Leveraging Industrial Decarbonisation Options in Indonesia by Anticipating International Carbon Tariff

Deliverable 3: Provincial-Level Impact Analysis

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CONTENTS

1 EXECUTIVE SUMMARY

This study builds on the national-level analysis by assessing the regional impacts of carbon border adjustment (CBA) measures in Indonesia. Using outputs from a global computable general equilibrium model and regional Input-Output tables, the study estimates changes in output, gross value added (GVA) and employment across provinces.

The analysis goes beyond the analysis of the direct impacts and considers indirect impacts that arise from sectoral interdependencies. This means that regional macroeconomic performance will not only be determined by the changes in the production of sectors that are directly affected by CBAM regulation such as iron and steel, aluminum, fertilisers and cement but also by changes in the production of goods that serve as intermediate inputs and energy sources.

The impact assessment performed at previous stages of the project covered the quantification of the effects of three alternative scenarios: i) a scenario where only the EU adopts CBAM (NDC+EUCBAM), ii) a scenario where the UK, the USA, Japan and Australia also adopt CBA measures (NDC+G1CBAM), and iii) a scenario where China, India and Canada also impose carbon tariffs on their imports (NDC +G2CBAM).

At the national level the impact assessment indicated that iron and steel industries could experience production losses between USD 2 billion and USD 15 billion throughout the projection period (2025-2050), non-ferrous metals losses of USD 3 billion to USD 12.5 billion, chemicals reductions in the range of USD 3.4 billion to USD 12 billion and coal industries losses between USD 5.7 billion to USD 7.2 billion.

The production of iron, steel and non-metallic minerals shows relatively high dispersion among Indonesian provinces, in contrast to the production of chemicals, which is highly concentrated in two regions (Jawa Barat and Jawa Timur). The allocation of national CBAM-related production drives, at a first stage, regional economic impact.

The second factor that drives regional results is the relative importance of these sectors for local economies. For example, in Kep. Bangka Belitung, Papua, Nusa Tenggara Barat, and Sulawesi Tengah, metal industries account for more than 10% of total GVA, while in Sulawesi Selatan, Sulawesi Tenggara, and Sulawesi Tengah, non-metallic minerals account for more than 8% of total GVA. Coal-related activities are located mainly in Kalimantan Timur, Kalimantan Selatan and Sumatera Selatan.

Finally, regional impacts will be also determined by production possibilities in other sectors such as transport equipment and consumer goods industries which are found to be positively affected at the national level.

In NDC+G1CBAM and NDC+G2CBAM, the regions that record the highest GDP losses are Kep. Bangka Belitung, Papua, Kalimantan Timur, Nusa Tenggara Barat and Sulawesi Tengah. These regions are projected to experience GDP losses greater than 0.2% compared to the reference case, both in 2035 and in 2050. Changes in Kalimantan Timur are driven by lower activity levels in coal production, in Kep. Bangka Belitung and Sulawesi Tengah by the reductions in metal industry and Sulawesi Tengah by the reduction in the production of non-metallic minerals.

The regional analysis reveals that, while regions that depend on CBAM-related and coal-related activities will experience GDP losses, there are other provinces that will benefit. For example, Jawa Barat is modelled to experience GDP gains in all scenarios examined, driven by increased output in consumer goods industries, transport equipment industries and services, while Jambi and Riau record positive GDP impacts in NDC+G1CBAM and NDC+G2CBAM, driven mainly by the primary sector. As a further example, Sumatera Utara records GDP gains driven by higher overall industrial output.

In overview, there are risks associated with the adoption of CBAM regulations, mainly in regions that depend on the metal industry (either extraction and/or manufacturing) and coal extraction, but also possibilities for regions that specialise in/concentrate on the production of other non-energy-intensive industrial goods and in primary production.

2 INTRODUCTION

This report presents the findings of the macroeconomic analysis regarding the impacts of the adoption of CBA measures by major Indonesian trading partners. CBA measures are policy instruments designed to reduce carbon leakage rates, and their effectiveness in protecting local industries has been at the centre of academic research for decades. In principle, CBA refers to the taxation of imports based on their emission content. In this way, exporters face the cost of their climate impacts. Typically, this type of measure includes energy/emission-intensive products, but they can be extended to any type of good.

The impact assessment is done using a general equilibrium model (GEM), GEM-E3-FIT. The economic analysis compares the performance of three alternative scenarios against a Reference scenario. The reference is a constructed scenario, i.e. it is calibrated to the most recent economic and demographic projections for Indonesia. Three scenarios were quantified and their effects on the economy of Indonesia were assessed: a scenario where a carbon border adjustment mechanism (CBAM) is adopted only by EU27 Member States; a scenario where the USA, Australia, Japan and the UK also implement similar measures; and a scenario where Canada, China and India also adopt CBAM. These countries have officially expressed interest in adopting CBAM policies as a tool for alleviating the impacts of more stringent national climate policies on domestic industries. The list of goods covered by the CBA measures in our analysis include iron and steel, aluminium, fertilisers, hydrogen and electricity.

Indonesia is a major exporter of iron and steel and in overall energy-intensive industries (ferrous and non-ferrous metals, chemicals, paper and pulp, non-metallic mineral goods), which account for approximately 7% of total national exports. This study provides a quantification of the extent to which Indonesian provinces will be affected by the adoption of CBAM by its main exporting partners, identifying potential indirect impacts and opportunities. The report is constructed as follows: Section 3 presents the GEM-E3-FIT model, Section 4 presents the main assumptions of the reference scenario and alternative scenarios examined, Section 5 presents the main findings of the study and Section 6 concludes.

3 METHODOLOGY

The analysis of the economic implications at the provincial level follows a top-down approach (Figure 1). At the top level, the general equilibrium GEM-E3 model determines the national macroeconomic impacts. GEM-E3 is a recursive dynamic computable general equilibrium model. It covers the global economy, represents explicitly bilateral trade flows, and ensures that, at any given point in time, supply is equal to demand in product, labour, and capital markets via adjustments of the relative prices. A detailed description of the model is provided in Deliverable 2.

At the second stage, national-level results (production and GDP) are disaggregated at the provincial level using information derived from the regional Input-Output tables published by the Indonesian statistical office (BPS). For the assessment of the subnational impact, we make use of the Leontief Input-Output multipliers[1]. These multipliers reflect the specificities of regional economies. The use of multipliers also allows us to capture indirect changes that reflect sectoral interdependencies and sectoral import dependence at the provincial level. Two types of multipliers have been considered in this analysis. The output multipliers capture the impact on production, and the GVA multipliers capture the impact on income generation. For example, an output multiplier of 1.5 means that for every dollar of additional demand for the good of a specific sector, the total output of the economy will be increased by USD 1.5 due to sector linkages (i.e. intermediate demand). Our analysis assumes no changes in prices at the provincial level but

[1] Leontief input-output multipliers quantify how changes in demand for one product ripple throughout the entire economy, accounting for all supply chain linkages.

rather considers the changes in prices at the national level as described by the GEM-E3 model. In addition, this analysis assumes that labour and capital move across regions freely and are spatially constrained at the national level as per the assumptions of the GEM-E3 model.

Hence, the analysis provides an estimation of the impacts arising from changes in the overall sectoral production levels as captured by the Input-Output multipliers. This type of analysis is not able to capture dynamical changes associated with capital accumulation, change in wages and capita rents, constraints in labour mobility and trade flows at the provincial level which will also influence the magnitude of the final impacts.

Figure 1. Subnational decomposition of GEM-E3 impacts.

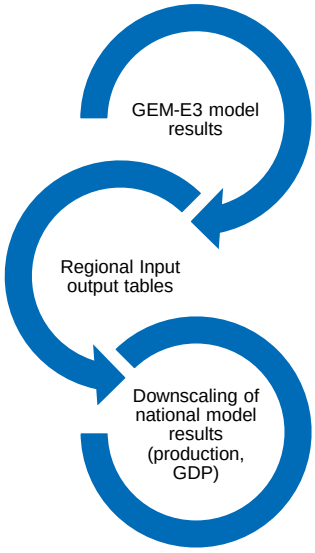


Table 1: Average provincial output and GVA multiplier for selected sectors (based on DVL2 findings).

	Average domestic output multiplier	Average GVA multiplier
Coal and Lignite Mining	1.13	0.71
Metal Ore Mining	1.20	0.78
Coal Industry and Oil and Gas Refineries	1.09	0.45
Food and Beverage Industry	1.38	0.38
Tobacco Processing Industry	1.02	0.07
Textile and Apparel Industry	1.15	0.17
Leather, Leather Goods and Footwear Industry	1.13	0.18
Chemical, Pharmaceutical and Traditional Medicine Industry	1.18	0.21
Non-Metal Excavated Goods Industry	1.43	0.58
Basic Metal Industry	1.26	0.49
YTDL Machinery and Equipment Industry	1.10	0.16
Transportation Equipment Industry	1.09	0.15
Electricity	1.92	0.38

4 SCENARIO FRAMEWORK

To examine the potential impact of more intense global climate action on Indonesia's economy, we formulate four scenarios. In the Reference scenario (NEUNDC), it is assumed that the world achieves its NDC pledges. Additional scenarios examine the adoption of CBAM by major economies. The scenario specification aims to shed light on the extent of Indonesia's export vulnerability, especially in the industrial sectors. We assume a gradual adoption of CBAM by the world's largest economies to identify the impacts by country groups. The first scenario, namely NDC+EUCBAM, assumes that the CBAM is implemented only in the EU27, while in the NDC+EUCBAMG1 scenario, it is also adopted by the USA, the UK, Australia, and Japan, and finally, in the NDC+EUCBAMG2 scenario, China, India, and Canada also introduce this mechanism. To ensure consistency across the three main scenarios, there is no differentiation in terms of climate policy.

Table 2. Scenarios used for the analysis

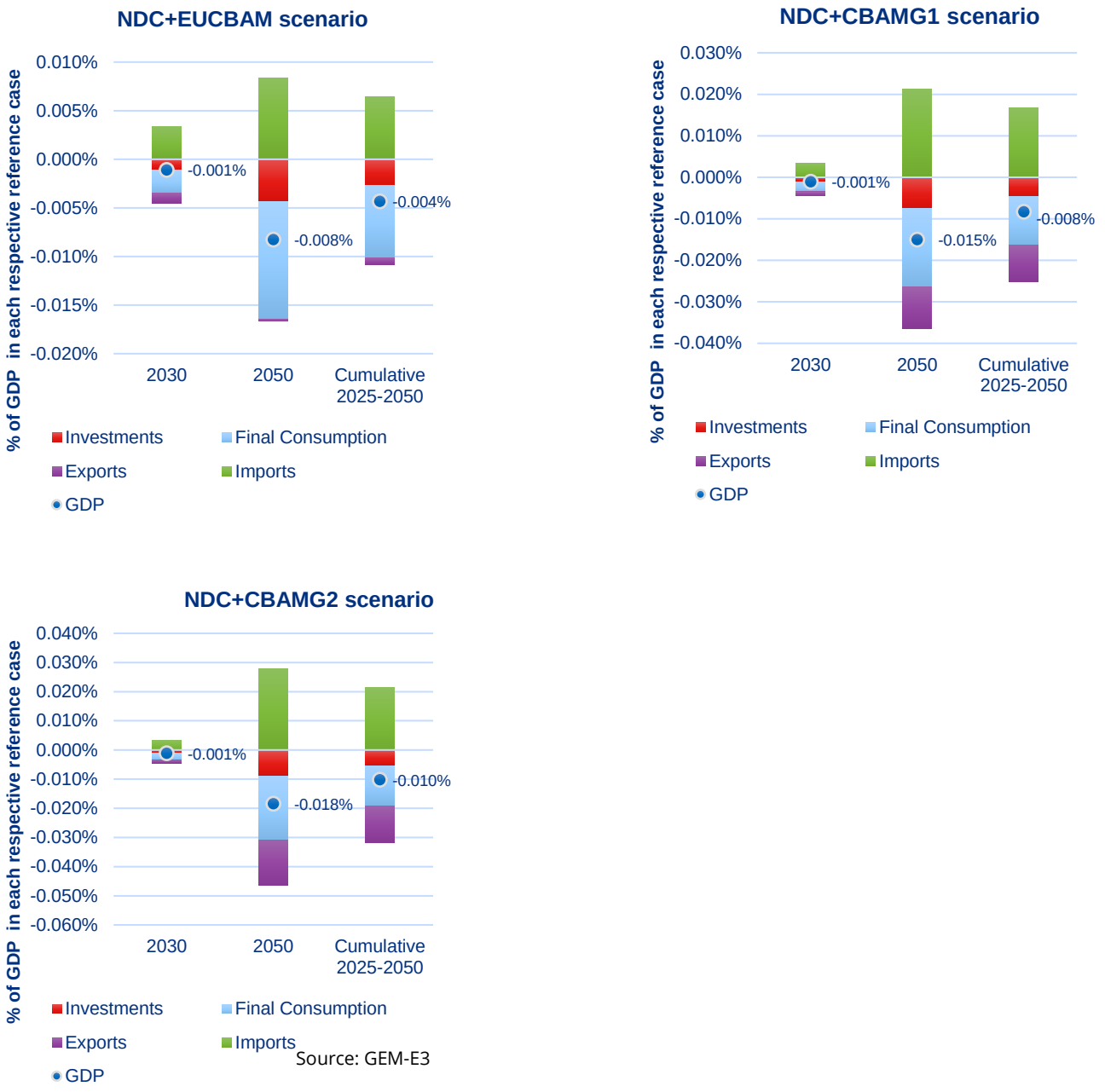
	NEUNDC (Intermediate reference)	NDC+EUCBAM	NDC+EUCBAMG1	NDC+EUCBAMG2
Indonesia climate policy	NDC	NDC	NDC	NDC
EU climate policy	Fit-for-55 extended to net zero GHG to 2050			
Global climate policy	NDC			
EU CBAM	No	EU CBAM Regulation (EU) 2023/956	EU CBAM Regulation (EU) 2023/956	EU CBAM Regulation (EU) 2023/956
Other CBAM	No	No	Carbon Border Adjustment schemes in Group 1 countries: **Australia, USA, UK and Japan**, considering domestic carbon pricing schemes or implicit carbon values from emission targets. CBAM is introduced gradually by 2026 and becomes fully effective from 2035 onwards	Carbon Border Adjustment schemes in Group 1 plus Group 2 countries: **Canada, China and India**, considering domestic carbon pricing schemes or implicit carbon values from emission targets. CBAM is introduced gradually by 2026 and becomes fully effective from 2035 onwards
Sectors under CBAM	No	Cement, iron and steel, aluminium, fertilisers, hydrogen, and electricity		

5 MACROECONOMIC IMPACTS

5.1 Impacts at the National level

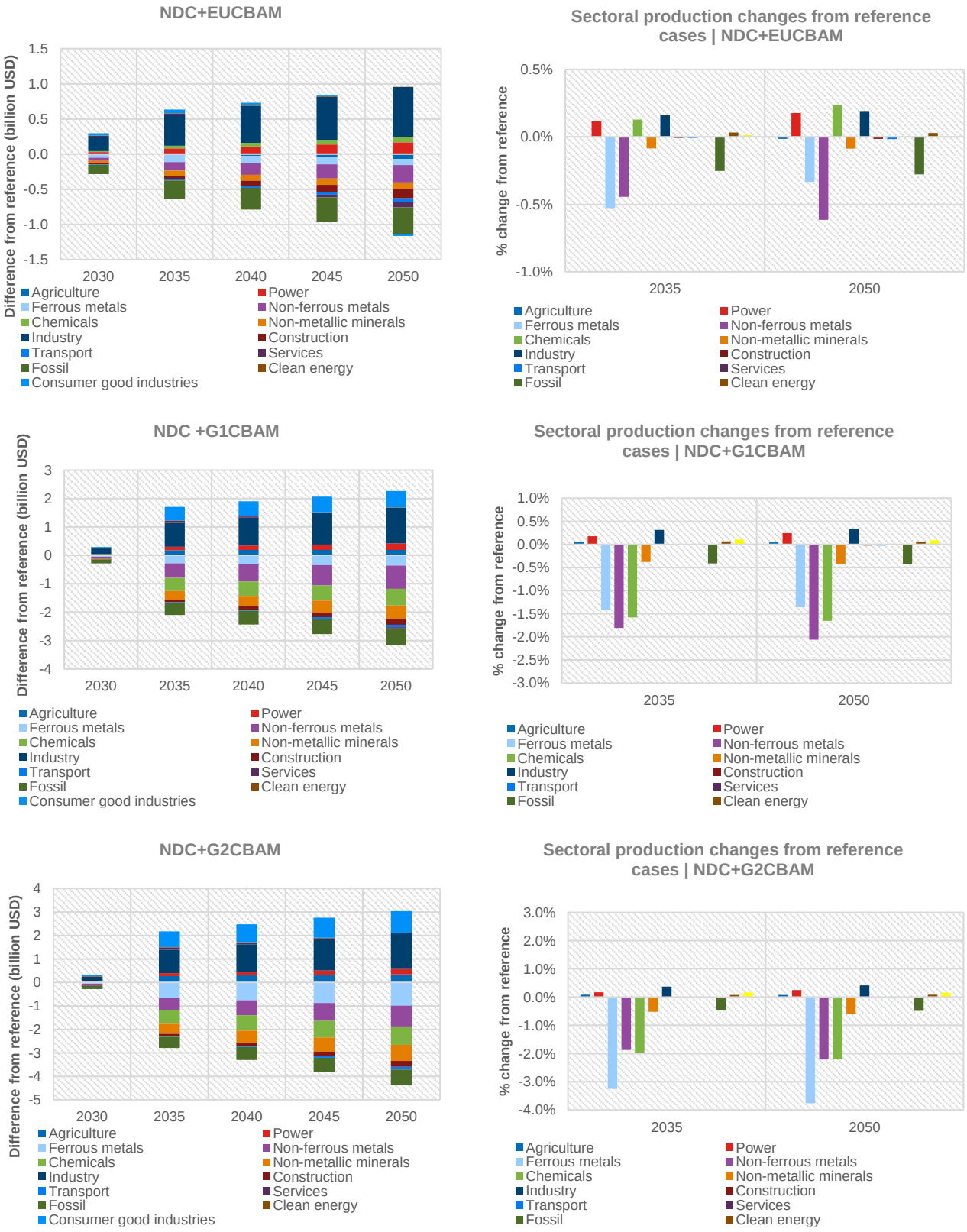
National-level implications are discussed in detail in Deliverable 2. GDP changes are small in magnitude in all scenarios examined, with cumulative losses reaching -0.01% in the NDC+G2CBAM scenario, where all major economies are assumed to adopt CBAM measures. Direct and indirect impacts of the introduction of CBAM in production drive overall GDP changes. Lower activity levels lead to lower employment and income in the economy. Hence, this causes a fall in private consumption. In NDC+G1CBAM and NDC+G2CBAM scenarios, where extra-EU countries also adopt the CBAM, the negative impact on exports is more pronounced, respectively, -0.01% and -0.015% in 2050. Lower imports in all scenarios are the product of lower domestic consumption, lower intermediate demand and, in certain cases, the increase in the relative cost of imports. The net effect on the current account balance is a (small) net increase in the projected surpluses.

Figure 2. Decomposition of GDP change per demand component



With respect to production, we find that negative impacts are associated with lower overall output in fossil fuel supply and energy-intensive sectors: in the NDC+EUCBAM scenario, production for ferrous metals and fossil fuels drops, respectively, by 0.5% and 0.25% in 2035. Negative impacts are also present in the NDC+G1CBAM and NDC+G2CBAM scenarios: -1.5% and -3% for ferrous metals in 2035 and around -0.5 in both scenarios for fossil fuels in 2035 (see Figure 3 for further details). However, there is a shift in the production towards consumer goods industries and other industrial goods (e.g., transport equipment, electronics and electrical equipment, rubber and plastic products, etc.) and in agriculture. For instance, in all three scenarios, consumer goods industry experiences an increase by almost 0.2% in 2035. The productive capacities released from reductions in activity from fossil fuel and CBAM-related sectors are directed at a lower cost to other production processes.

Figure 3. Sectoral production



5.2 Overview of subnational economies

With respect to the macroeconomic implications of the assessed scenarios, these will be largely determined by two factors: i) the structure of regional production and ii) the sectoral multiplier of winning/losing sectors. High dependence of the provincial economy on CBAM-related sectors and fossil fuel activities is expected

to exert a stronger pressure on GDP, as regional income generation depends greatly on these activities. The economy has limited alternative production pathways that would counterbalance the loss of income from these industries. On the other hand, a low dependence on these sectors, coupled with relatively higher productive capacities in non-CBAM industries (e.g. consumer goods industries, other equipment goods, etc.), is projected to exert a positive pressure on GDP. Furthermore, a higher domestic multiplier implies stronger interlinkages with other sectors within the region. Hence, the impacts will propagate to the domestic economy and will have a higher influence on the total domestic activity.

As mentioned above, regions with a relatively strong presence of metal industries (either mining or manufacturing), non-metallic minerals and chemicals are expected to record the highest changes compared to other regions. With respect to metal-related activities, approximately 60% of national output is concentrated in 7 regions, while in the non-metallic minerals, the respective share is concentrated in 6 regions. The production of chemicals shows greater concentration in two regions (Jawa Timur and Jawa Barat), accounting for almost 50% of the total national production. Jawa Timur, Java Barat, Banten, Jawa Tengah and DKI Jakarta are the five regions where most of the CBAM-related production is found.

Figure 4: Share in national production and GVA by province (metal industry)

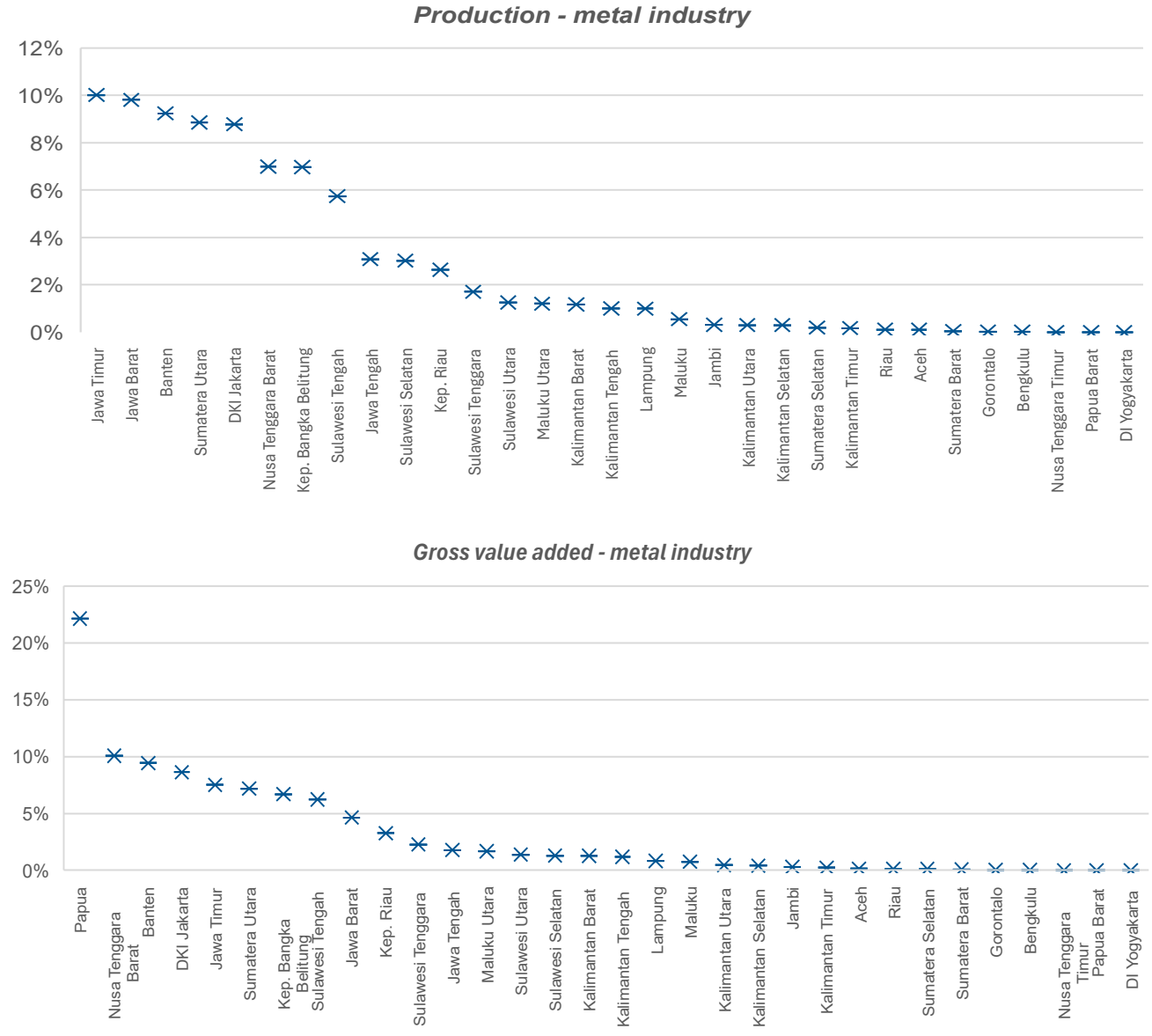
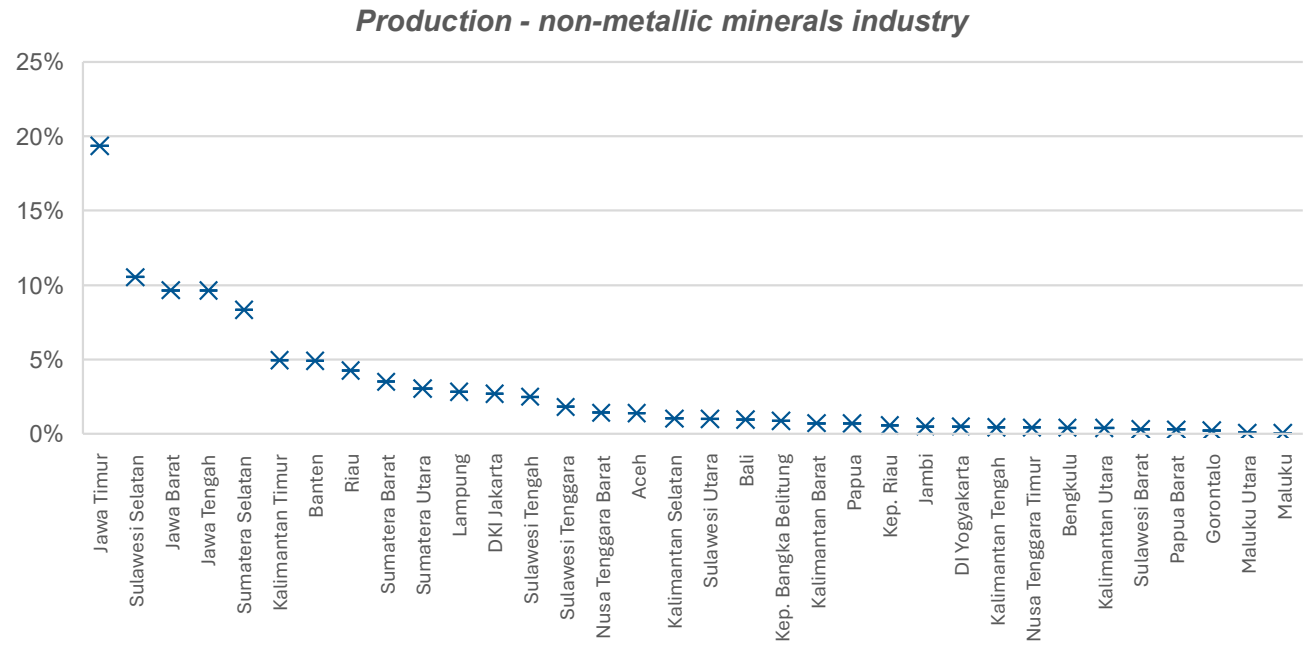


Figure 5. Share in national production and GVA by province (non-metallic minerals industry)



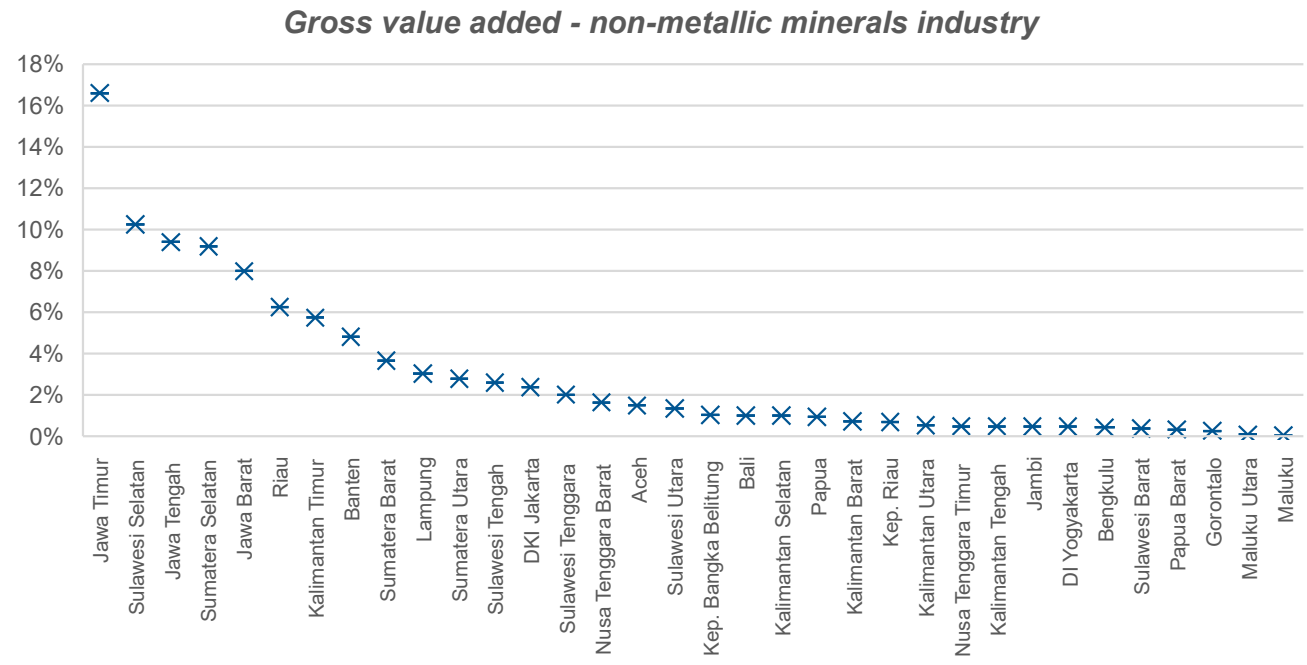
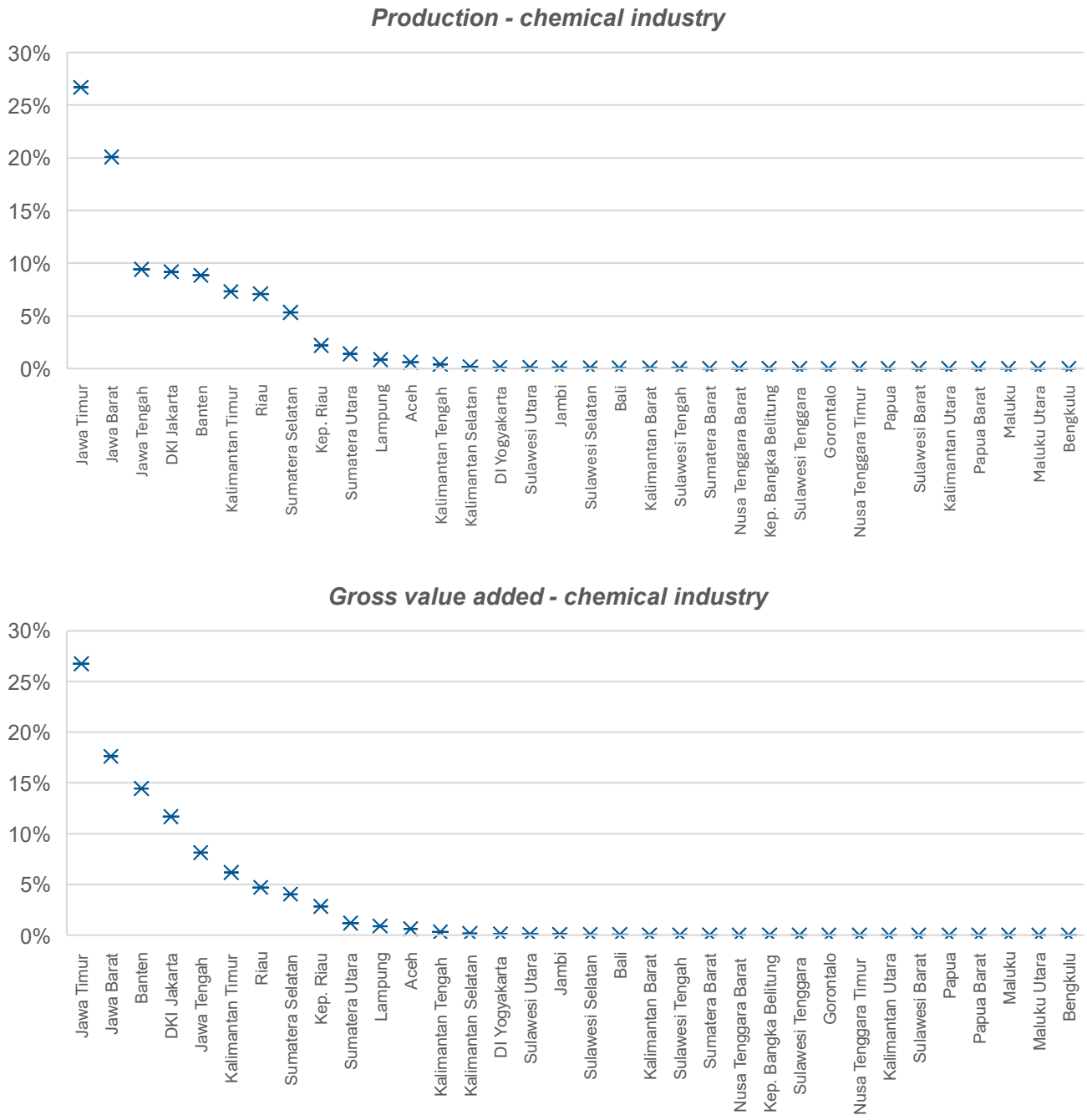


Figure 6. Share in national production and GVA by province (chemical industry)



The presence of the analysed CBAM industries is one of the three indicators that influence economic changes at the provincial level. The second factor that contributes to the overall GDP changes, and should be co-considered, is the relative importance of these sectors to total provincial output and GVA. While the third factor that drives the economic impacts is the multiplier.

The relative importance of the analysed CBAM sectors on the overall provincial economy is presented in Figure 7 to Figure 9. The metal industry plays an important role in the economies of several provinces, particularly Kep. Bangka Belitung (25% of total output), Papua (22%), Nusa Tenggara Barat (13%) and Sulawesi Tengah (12%). In contrast, the non-metallic minerals sector holds higher shares in Sulawesi Selatan (10%), Sulawesi Tenggara (8%) and in Sulawesi Tengah (8%).

The contribution of the chemical industry, however, remains very small, accounting for less than 3% of total output across provinces. Nevertheless, its significance increases when measured in terms of GVA. For

instance, while chemical products contribute approximately 3% to total production in some regions, their share in provincial GVA can reach nearly 6%.

Figure 7. Share of metal industries in total provincial output and GVA

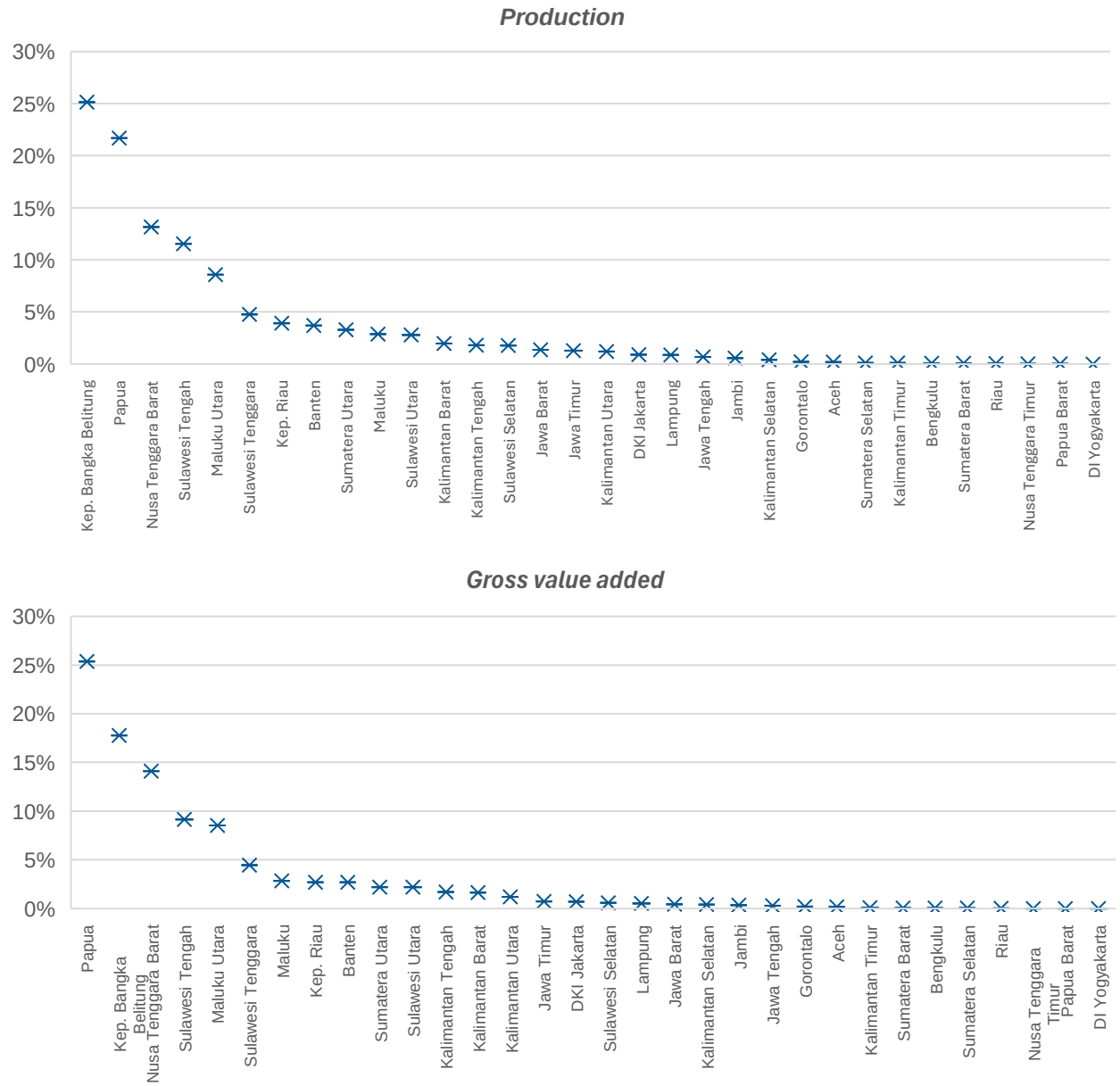


Figure 8: Share of non-metallic mineral industries in total provincial output and GVA

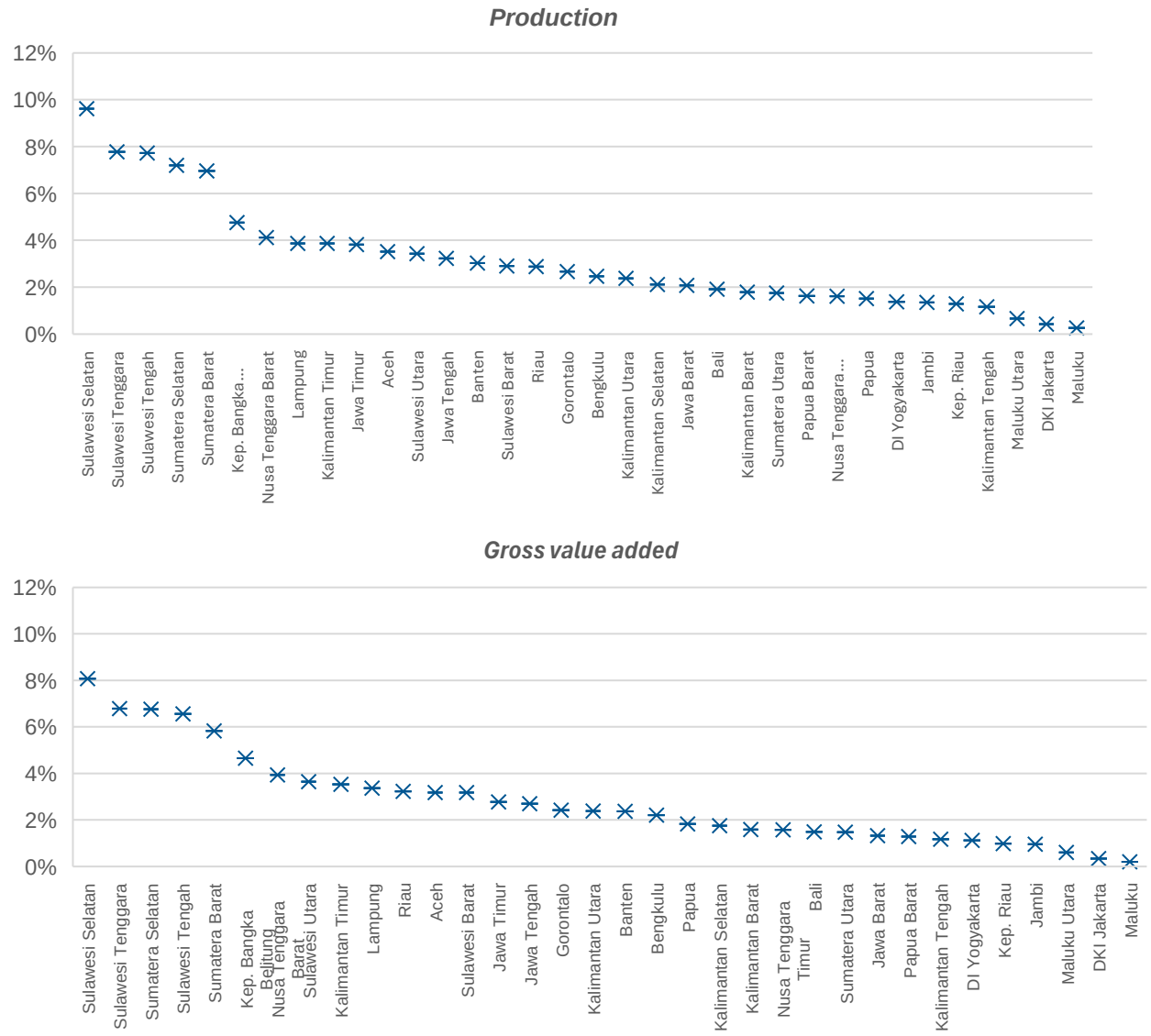
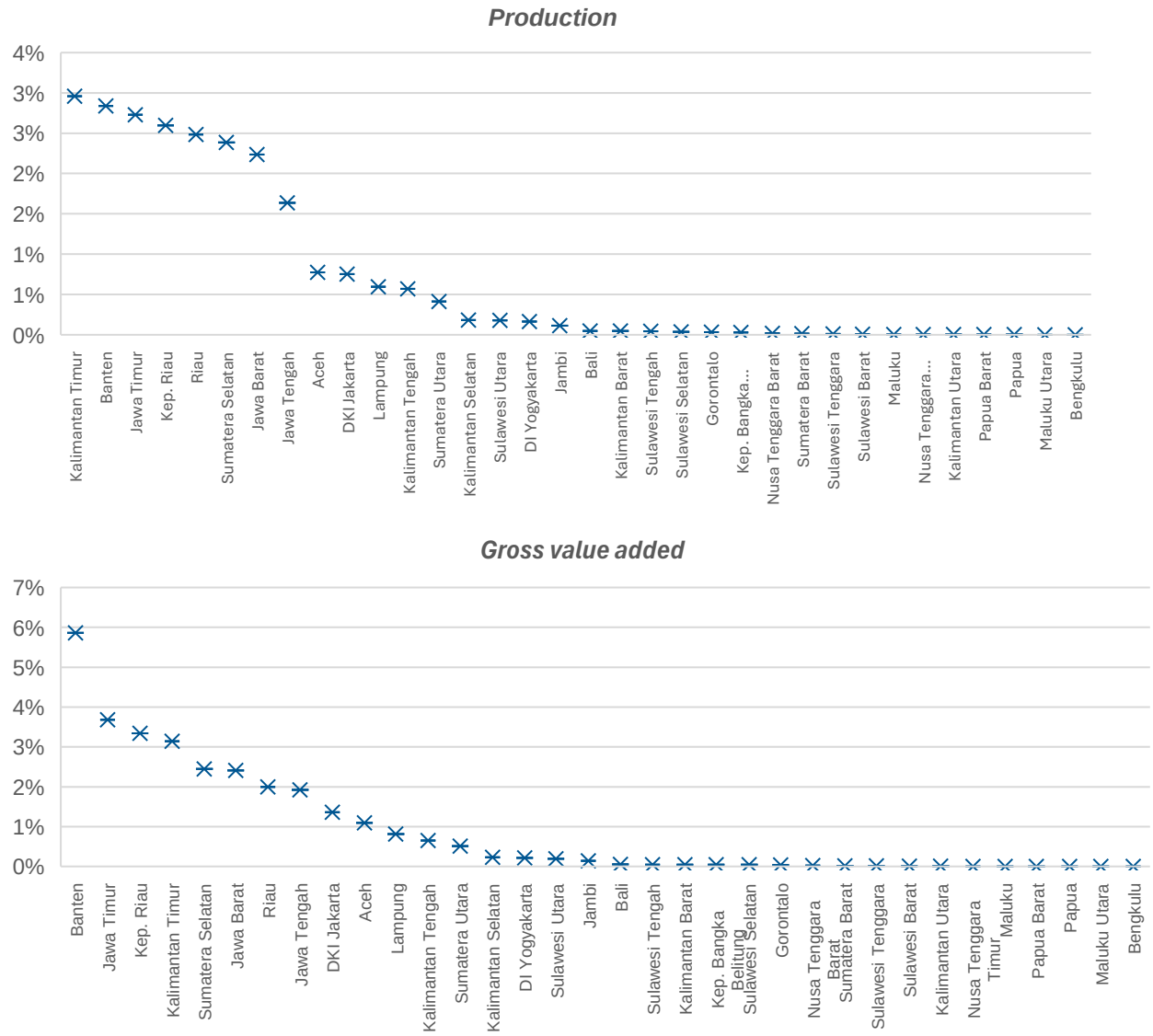


Figure 9. Share of chemical industries in total provincial output and GVA



Finally, we assess the economic impacts both in terms of total production and in terms of GDP, as sectoral output and GVA multiplier differ. In terms of production, the highest output multipliers in most regions are found in electricity, non-metallic excavated goods and food and beverage industries (

Figure 10), while the highest GVA multiplier relates to primary production activities, gas supply and metal ore mining. In principle, sectors that are capital or labour intensive, such as agriculture, mining activities and services, tend to have higher GVA multipliers. Moreover, if the intermediate inputs are domestically produced (within the province in our case), the value of the multiplier is higher.

Figure 10. Sectors with the highest provincial output multiplier by number of appearances

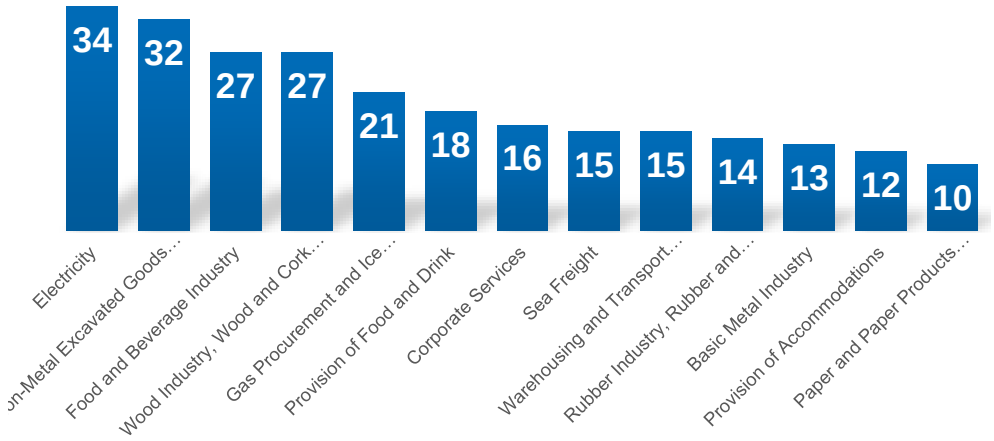
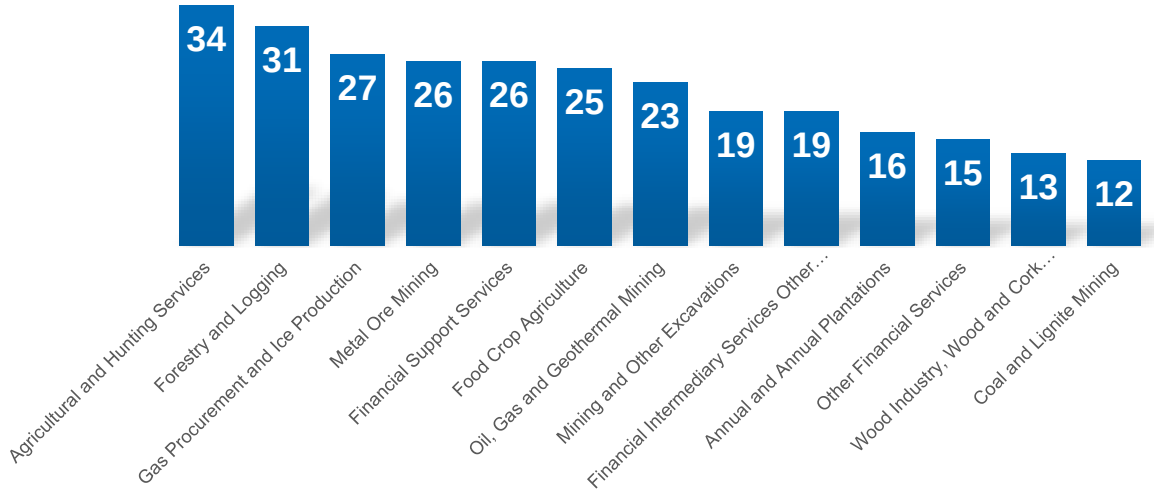


Figure 11: Sectors with the highest provincial GVA multiplier by number of appearances



5.3 Socioeconomic impacts at the sub-national level

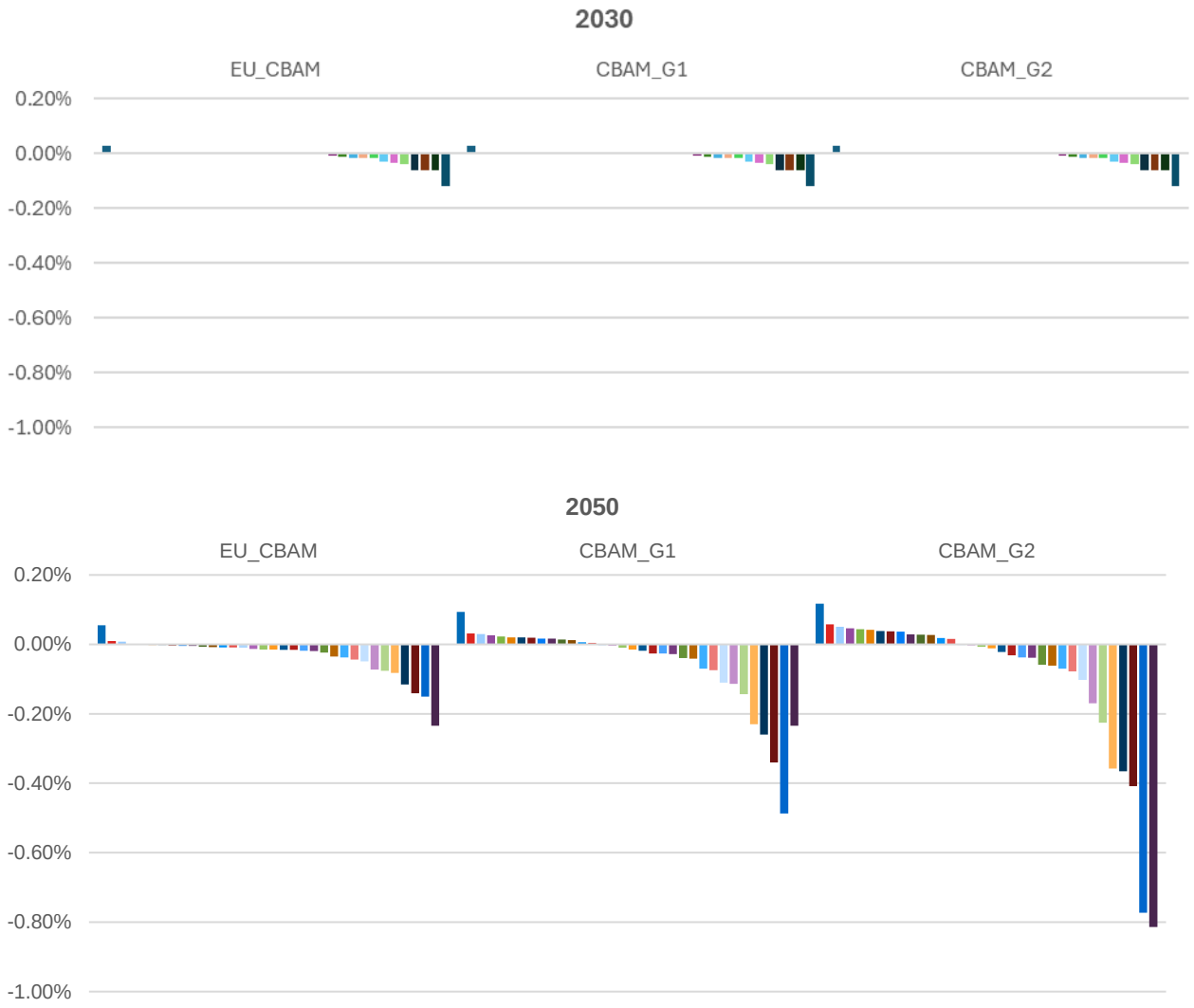
GDP impacts are small and are projected to change by less than 1% in all alternative CBAM scenarios compared to the Reference scenario. Figure 12 ranks the macroeconomic impacts by province, showing the distribution of the assessed impacts in alternative scenarios. In 2030, GDP impacts are marginal and no significant deviations from the Reference GDP is expected in most of the provinces. While in 2050, in NDC+EUCBAM, GDP impacts range from 0.05% to -0.23%, in NDC+EUCBAMG1 from 0.1% to -0.5% and in NDC+EUCBAMG2 from 0.12% to -0.82%.

Overall, it is found that in 2050, 3 out of 34 regions record GDP gains in NDC+EUCBAM and 14 regions do so in the NDC+EUCBAMG1 and NDC+EUCBAMG2 scenarios. The rest of the regions record losses, which depend on their economic structure and their contribution to national production. The presence of fossil fuel activities (coal and oil) and of metal and non-metallic minerals industries is projected to exert negative pressure on macro performance. Furthermore, due to the lower overall activity, construction is also projected to record reductions in its activity levels compared to the reference, and therefore negatively impacts the GDP.

In NDC+EUCBAMG1 and NDC+EUCBAMG2 scenarios, gains are projected for certain non-CBAM industries, e.g. in transport equipment, in the manufacturing of equipment goods and to a lesser extent in the production of rubber and plastic products, which lead to higher overall output and gross value added in regions where the productive capacities of these sectors are located. The results imply a reallocation of productive factors between regions.

In the NDC+EUCBAM scenario, the top losing provinces are Nusa Tenggara Barat, Kalimantan Selatan, Papua, Kep. Bangka Belitung, and Kalimantan Timur. While small increases are projected for Jawa Barat, Kep. Riau and DKI Jakarta. The effects are more pronounced in the longer-term compared to 2030.

Figure 12: GDP impacts in 2030 and in 2050 by province



In terms of employment, the impact of NDC+EU CBAM is relatively low, ranging from a minimal increase of 0.05% to a decline of -0.12%. In absolute terms, this corresponds to an estimated loss of 4,000 jobs in Kalimantan Timur and a gain of approximately 7,500 jobs in Jawa Barat.

The regions expected to experience the greatest job losses include Kalimantan Timur, Kalimantan Selatan, and Kalimantan Utara, primarily due to a decline in coal production. Conversely, employment in Jawa Barat is projected to increase, driven by higher production in non-energy-intensive manufacturing sectors.

presents the sectoral decomposition of GVA changes, which helps to identify the drivers behind the estimated impacts. Negative impacts are largely driven by changes in CBAM sectors:

- The adoption of CBAM by the EU implies lower overall imports, as the carbon tariffs increase the cost of imported products over domestically produced ones, where third-country producers have a higher carbon intensity, triggering substitution effects. In line with this, we find that three out of five top losing provinces have substantial capacities in metal production.
- An indirect impact of the CBAM is the reduction in coal exports to India (2). EU27 holds an important share of total Indian exports, especially in iron and steel. The reduction of Indian exports to the EU27 leads to an overall decrease in sectoral activity and hence demand for coal (which is a main source of energy). Hence, it is expected that Indonesian regions that depend on coal supply activities will be adversely affected, which is the case for Kalimantan Timur and Kalimantan Selatan.
- Finally, another indirect effect of the CBAM scenarios is the increase in the output of non-energy-intensive manufacturing industries. Indonesian provinces with a high concentration of these types of industries can reap the benefits of higher demand and experience GDP gains. For example, in Jawa Barat, gains are associated with the increased manufacturing output in transport equipment and machinery. These industries are projected to record higher activity levels due to competitiveness gains driven by the released productive capacities, primarily by the metal and non-metallic minerals industries. Overall, the projected impacts are relatively small in magnitude, in accordance with the macroeconomic projections at the national level. The NDC+EUCBAM scenario produces lower GDP impacts compared to the NDC+EUCBAMG1 and NDC+EUCBAMG2 scenarios.

Table 3. GDP impacts by province (NDC+EUCBAM)

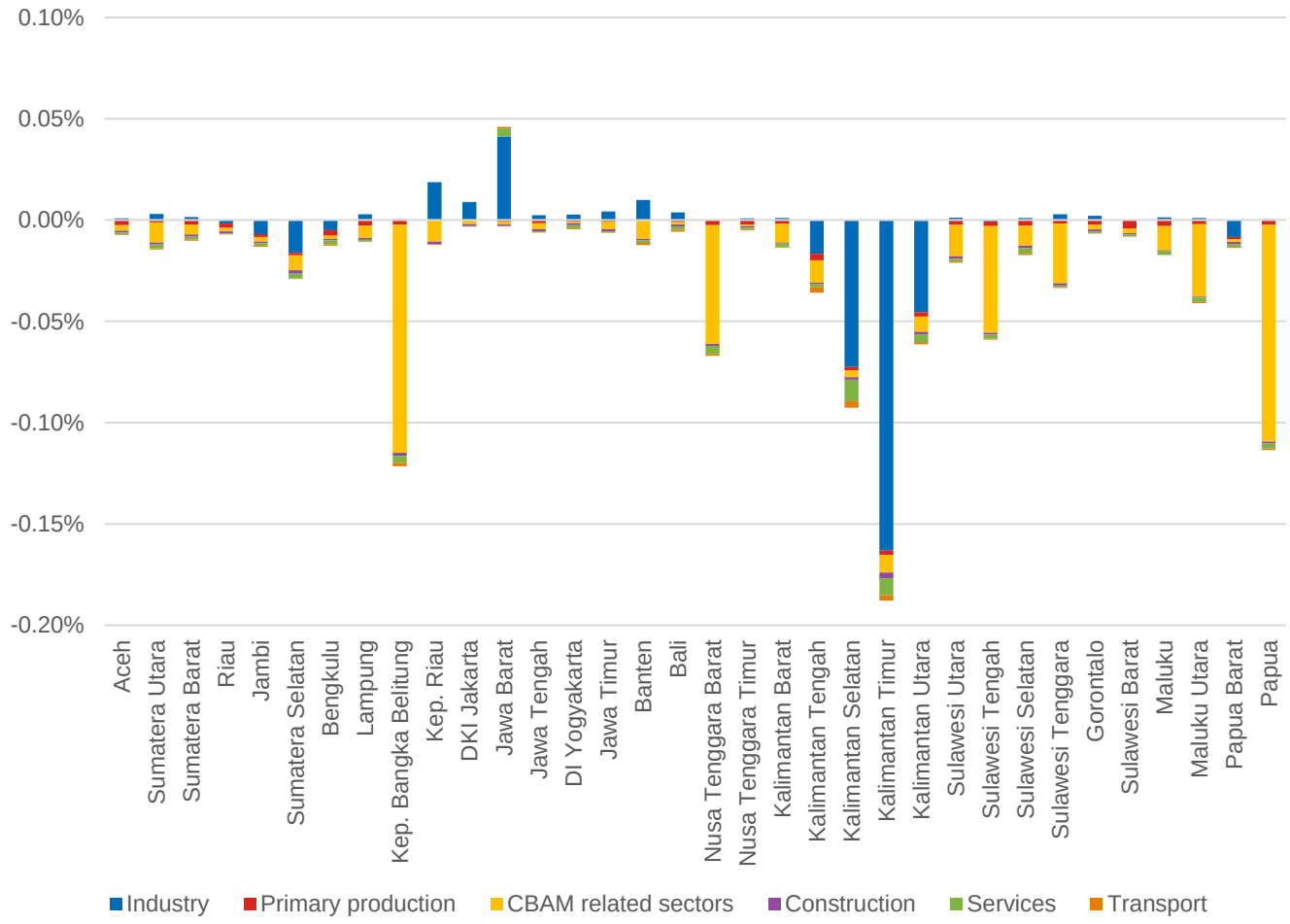
	2030	2035	2050
Jawa Barat	0.03%	0.05%	0.06%
DKI Jakarta	0.01%	0.01%	0.01%
Kep. Riau	0.01%	0.01%	0.01%
DI Yogyakarta	0.00%	0.01%	0.00%
Riau	0.00%	0.01%	-0.01%
Bali	0.00%	0.01%	0.00%
Jawa Timur	0.00%	0.00%	0.00%
Jawa Tengah	0.00%	0.00%	0.00%
Nusa Tenggara Timur	0.00%	0.00%	0.00%
Banten	0.00%	0.00%	0.00%
Gorontalo	0.00%	0.00%	0.00%
Sulawesi Barat	0.00%	0.00%	-0.01%
Lampung	0.00%	0.00%	-0.01%
Aceh	0.00%	0.00%	-0.01%
Sumatera Barat	0.00%	0.00%	-0.01%
Sumatera Utara	0.00%	0.00%	-0.01%
Kalimantan Barat	0.00%	-0.01%	-0.01%
Papua Barat	0.00%	-0.01%	-0.02%
Jambi	0.00%	-0.01%	-0.02%
Bengkulu	0.00%	-0.01%	-0.01%
Sulawesi Selatan	0.00%	-0.01%	-0.02%
Maluku	0.00%	-0.01%	-0.02%
Sulawesi Utara	-0.01%	-0.01%	-0.02%
Sumatera Selatan	-0.02%	-0.03%	-0.04%

Sulawesi Tenggara	-0.01%	-0.03%	-0.04%
Kalimantan Tengah	-0.02%	-0.03%	-0.04%
Maluku Utara	-0.02%	-0.04%	-0.05%
Sulawesi Tengah	-0.03%	-0.06%	-0.07%
Kalimantan Utara	-0.04%	-0.07%	-0.08%
Nusa Tenggara Barat	-0.03%	-0.07%	-0.08%
Kalimantan Selatan	-0.06%	-0.11%	-0.11%
Papua	-0.06%	-0.13%	-0.14%
Kep. Bangka Belitung	-0.06%	-0.13%	-0.15%
Kalimantan Timur	-0.12%	-0.21%	-0.23%

In terms of employment, the impact of NDC+EU CBAM is relatively low, ranging from a minimal increase of 0.05% to a decline of -0.12%. In absolute terms, this corresponds to an estimated loss of 4,000 jobs in Kalimantan Timur and a gain of approximately 7,500 jobs in Jawa Barat.

The regions expected to experience the greatest job losses include Kalimantan Timur, Kalimantan Selatan, and Kalimantan Utara, primarily due to a decline in coal production. Conversely, employment in Jawa Barat is projected to increase, driven by higher production in non-energy-intensive manufacturing sectors.

Figure 13: Sectoral decomposition of GVA changes in the NDC+EUCBAM scenario (2050)[2],[3]



[2] IND = industry (excl. CBAM), PRIMARY = primary production sectors, CBAM = CBAM sectors, CON = construction, SRV = services, TRA= transport. The industrial (IND) sector includes also energy related activities and mining of fossil fuels.

[3] Provinces have been split to two groups to improve readability of the graphs.

Figure 14. Employment impacts in 2050

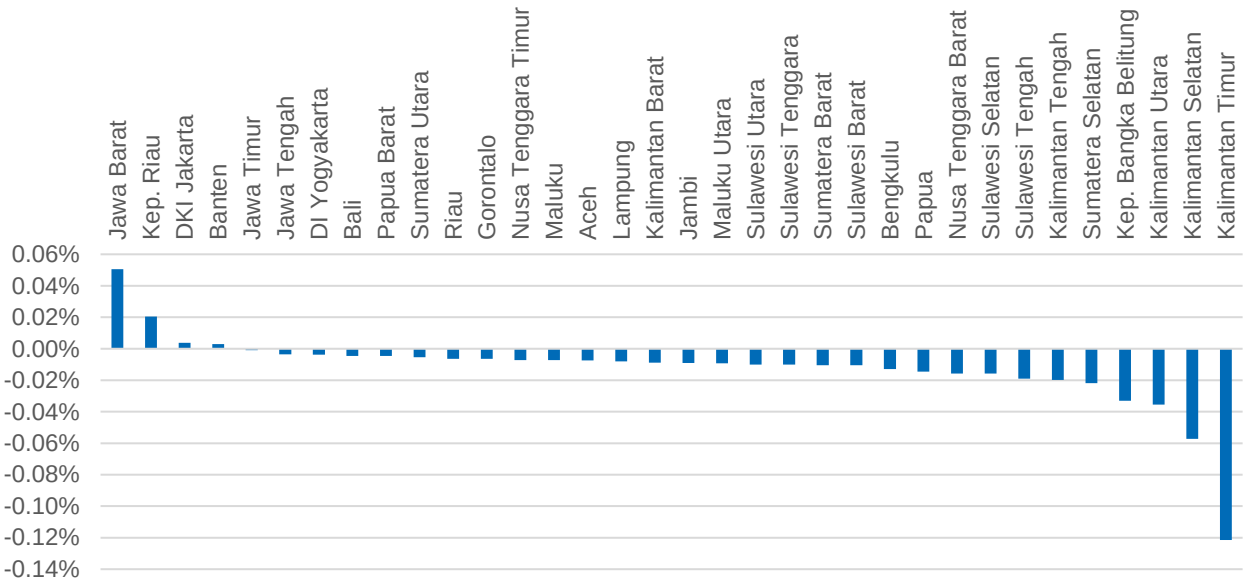
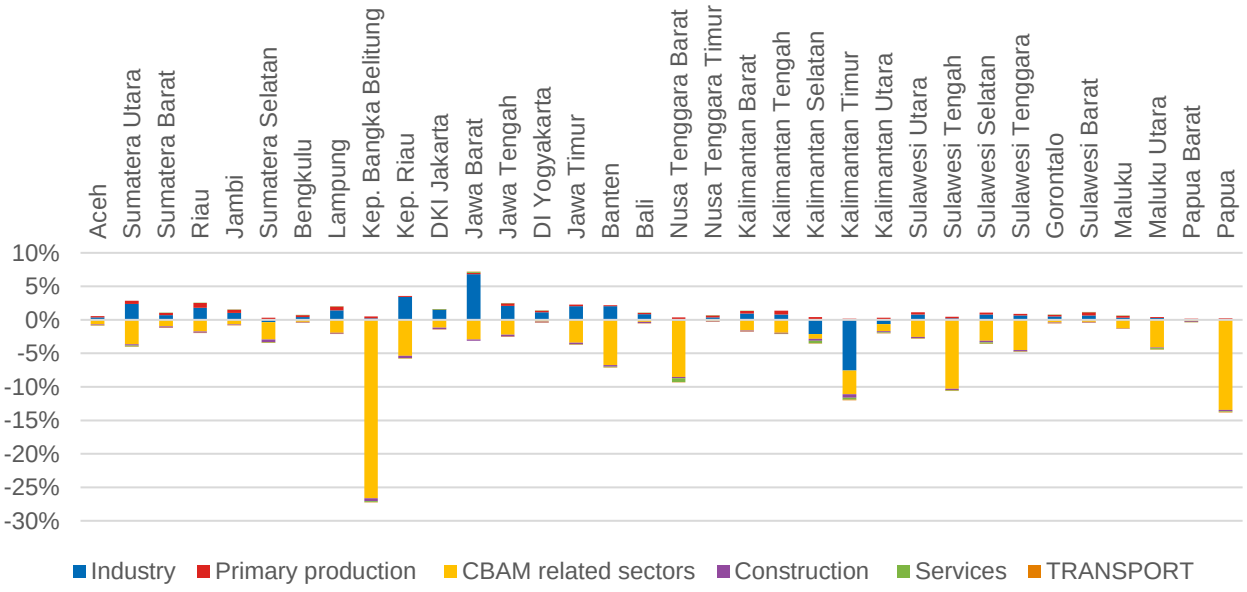


Figure 15. Decomposition of employment changes in 2050



Under the NDC+EUCBAMG1 scenario, the provinces experiencing the most significant losses include Sulawesi Tengah, Nusa Tenggara Barat, Kalimantan Timur, Papua, and Kep. Bangka Belitung. The GDP impacts in this scenario are more pronounced compared to the NDC+EUCBAM scenario, as the decline in Indonesian exports, particularly in metals, both ferrous and non-ferrous, leads to a sharper contraction in production.

These shifts influence macroeconomic performance and regional ranking. For example, in Kep. Riau and Banten, lower activity of metal and chemical industries underpins regional performance leading to losses in GDP and, to a lesser extent, GVA. Similarly, in Papua, the steeper decline in metal exports to Australia and USA exacerbates GDP losses compared to the NDC+EUCBAM scenario.

On the other hand, the top three gaining regions under this scenario are Jawa Barat, Sulawesi Barat, and DI Yogyakarta. DI Yogyakarta, in particular, benefits from increased activity in consumer goods and transport equipment industries.

Table 4. GDP impacts by province (NDC+EUCBAMG1)

	2030	2035	2050
Jawa Barat	0.03%	0.09%	0.09%
DKI Jakarta	0.01%	0.03%	0.02%
Kep. Riau	0.01%	-0.01%	-0.02%
DI Yogyakarta	0.00%	0.04%	0.03%
Riau	0.00%	0.03%	0.02%
Bali	0.00%	0.03%	0.02%
Jawa Timur	0.00%	0.00%	-0.01%
Jawa Tengah	0.00%	0.02%	0.01%
Nusa Tenggara Timur	0.00%	0.03%	0.03%
Banten	0.00%	-0.03%	-0.04%
Gorontalo	0.00%	0.03%	0.02%
Sulawesi Barat	0.00%	0.04%	0.03%
Lampung	0.00%	0.03%	0.01%
Aceh	0.00%	0.01%	0.01%
Sumatera Barat	0.00%	0.02%	0.00%
Sumatera Utara	0.00%	0.01%	0.00%
Kalimantan Barat	0.00%	0.01%	0.00%
Papua Barat	0.00%	-0.01%	-0.01%
Jambi	0.00%	0.03%	0.02%
Bengkulu	0.00%	0.03%	0.02%
Sulawesi Selatan	0.00%	-0.01%	-0.03%
Maluku	0.00%	-0.01%	-0.03%
Sulawesi Utara	-0.01%	-0.03%	-0.04%
Sumatera Selatan	-0.02%	-0.06%	-0.07%
Sulawesi Tenggara	-0.01%	-0.09%	-0.11%
Kalimantan Tengah	-0.02%	-0.01%	-0.03%
Maluku Utara	-0.02%	-0.12%	-0.14%
Sulawesi Tengah	-0.03%	-0.20%	-0.23%
Kalimantan Utara	-0.04%	-0.07%	-0.07%
Nusa Tenggara Barat	-0.03%	-0.22%	-0.26%
Kalimantan Selatan	-0.06%	-0.10%	-0.11%
Papua	-0.06%	-0.44%	-0.49%
Kep. Bangka Belitung	-0.06%	-0.45%	-0.51%
Kalimantan Timur	-0.12%	-0.32%	-0.34%

In terms of employment, changes range from a decline of -0.21% in Kalimantan Timur to a growth of 0.09% in Jawa Barat. In the NDC+EUCBAMG1 scenario, the top losing regions in 2050 include Kalimantan Timur, Kep. Bangka Belitung and Sulawesi Tengah with job losses primarily driven by reduced activity in key sectors, particularly:

- Kalimantan Timur sees a decline in coal production (-2.2%);
- Kep. Bangka Belitung (-1.5%) and Sulawesi Tengah (-1.2%) are affected by reduced metal industry activity;
- Sulawesi Tengah is characterised by lower output in the non-metallic mineral sector (-0.4%).

In other provinces with significant metal manufacturing facilities, such as Banten, Jawa Timur and DKI Jakarta, employment losses in metal-related sectors are partially offset by job growth in other manufacturing activities. Furthermore, in these regions, the relative contribution of CBAM-affected sectors to total provincial employment is lower compared to the top three losing regions, making the overall impact less severe.

Figure 16: Decomposition of GVA changes in the NDC+EUCBAMG1 scenario (2050)

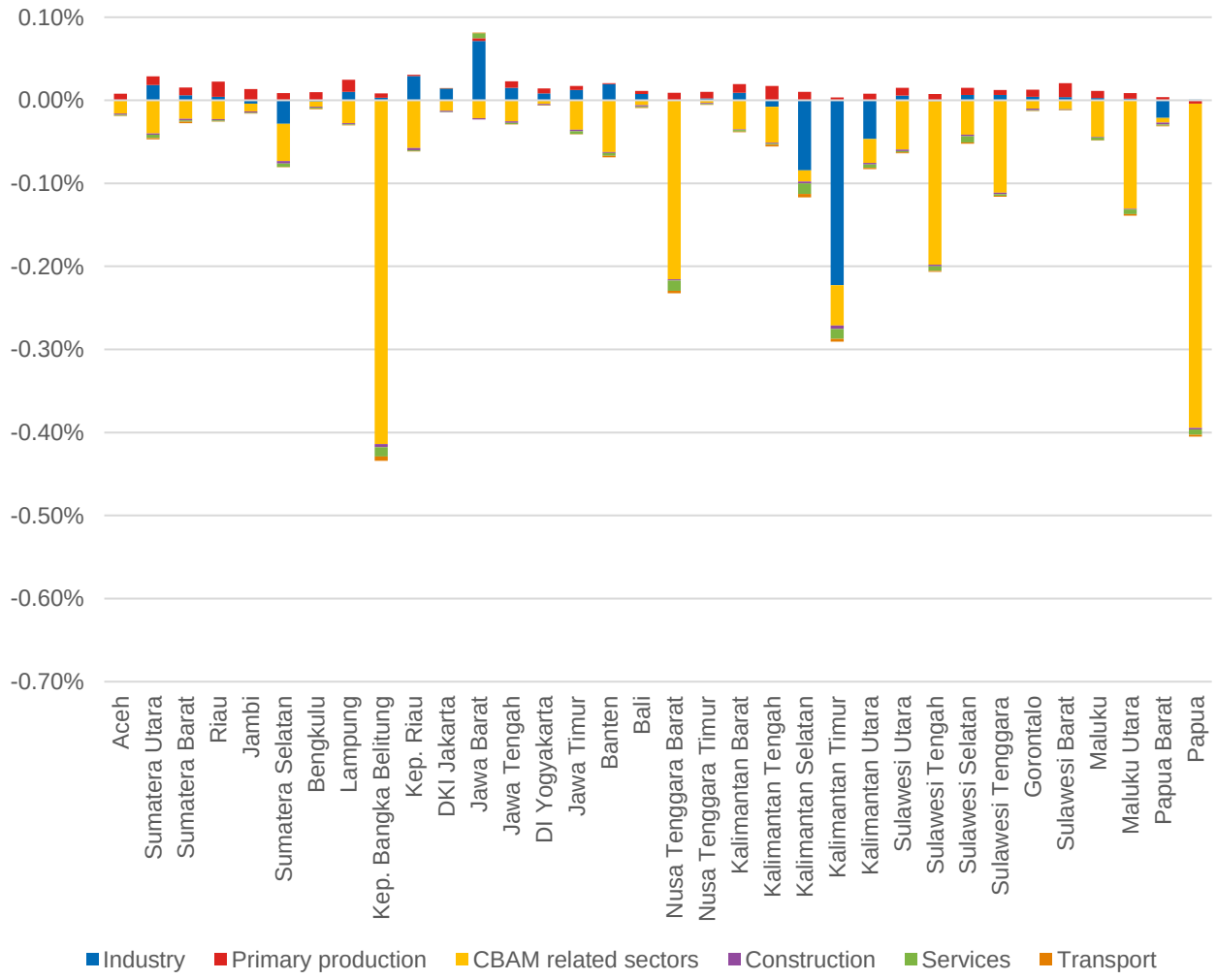


Figure 17. Employment changes in 2050

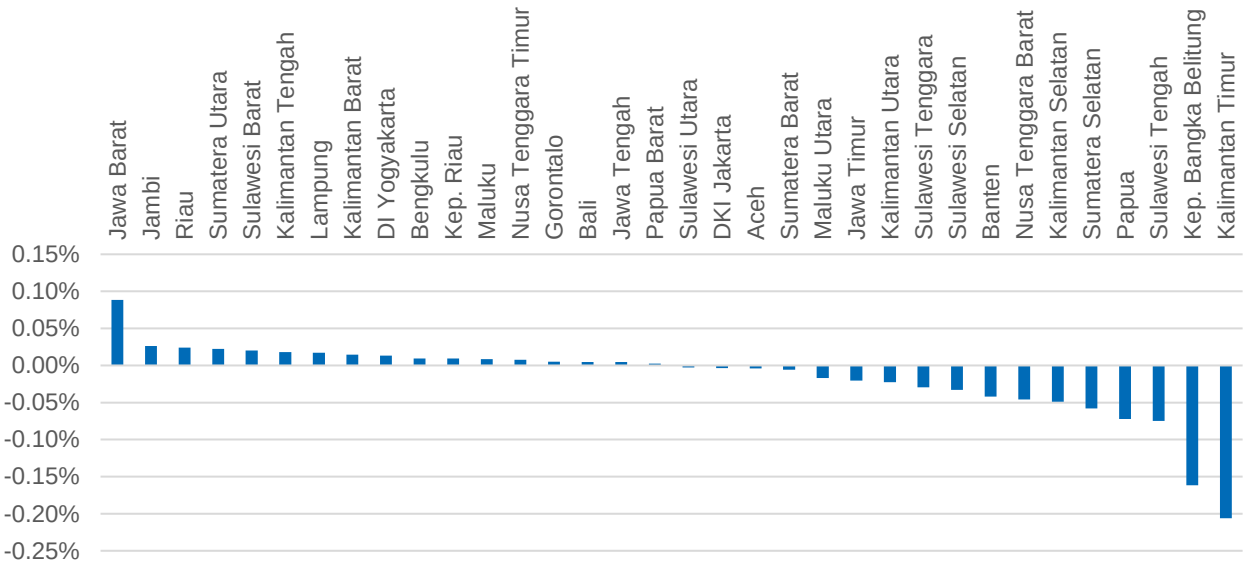
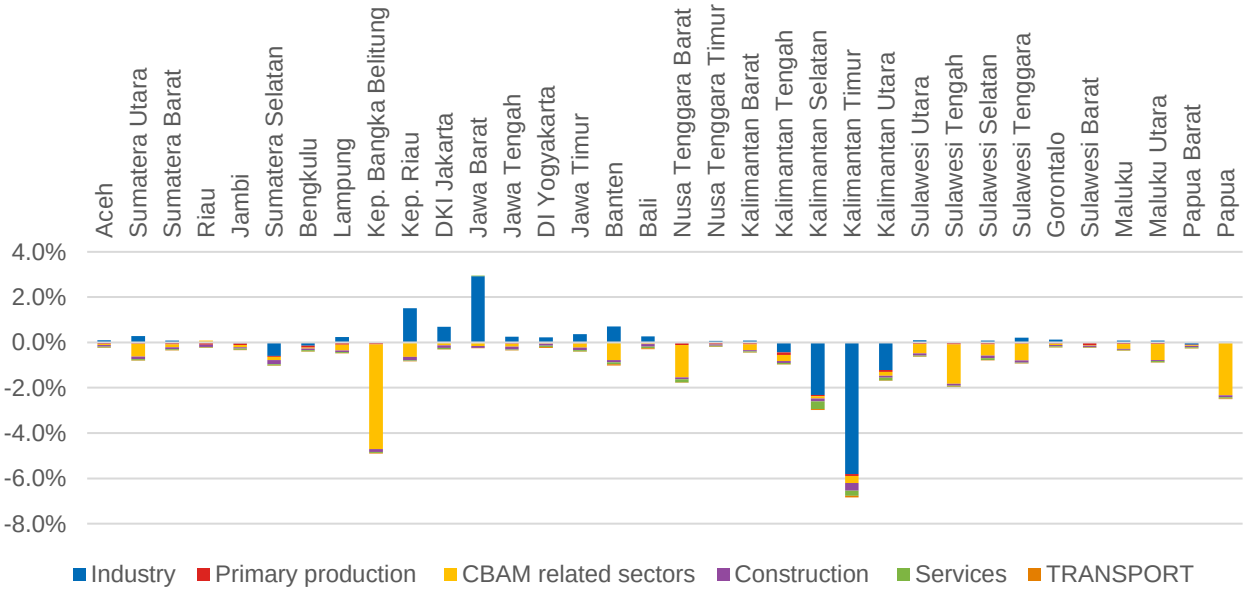


Figure 18. Decomposition of employment changes in 2050



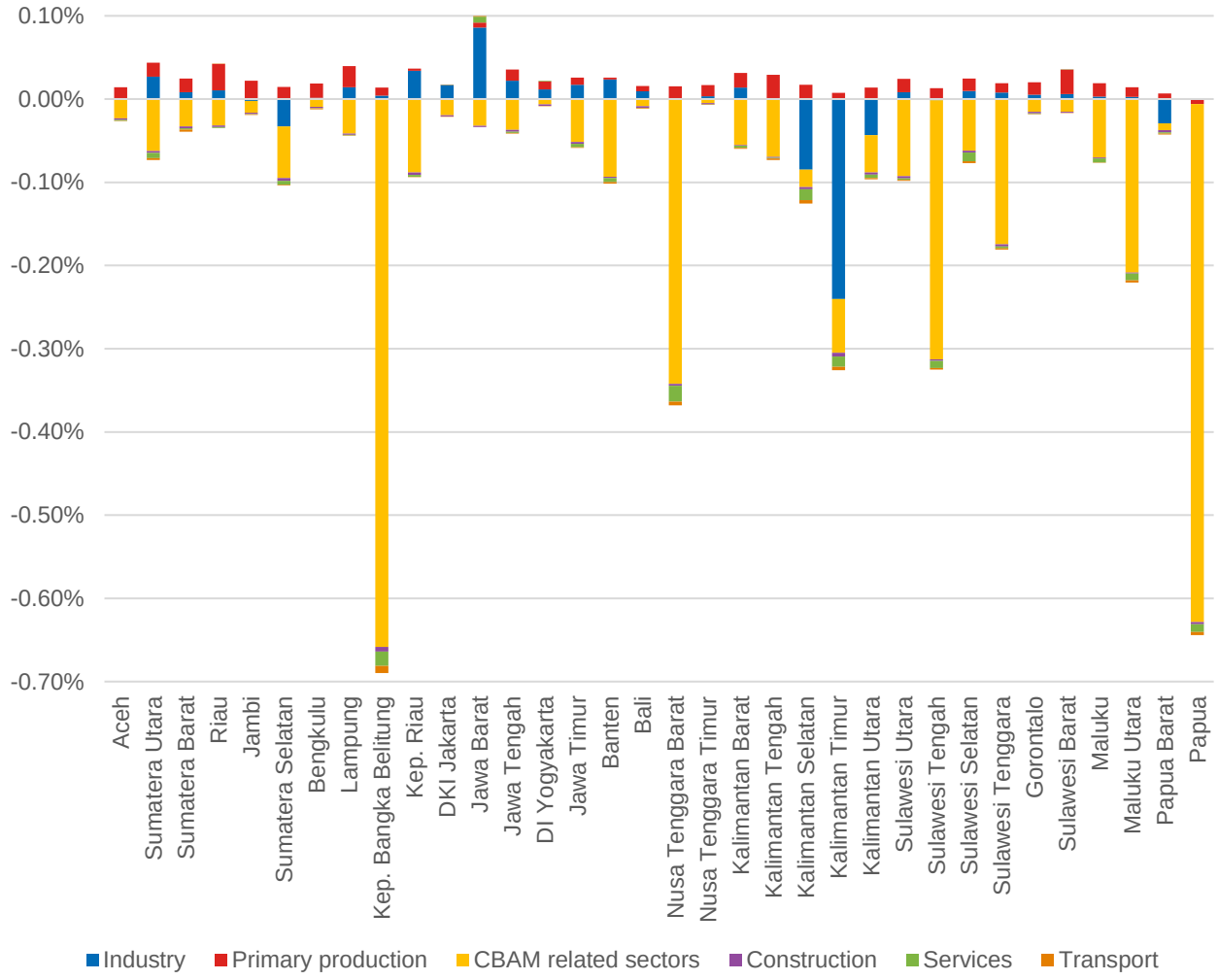
The analysis reveals no significant changes in the ranking of regions according to their GDP impacts in the NDC+EUCBAMG2 scenario compared to the NDC+EUCBAMG1 scenario. However, the magnitude of impacts increases, reflecting stronger effects on exports due to the broader adoption of CBAM.

The only notable exceptions are Riau and DI Yogyakarta. Riau performs better under the NDC+EUCBAMG2 scenario, benefitting from higher output in primary sectors and consumer goods industries, which mitigates some of the negative impacts observed in other regions.

Table 5. GDP impacts by province (NDC+EUCBAMG2)

	2030	2035	2050
Jawa Barat	0.03%	0.11%	0.12%
DKI Jakarta	0.01%	0.03%	0.03%
Kep. Riau	0.01%	-0.03%	-0.04%
DI Yogyakarta	0.00%	0.06%	0.05%
Riau	0.00%	0.05%	0.04%
Bali	0.00%	0.04%	0.04%
Jawa Timur	0.00%	0.00%	-0.01%
Jawa Tengah	0.00%	0.03%	0.03%
Nusa Tenggara Timur	0.00%	0.05%	0.05%
Banten	0.00%	-0.05%	-0.06%
Gorontalo	0.00%	0.04%	0.04%
Sulawesi Barat	0.00%	0.06%	0.06%
Lampung	0.00%	0.04%	0.03%
Aceh	0.00%	0.02%	0.02%
Sumatera Barat	0.00%	0.03%	0.02%
Sumatera Utara	0.00%	0.02%	0.00%
Kalimantan Barat	0.00%	0.01%	0.00%
Papua Barat	0.00%	0.00%	-0.01%
Jambi	0.00%	0.04%	0.04%
Bengkulu	0.00%	0.05%	0.04%
Sulawesi Selatan	0.00%	-0.02%	-0.03%
Maluku	0.00%	-0.02%	-0.04%
Sulawesi Utara	-0.01%	-0.04%	-0.06%
Sumatera Selatan	-0.02%	-0.07%	-0.08%
Sulawesi Tenggara	-0.01%	-0.14%	-0.17%
Kalimantan Tengah	-0.02%	-0.01%	-0.02%
Maluku Utara	-0.02%	-0.18%	-0.23%
Sulawesi Tengah	-0.03%	-0.29%	-0.36%
Kalimantan Utara	-0.04%	-0.06%	-0.07%
Nusa Tenggara Barat	-0.03%	-0.33%	-0.41%
Kalimantan Selatan	-0.06%	-0.09%	-0.10%
Papua	-0.06%	-0.66%	-0.77%
Kep. Bangka Belitung	-0.06%	-0.68%	-0.81%
Kalimantan Timur	-0.12%	-0.34%	-0.37%

Figure 19. Decomposition of GVA changes in the NDC+EUCBAMG2 scenario (2050)



In the NDC+G2CBAM scenario, employment impacts are like the NDC+G1CBAM. No significant changes are found both in terms of ranking and in terms of magnitude. Employment changes range between 0.03% and -0.21%. In absolute terms employment changes between -6,300 jobs and 13,100 jobs.

Figure 20. Employment impacts in 2050

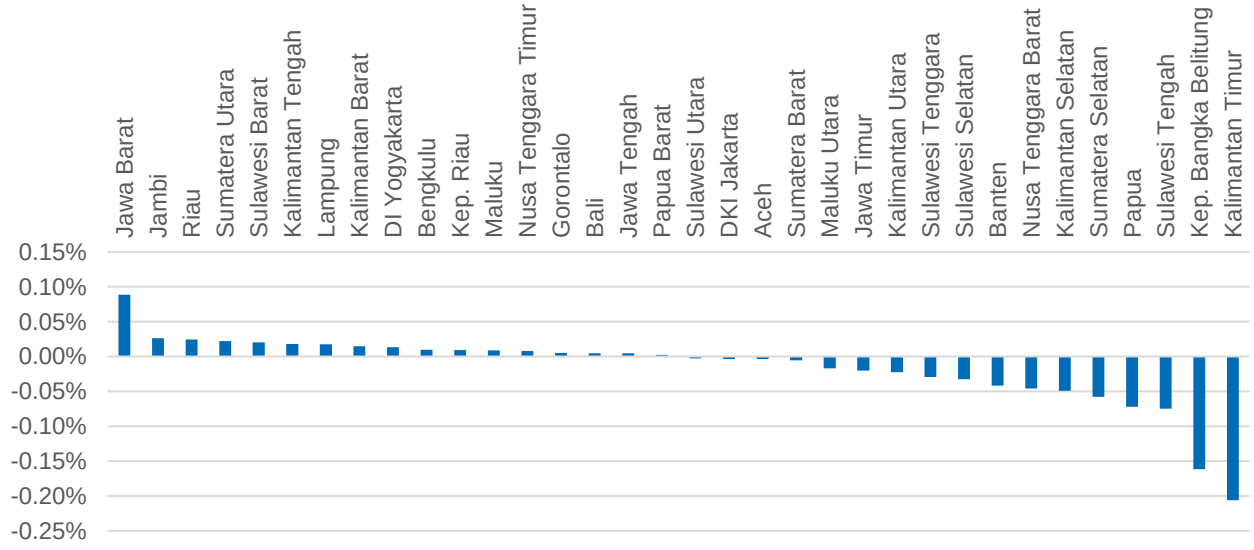
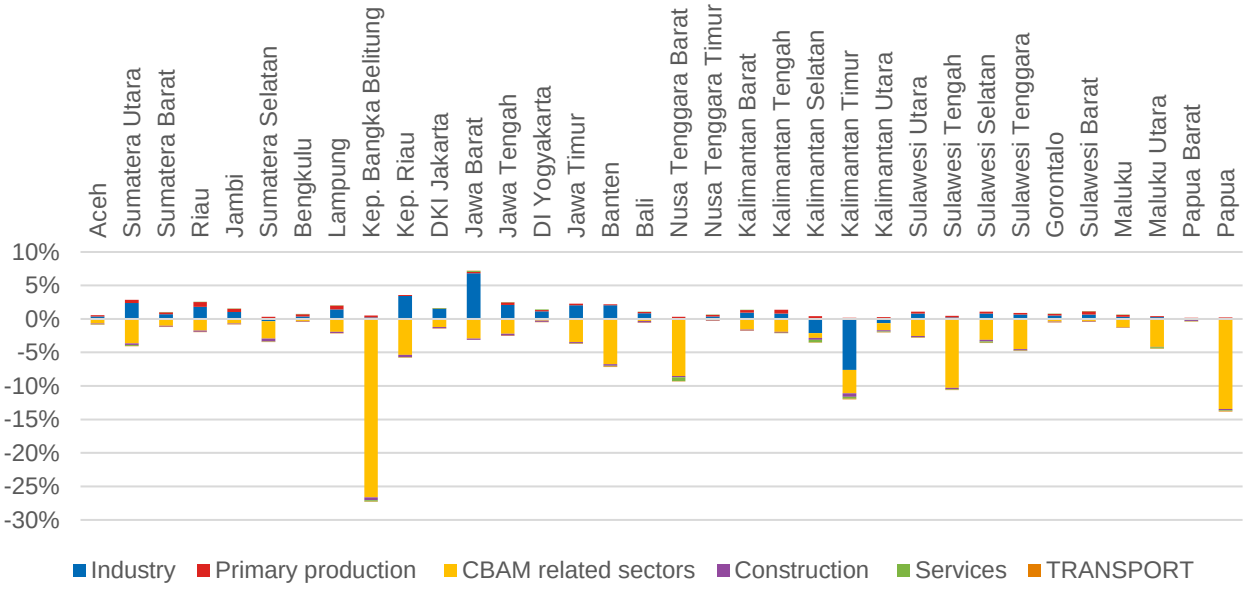


Figure 21. Decomposition of employment changes in 2050



6 CONCLUSIONS

This study expands on the national-level analysis of CBAM by examining its differentiated impacts across Indonesia's provinces. By combining national-level modelling from the GEM-E3-FIT general equilibrium framework with province-specific Input-Output data, the assessment captures how economic structure, industrial composition, and sectoral linkages influence regional exposure to international carbon pricing.

While the overall macroeconomic effects of CBAM remain modest, with provincial GDP changes remaining below ±1% across all scenarios, the subnational distribution of impacts is highly uneven, and in some cases, regionally significant. These disparities arise from three main factors:

1. The geographic concentration of CBAM-exposed sectors, especially iron and steel, aluminium, fertilisers, cement, and coal.
2. The relative weight of these sectors in provincial economies, i.e., their contribution to local gross value added (GVA) and employment.
3. The strength of sectoral multipliers, which determine how activity in CBAM-exposed sectors spills over into the broader provincial economy.

Provinces such as Kalimantan Timur, Kalimantan Selatan, and Kalimantan Utara, which rely heavily on coal production, face the most significant downside risks. In these areas, GDP losses reach up to -0.8% by 2050 in the scenario where a high number of countries implement a CBAM-like measure (NDC+G2CBAM). These losses are primarily indirect, resulting from reduced coal demand in partner countries, especially India, rather than from direct CBAM charges on coal.

Similarly, provinces like Kep. Bangka Belitung, Papua, and Sulawesi Tengah, which have a high concentration of metal and non-metallic minerals production, are projected to experience small persistent declines in GDP and employment. Despite the small impacts, these regions are more vulnerable due to their reliance on emission-intensive exports and limited diversification of economic activity.

In contrast, the analysis identifies a group of provinces that are well-positioned to benefit from the structural shifts induced by CBAM. Regions such as Jawa Barat, DI Yogyakarta, Sulawesi Barat, and Riau are expected

to experience GDP and employment gains driven by an increase in output from non-CBAM sectors such as transport equipment, electronics, consumer goods, and primary industries, a re-allocation of capital and labour from declining CBAM-affected sectors and improved relative competitiveness in lower-emission manufacturing.

For instance, Jawa Barat consistently records GDP gains across all scenarios, supported by strong growth in transport equipment and consumer goods manufacturing. These gains highlight that CBAM can reinforce existing industrial strengths in provinces with diversified economies and lower carbon intensity.

The employment effects mirror these trends: losses are concentrated in coal and metal-producing regions, while modest gains are projected in provinces where industrial restructuring leads to new job creation in cleaner manufacturing and services. Notably, employment losses in some CBAM-exposed regions, such as Kalimantan Timur, could reach over 6,000 jobs by 2050, whereas provinces like Jawa Barat could gain over 13,000 jobs, depending on the scenario.

Importantly, this analysis shows that CBAM is not solely a climate policy; it is also an industrial policy signal. It will reward cleaner, more efficient production and penalise high-emission processes. Provinces that anticipate and adapt to these shifts will not only avoid losses but can become frontrunners in Indonesia's low-carbon industrial transformation.

In conclusion, while CBAM's overall economic impacts on Indonesia are modest, its regional implications are structurally important. The policy will reinforce the competitive disadvantage of carbon-intensive production while opening new opportunities for regions capable of industrial adaptation. Ensuring that these opportunities are equitably distributed – and that vulnerable regions receive the support needed to transition – will be critical to managing the long-term socioeconomic impacts of CBAM implementation.

6.1 Policy implications

This assessment allows us to provide further detail on the policy implications under Deliverable 2, identifying the provinces which will need focused policy support. As mentioned in the Deliverable 2 report, while a full policy assessment with detailed identification and recommendations for incentives and disincentives for industrial decarbonisation will be delivered separately as part of this project under Deliverable 6 and the mapping of relevant stakeholders in implementation will be delivered under Deliverable 7, high-level policy implications and recommendations based on this analysis can be outlined. These build on the assessment and conclusions developed for the previous deliverable.

Plan a decarbonisation strategy for the coal sector

The central government should lead the design of a national decarbonisation strategy as the strategy the Ministry of Industry is developing, but provinces like Kalimantan Timur, Kalimantan Selatan, and Kalimantan Utara must be engaged early to ensure locally focused strategies. Provinces can contribute by mapping local infrastructure needs, repurposing coal assets, and supporting labour market transition through upskilling and reskilling by adopting complementary measures to address the local needs.

As complementary measures, provincial authorities might finance local infrastructures such as electricity grids or logistic hubs, drawing on their detailed understanding of regional needs and contexts. In this role, they can actively engage with national policymakers to share critical local insights and coordinate planning of interventions that enable an effective transition.

Accelerate clean energy deployment, energy efficiency, and low-carbon technology

Similarly to the above point, provinces can support a national plan to accelerate clean energy deployment through mapping optimal sites for renewable energy deployment, especially near industrial clusters. Planning and co-financing transmission and distribution infrastructures to meet future industrial electricity demand and identifying geologically suitable locations to utilise or store captured carbon (CCUS), informing

both local industrial strategy and national CCUS policy design. Dinas ESDM (Provincial Energy and Mineral Resources Agencies) could map the potential renewable energy sites and suitable locations for CCUS, submitting these data to the Pusdatin ESDM (Centre for Data and Information MEMR). Pusdatin ESDM would process and integrate the data to the ESDM OneMap. At the local level, this information can shape businesses' decarbonisation strategies by guiding investment decisions and identifying viable options for emissions reduction. At the national level, it can inform policy targets and help calibrate the scale and allocation of incentives for carbon capture and storage (CCS) technologies or other technologies. Finally, provinces can promote energy efficiency in businesses through awareness-raising campaigns and further measures that do not overlap with and not undermine the consistency with the national regulatory framework.

Promote Cross-Government Data Sharing and Planning

To ensure effective mitigation of CBAM-related impacts and support coordinated responses, it is essential to strengthen data sharing and collaborative planning between national and provincial authorities. Local governments often hold critical insights into industrial profiles, infrastructure readiness, and workforce capabilities that are not fully captured in national-level datasets. By sharing this information systematically, such as emissions data, spatial planning priorities, and projections of local energy demand, provincial authorities can play a key role in informing national transition strategies. In turn, national planning agencies can integrate these inputs to better align economic, energy, and industrial policies with on-the-ground realities. This two-way flow of information will be vital to designing spatially targeted interventions, avoiding policy overlaps, and ensuring that public investment in the low-carbon transition is both efficient and equitable.