all levels of government is essential to advance the energy transition. Strengthening institutions like the National Energy Council (Dewan Energi Nasional) as central coordination hubs can help align national energy policies with just transition objectives. The government should also appoint GEDSI focal points within Kementerian ESDM and related agencies to coordinate inclusive energy planning across sectors.

Expand Social Safety Nets for Informal Workers

Coal mine closures will disproportionately impact informal workers and vulnerable groups reliant on coal-related demand. To protect them, the government can expand financial protection mechanisms through a robust social safety net. This can be achieved by adapting existing programs—such as the Pre-Employment Card (Pra-Kerja) and the Family Hope Program (Program Keluarga Harapan)—to the context of the energy transition. Coordinated planning between Kementerian ESDM and Kementerian Ketenagakerjaan (the Ministry of Manpower) will be key to targeting support effectively.

Mainstream GEDSI in Energy and Development Policies

Despite existing gender mainstreaming regulations, implementation within the energy sector remains weak. Indonesia's energy and development strategies must be updated to explicitly include gender and social inclusion. This includes revising national energy plans (e.g., KEN), establishing coordination institutions to oversee implementation, and improving interministerial collaboration for gender-responsive energy planning.

5.2.2 Just Transition Research Methods Recommendations

Stimulate Economic Sectors With High Potential

To sustain economic performance during and after coal mine closures, local governments should prioritize direct fiscal injections into productive non-coal sectors—particularly agriculture, manufacturing, and services. Stimulating investment in sectors with the highest output multipliers (e.g., construction, food processing, tourism) can generate significant employment and income impacts. Concurrently, green sectors such as renewable energy, ecotourism, and creative industries with minimal linkages to coal should be promoted through targeted incentives, infrastructure investment, training, and enabling regulations.

Design a Roadmap for a Just Transition

While the government has a roadmap to guide Indonesia through a successful energy transition, including the Economic Transformation Plan, the National Just Energy Transition Framework, and Skill Road Map, these frameworks lack GEDSI incorporation and focus. As such, they need to be grounded in disaggregated data (by sex, age, and socio-economic status) and to be adapted to integrate GEDSI principles at every stage.

Monitoring of inclusive transition planning must involve women and vulnerable groups in policy discussions and local governance. This requires capacity-building initiatives, access to information, and the development of gender-sensitive planning tools. Their participation ensures local needs are reflected in energy and economic policies, and no one is left behind.

Restore Ecosystems With Local Participation

Post-mining land restoration should be linked to community participation. Environmental recovery offers opportunities to improve local livelihoods and quality of life while contributing to broader sustainability goals. Indigenous communities need to be prioritized and given a space to engage and contribute to the transition planning process. Programs that engage residents—particularly women and youth—in ecosystem restoration, such as community farming, can simultaneously address economic and ecological objectives.

Foster Multistakeholder Collaboration

A just energy transition requires collective action. Government agencies must work in partnership with local communities, civil society, private investors, unions, and development partners. Effective collaboration will require trust, aligned goals, and resource sharing. Inclusive stakeholder engagement ensures equitable outcomes and enhances the legitimacy of transition policies.

5.3 Assessment of the Mixed-Methods Approach

Research on the gendered impacts of the mining sector in relation to a just transition in Indonesia is comparatively less established than that focused on traditional economics and emissions modelling. With respect to a just transition, our modelling was able to pull out significant useful information related to the employment impacts that may be felt during a coal transition, but was less able to generate information on gender and social inclusion impacts. As a result, the modelling exercise provided a useful but incomplete picture. Models could be adapted for GEDSI-specific assessment of the coal transition in Indonesia, but the approaches currently used in the coal sector in Indonesia do not provide the full picture needed for a just transition, including a GEDSI analysis.

With that said, our qualitative analysis has filled this gap for the most part. Qualitative research was essential in capturing the lived realities of communities, workers, and local institutions, and thereby provided nuanced evidence that could strengthen macroeconomic policy design at the regency and province levels. In the context of Indonesia's just energy transition, such insights will help ensure economic models and policy frameworks are grounded in local social, cultural, and institutional dynamics rather than relying solely on aggregate quantitative indicators. FGDs, interviews, and other qualitative methods were able to dig into the gender-specific impacts that were missing from the high-level modelling results. Specific impacts on women and the roles of women and vulnerable groups in the mining sector were well covered. This information can be combined with data on employment impacts and broader economic impacts, identified by the modelling exercise, to provide a fuller picture for a just transition.

We can thus make a good case for using mixed-methods approaches in just transition analysis as part of policy design and implementation going forward. The research exercise has been able to identify several recommendations for policy and research methods, which helps prove the usefulness of the mixed-methods approach of this exercise.

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Appendix A. Full Detail of the Scenarios by Province

Table A1. Economic impact of coal mining closure in South Sumatra province

	Economic impact	Top impacted sector (in South Sumatera)	Top sectoral impact on other provinces
Output	Provincial impact: (USD 23.10 billion) National impact: (USD 26.66 billion)	Coal and lignite mining; Other mining and quarrying; Construction	Business activities; Manufacture of transport equipment; and Manufacture of fabricated metal products, Computer, and optical products, and electrical equipment in Jakarta Business activities; Crude petroleum, natural gas, and geothermal in East Java Natural gas, and geothermal in Jambi
Sectoral income	Provincial impact: (USD 2.33 billion) National impact: (USD 3.15 billion)	Coal and lignite mining; Other mining and quarrying; Wholesale and retail trade except motor vehicles and motorcycles	Business activities; Financial intermediary services; and Wholesale and retail trade except motor vehicles and motorcycles in Jakarta Business activities; Natural gas, and geothermal in East Java
Labour	Provincial impact: (474,701) people National Impact: (634,402) people	Coal and lignite mining; Wholesale and retail trade except motor vehicles and motorcycles; Business activities	Business activities in Jakarta Forestry and logging in Jambi Retail trade except motor vehicles and motorcycles in West Java

Source: Authors' analysis with data from Statistics Indonesia, 2021, 2023.

*Numbers in () indicate negative or minus.

Table A2. Economic impact of coal mining closure in South Sumatra province

	Economic impact	Top impacted sector (in South Sumatera)	Top sectoral impact on other provinces
Output	Provincial impact: (USD 23.10 billion)	Coal and lignite mining; Other mining and quarrying; Construction	Business activities; Manufacture of transport equipment; and Manufacture of fabricated metal products, Computer, and optical products, and electrical equipment in Jakarta
	National impact: (USD 26.66 billion)		Business activities; Crude petroleum, natural gas, and geothermal in East Java
			Natural gas and geothermal in Jambi
Sectoral income	Provincial impact: (USD 2.33 billion)	Coal and lignite mining; Other mining and quarrying; Wholesale and retail trade except motor vehicles and motorcycles	Business activities; Financial intermediary services; and Wholesale and retail trade except motor vehicles and motorcycles in Jakarta
	National impact: (USD 3.15 billion)		Business activities; Natural gas, and geothermal in East Java
Labour	Provincial impact: (474,701) people	Coal and lignite mining; Wholesale and retail trade except motor vehicles and motorcycles; Business activities	Business activities in Jakarta
	National Impact: (634,402) people		Forestry and logging in Jambi
			Retail trade except motor vehicles and motorcycles in West Java

Source: Authors' analysis with data from Statistics Indonesia, 2021, 2023.

*Numbers in () indicate negative or minus.

The closure of coal mines will cause a decrease in the gross regional domestic product (GRDP) of South Sumatra Province by 26.41%. The real GRDP will decrease to USD 5.70 billion, and the nominal GRDP will decrease by USD 9.93 billion. The sectors affected by the significant decline are business activities, financial supporting services, and manufacture of leather and related products and footwear. Then, when viewed from three economic indicators, the closure of coal mines will result in a decrease in sectoral output in South Sumatra Province by USD 23.10 billion, a decrease in sectoral income by USD 2.33 billion, and a decrease in the number of workers by 474,701. In addition to having an impact on the economy at the provincial level, the ending of mining in Sumatra Province will also have an impact on the national economy. National output will decrease by USD 26.66 billion, sectoral income will also decrease by USD 3.15 billion, and the number of workers nationally will decrease by 634,402. The closure of coal mining in South Sumatra Province could also have an impact on sectors in other provinces, including the business activities sector in Jakarta

Province, which could experience the greatest impact in the form of a decrease in sectoral output of IDR 13.01 trillion, sectoral income decreased by IDR 3.67 trillion, and a decrease in the number of workers of 9,862. In addition to DKI Jakarta Province, the closure of coal mines in South Sumatra Province also has an impact on the business activities sector in East Java, the natural gas and geothermal sector in East Java and Jambi, the forestry and logging sector in Jambi, retail trade except motor vehicles and motorcycles in West Java, and various sectors in other provinces.

Table A3. Economic impact of coal mine closure in South Kalimantan province

	Economic impact	Top impacted sector (in South Kalimantan)	Top sectoral impact on other provinces
Output	Provincial impact: (USD 10.43 billion) National impact: (USD 12.30 billion)	Coal and lignite mining; Business activities; Information and communication	Business activities; and Information and communication in the Special Capital Region of Yogyakarta Manufacture of machinery and equipment in West Java Manufacture of chemicals and pharmaceuticals and botanical products in East Kalimantan
Sectoral income	Provincial impact: (USD 0.38 billion) National impact: (USD 0.73 billion)	Coal and lignite mining; Business activities; Financial intermediary services	Business activities; Information and communication; and financial intermediary services in the Special Capital Region of Yogyakarta Manufacture of machinery and equipment; and Manufacture of transport equipment in West Java Information and communication in East Java
Labour	Provincial impact: (276,866) people National impact: (369,540) people	Coal and lignite mining; Wholesale and retail trade except motor vehicles and motorcycles; Land transport	Wholesale and retail trade except motor vehicles and motorcycles; Manufacture of machinery and equipment; Land transport; and Manufacture of transport equipment in West Java Land transport in Central Java and the Special Capital Region of Yogyakarta

Source: Authors' analysis with data from Statistics Indonesia, 2021, 2023.

*Numbers in () indicate negative or minus.

In South Kalimantan Province, the closure of coal mines caused a contraction in GRDP of 37.63%. With the inter-sectoral linkages, direct and indirect impacts, the financial supporting service sector, the procurement of gas and ice production sector, the business activities sector, and the electricity sector are the sectors that could experience the greatest impact. If we look at the impact on South Kalimantan Province, there was a decrease in sectoral output of USD 10.43 billion, sectoral income of USD 0.38 billion, and a decrease in the number of workers of 276,866. The sectors most affected based on the three indicators are the coal and lignite mining sector; business activities sector; information and communication sector, financial intermediary services sector, wholesale and retail trade except motor vehicles and motorcycles sector; and the land transport sector. Meanwhile, at the national level, the impact of coal mine closure in South Kalimantan Province could decrease sectoral output by USD 12.30 billion, sectoral income by USD 0.73 billion, and decrease the number of workers by 369,540. The closure also could have a major impact on the business activities sector in the Special Region of Yogyakarta Province, which could experience a decrease in output of USD 0.13 billion, and a decrease in sectoral income of USD 36.71 billion. Meanwhile, the wholesale and retail trade except motor vehicles and motorcycles sector in West Java Province is the sector that could experience the largest decrease in the number of workers (5,041) if coal mining in South Kalimantan Province is ended. In addition, the closure of coal mines in South Kalimantan Province could also have a major impact on other sectors in the Special Region of Yogyakarta Province, West Java Province, East Java Province, East Kalimantan Province, among others.

Table A4. Economic impact of coal mine closure in Central Kalimantan province

	Economic impact	Top impacted sector (in Central Kalimantan)	Top sectoral impact on other provinces
Output	Provincial impact: (USD 3.06 billion)	Coal and lignite mining; River, lake, and ferry transport; Sea transport	Business activities in Jakarta Manufacture of coal and refined petroleum products in East Kalimantan Manufacture of coal and refined petroleum products in West Java
	National impact: (USD 3.9 billion)		
Sectoral income	Provincial impact: (USD 0.17 billion)	River, lake, and ferry transport; Coal and lignite mining; Sea transport	Business activities; and Financial intermediary services in Jakarta River, lake, and ferry transport in Lampung Manufacture of coal and refined petroleum products in East Kalimantan
	National impact: (USD 0.34 billion)		

	Economic impact	Top impacted sector (in Central Kalimantan)	Top sectoral impact on other provinces
Labour	Provincial impact: (315,560) people National impact: (356,826) people	Coal and lignite mining Wholesale and retail trade except motor vehicles and motorcycles River, lake, and ferry transport	Manufacture of coal and refined petroleum products; and wholesale and retail trade except motor vehicles and motorcycles in West Java Business activities in Jakarta River, lake, and ferry transport in Lampung

Source: Authors' analysis with data from Statistics Indonesia, 2021, 2023.

*Numbers in () indicate negative or minus.

The closure of coal mining in Central Kalimantan Province could cause GRDP to contract by 13.23%. The business activities sector; the gas procurement and ice production sector; and the coal and lignite mining sector are the sectors that could experience the greatest impact. When viewed from three economic indicators, the closure of coal mining will reduce sectoral output in Central Kalimantan Province by USD 3.06 billion, a decrease in sectoral income by USD 0.17 billion, and a decrease in the number of workers by 315,560. In addition to having an impact on the local economy, the ending of mining in Central Kalimantan Province could also impact the national economy. National output could fall by USD 3.99 billion, sectoral income by USD 0.34 billion, and the number of workers nationally could fall by 356,826. The ending of coal mining in Central Kalimantan Province could also impact sectors in other provinces, including the business activities sector in DKI Jakarta Province, which experienced the greatest impact in the form of a decrease in sectoral output of IDR 1.34 trillion and sectoral income decreased by IDR 379.77 trillion. Meanwhile, regarding the workforce indicator, the manufacturing of coal and refined petroleum products sector in West Java Province could experience the largest decrease in the number of workers (1,480). In addition to DKI Jakarta Province and West Java Province, the ending of coal mining in Central Kalimantan Province could also impact other sectors in East Kalimantan Province, Lampung Province, and other provinces.

Table A5. Economic impact of coal mine closure in Jambi Province

	Economic impact	Top impacted sector (in South Sumatera)	Top sectoral impact on other provinces
Output	Provincial impact: (USD 1.77 billion) National impact: (USD 2.50 billion)	Coal and lignite mining Wholesale and retail trade except motor vehicles and motorcycles Land transport	Coal and lignite mining in South Sumatera Other mining and quarrying in South Sumatera Manufacture of coal and refined petroleum products in South Sumatera

	Economic impact	Top impacted sector (in South Sumatera)	Top sectoral impact on other provinces
Sectoral income	Provincial impact: (USD 0.19 billion)	Coal and lignite mining	Coal and lignite mining in South Sumatera
	National impact: (USD 0.28 billion)	Wholesale and retail trade except motor vehicles and motorcycles	Other mining and quarrying in South Sumatera
		Business activities	Business activities in Jakarta
Labour	Provincial impact (58,509) people	Coal and lignite mining	Coal and lignite mining in South Sumatera
	National impact: (83,224) people	Wholesale and retail trade except motor vehicles and motorcycles	Wholesale and retail trade except motor vehicles and motorcycles in South Sumatera and West Java
		Wholesale and retail trade and repair of motor vehicles and motorcycles	Business activities in South Sumatera

Source: Authors' analysis with data from Statistics Indonesia, 2021, 2023.

*Numbers in () indicate negative or minus.

The ending of coal mining in Jambi Province could cause a contraction in GRDP of 6.02%. With the intersectoral linkages and direct and indirect impacts, the manufacture of transport equipment sector is the sector that could experience the greatest impact besides the coal and lignite mining sector. If we look at the impact on Jambi Province, output could decrease by USD 1.77 billion, sectoral income by USD 0.19 billion, and employment by 58,509. The sectors most affected based on the three indicators would be the coal and lignite mining sector; wholesale and retail trade except motor vehicles and motorcycles; business activities; wholesale and retail trade and repair of motor vehicles and motorcycles; and land transport. At the national level, the ending of coal mining in Jambi Province could decrease output by USD 2.50 billion, national income by USD 0.28 billion, and the number of workers by 83,224. Coal mine closure could also have a major impact on the coal and lignite mining sector in South Sumatra Province, with decreased output of USD 0.31 billion, sectoral income by USD 19.32 billion, and a decrease in employment opportunities for 83,224 people. In addition, the closure of coal mining in Jambi Province could also have a major impact on other sectors in South Sumatra Province, DKI Jakarta Province, West Java Province, and other provinces.

Table A6. Economic impact of coal mining closure in East Kalimantan Province

	Economic impact	Top impacted sector (in South Sumatera)	Top sectoral impact on other provinces
Output	Provincial Impact: (USD 41.89 billion) National impact: (USD 44.54 billion)	Coal and lignite mining; Manufacture of coal and refined petroleum products; Other mining and quarrying	Manufacture of machinery and equipment; wholesale and retail trade except motor vehicles and motorcycles; manufacture of transport equipment in West Java Business activities in Jakarta Crude petroleum, natural gas, and geothermal in East Java
Sectoral income	Provincial impact: (USD 5.51 billion) National impact: (USD 6.50 billion)	Coal and lignite mining; Other mining and quarrying; Construction	Manufacture of machinery and equipment; Wholesale and retail trade except motor vehicles and motorcycles; Manufacture of transport equipment in West Java Business activities in Jakarta Crude petroleum, natural gas, and geothermal in East Java
Labour	Provincial impact: (490,251) people National impact: (788,491) people	Coal and lignite mining Wholesale and retail trade except motor vehicles and motorcycles Business activities	Wholesale and retail trade except motor vehicles and motorcycles; Manufacture of machinery and equipment; Manufacture of transport equipment; Land transport; and Wholesale and retail trade and repair of motor vehicles and Motorcycles in West Java

Source: Authors' analysis with data from Statistics Indonesia, 2021, 2023.

*Numbers in () indicate negative or minus

In East Kalimantan Province, the closure of coal mining could cause a contraction in GRDP of 45.79%. With the intersectoral linkages, direct and indirect impacts, the financial supporting service sector; business activities sector; and other manufacturing, repair, and installation of machinery and equipment are the sectors that could experience the greatest impact. If we look at the impact on East Kalimantan Province, sectoral output could decrease by USD 41.89 million, sectoral income by USD 5.51 billion, and the number of workers by 490,251. The sectors that could be most affected based on the three indicators are the coal and lignite mining sector; other mining and quarrying sector; and wholesale and retail trade except motor vehicles and motorcycles. At the national level, the ending of coal mining in East Kalimantan Province could cause a decrease in sectoral output of USD 44.54 billion, sectoral income of USD 6.50 million, and a decrease in the number of workers nationally of 788,491 people. The closure also could also have a major impact on the manufacturing of machinery and equipment sector in West Java Province, which could experience decreases in output of

USD 1.03 billion, and sectoral income of USD 5.51 billion. Meanwhile, the wholesale and retail trade except motor vehicles and motorcycles sector in West Java Province could be the most impacted sector, with the largest decrease in the number of workers if coal mining in South Kalimantan Province is closed (44,776). In addition, the ending of coal mining in East Kalimantan Province could also have a major impact on other sectors in West Java Province, East Java Province, and DKI Jakarta Province, among others.

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