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Data Analytics for a Just Transition

Distributional Impacts of Environmental Policies (Indonesia)

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Data Analytics for a Just Transition: Distributional Impacts of Environmental Policies (Indonesia)

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Résumé
L'engagement de l'Indonésie en faveur de l'Accord de Paris pour le climat a placé la tarification du carbone; par le biais de taxes et d'échanges d'émissions, au centre de sa politique climatique. Ces instruments sont conçus pour réduire les émissions de GES et encourager l'investissement dans une énergie plus propre, mais ils comportent le risque d'un impact social inégal. Les ménages et les travailleurs à faible revenu des secteurs à forte intensité carbone sont particulièrement vulnérables aux coûts énergétiques plus élevés et aux chocs sur l'emploi.

Cette étude utilise un cadre de microsimulation, combinant données d'enquêtes et modélisation fiscale et comportementale, pour évaluer les effets distributionnels de la tarification du carbone et des réformes en Indonésie. L'analyse retrace la manière dont les chocs politiques sont transmis par le biais des prix de l'énergie, des coûts indirects de production et des ajustements du marché du travail, et évalue d'éventuelles mesures d'atténuation des impacts sociaux via la protection sociale ou le recyclage des recettes d'une taxe carbone.

Les résultats suggèrent que la tarification du carbone, considérée isolément, tend à être régressive. Ses effets négatifs peuvent toutefois être considérablement réduits, voire inversés, lorsque les recettes sont affectées à des transferts ciblés, au soutien de l'efficacité énergétique ou à des investissements publics qui bénéficient aux groupes vulnérables. L'étude conclut que le succès de la transition énergétique en Indonésie dépendra non seulement de son efficacité environnementale, mais aussi de sa capacité à garantir l'équité entre les différents segments de la société.

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Notre reconnaissance va au ministère des Finances d'Indonésie, en particulier à l'ex-bureau fiscal. Nous sommes particulièrement reconnaissants envers le Centre pour le financement climatique et la politique multilatérale et le Centre pour la politique fiscale de l'État. Des remerciements spéciaux à Irwan Dharmawan et Hadi Setiawan ainsi qu'à l'équipe pour leur engagement en tant que partenaires dans les discussions qui ont façonné ce rapport depuis sa création.

Mots-clés
taxe carbone, échange de quotas d'émission, subventions énergétiques, inégalité, microsimulation, transition juste

Géographies :
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Abstract

Indonesia's commitment to the Paris Agreement has placed carbon pricing through taxes and emissions trading at the center of its climate policy. These instruments are designed to reduce greenhouse gas emissions and encourage investment in cleaner energy, yet they also carry the risk of uneven social impacts. Low-income households and workers in carbon-intensive sectors are especially vulnerable to higher energy costs and employment shocks.

This paper applies a microsimulation framework that combines household survey data with fiscal and behavioural modelling to assess the distributional effects of carbon pricing and energy reforms in Indonesia. The analysis traces how policy shocks are transmitted through energy prices, indirect production costs, and labour market adjustments, and evaluates possible mitigation through social protection programs and revenue recycling.

The results suggest that carbon pricing alone tends to be regressive. Its negative effects can be substantially reduced, or even reversed, when revenues are directed to targeted transfers, support for energy efficiency, or public investment that benefits vulnerable groups. The study concludes that the success of Indonesia's energy transition will depend not only on its environmental effectiveness but also on its ability to ensure fairness across different segments of society.

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Keywords

carbon tax, emissions trading, energy subsidies, inequality, microsimulation, just transition

Geographies:

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Abstrak
Komitmen Indonesia terhadap Perjanjian Paris menempatkan instrumen harga karbon, baik melalui pajak maupun perdagangan emisi, sebagai inti dari kebijakan iklim nasional. Instrumen-instrumen ini dirancang untuk menurunkan emisi gas rumah kaca dan mendorong investasi pada energi yang lebih bersih, namun pada saat yang sama juga membawa risiko dampak sosial yang tidak merata. Rumah tangga berpendapatan rendah dan pekerja di sektor yang intensif karbon menjadi kelompok yang paling rentan terhadap kenaikan biaya energi dan guncangan ketenagakerjaan.

Makalah ini menggunakan kerangka mikrosimulasi yang mengombinasikan data survei rumah tangga dengan pemodelan fiskal dan perilaku untuk menilai dampak distribusi dari harga karbon dan reformasi energi di Indonesia. Analisis ini menelusuri bagaimana guncangan kebijakan ditransmisikan melalui harga energi, biaya produksi tidak langsung, serta penyesuaian di pasar tenaga kerja, sekaligus mengevaluasi kemungkinan mitigasi melalui program perlindungan sosial dan skema daur ulang penerimaan negara.

Hasil kajian menunjukkan bahwa harga karbon pada dasarnya cenderung bersifat regresif. Dampak negatifnya dapat berkurang secara signifikan, atau bahkan berbalik menjadi progresif, apabila penerimaan negara diarahkan untuk transfer yang tepat sasaran, dukungan bagi efisiensi energi, atau investasi publik yang memberi manfaat bagi kelompok rentan. Studi ini menyimpulkan bahwa keberhasilan transisi energi di Indonesia tidak hanya ditentukan oleh efektivitasnya dalam menurunkan emisi, tetapi juga oleh kemampuannya memastikan keadilan bagi berbagai kelompok masyarakat.

Ucapan Terima Kasih
Kami menyampaikan penghargaan yang mendalam kepada Emmanuel Fourmann dan Ekky Gompa Simanjuntak dari Agence Française de Développement (AFD) atas arahan dan dukungan berkesinambungan sepanjang penyusunan laporan ini. Kami juga berterima kasih kepada Profesor Nora Lustig dari Tulane University atas masukan kritis dan ulasan konstruktifnya yang telah memperkaya kualitas laporan ini.

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Kata kunci
Pajak karbon, Perdagangan emisi, Subsidi energi, Ketimpangan, Mikrosimulasi, Transisi yang berkeadilan

Wilayah kajian
Indonesia, Indo-Pasifik, Asia.

Klasifikasi JEL
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Diterima pada
September 2025

1. Unpacking Carbon Emission Policies for a Fairer Indonesia

1.1. Background

Indonesia's commitment to carbon emission reduction is aligned with its global responsibilities under the Paris Agreement. The agreement aims for a global shift towards lower carbon emissions to mitigate climate change risks, especially for vulnerable communities. Its main goal is to limit the global average temperature increase to well below 2°C above pre-industrial levels while striving to limit the increase even further to 1.5°C. On April 22, 2016, the Government of Indonesia (GoI) signed the Paris Agreement in New York, USA. It ratified it through Law 16/2016, affirming its commitment to the agreement's goals within the United Nations Framework Convention on Climate Change. Through this ratification, Indonesia pledged to achieve a reduction of 29% in greenhouse gas (GHG) emissions by 2030 independently, or a reduction of 41% with international cooperation. Later in 2022, the GoI updated its commitment to a higher GHG emissions reduction target of 31.89% (unconditional) and 43.2% (conditional).

Carbon pricing is a critical strategy to reduce GHG emissions by putting prices on carbon emissions. This strategy can lead to increased fossil fuel costs, discouraging their energy production use and encouraging companies to invest in more environmentally friendly options (ADB, 2021). The primary carbon pricing methods include carbon taxes and Emission Trading Systems (ETSs). Carbon taxes directly influence carbon prices, whereas ETSs limit the amount of carbon that emitters can release, indirectly influencing carbon prices through the cost of emission permits.

Indonesia is among the 52 national jurisdictions worldwide that have established carbon pricing regulations (World Bank, 2023). The country has initiated a carbon pricing framework with the issuance of Presidential Regulation 98/2021, aimed at meeting its climate targets and managing GHG emissions within its national development plans. Following this, a series of implementing regulations have been enacted by various ministries. These include the Ministry of Environment and Forests (MoEF) Regulation 21/2022 on the procedure for implementation of carbon pricing, the Ministry of Energy and Mineral Resources (MEMR) Regulation 16/2022 on the implementation of carbon pricing in the power/electricity generation sub-sector, as well as MoEF Regulation 7/2023 regarding the implementation of the carbon market in the forestry sector.

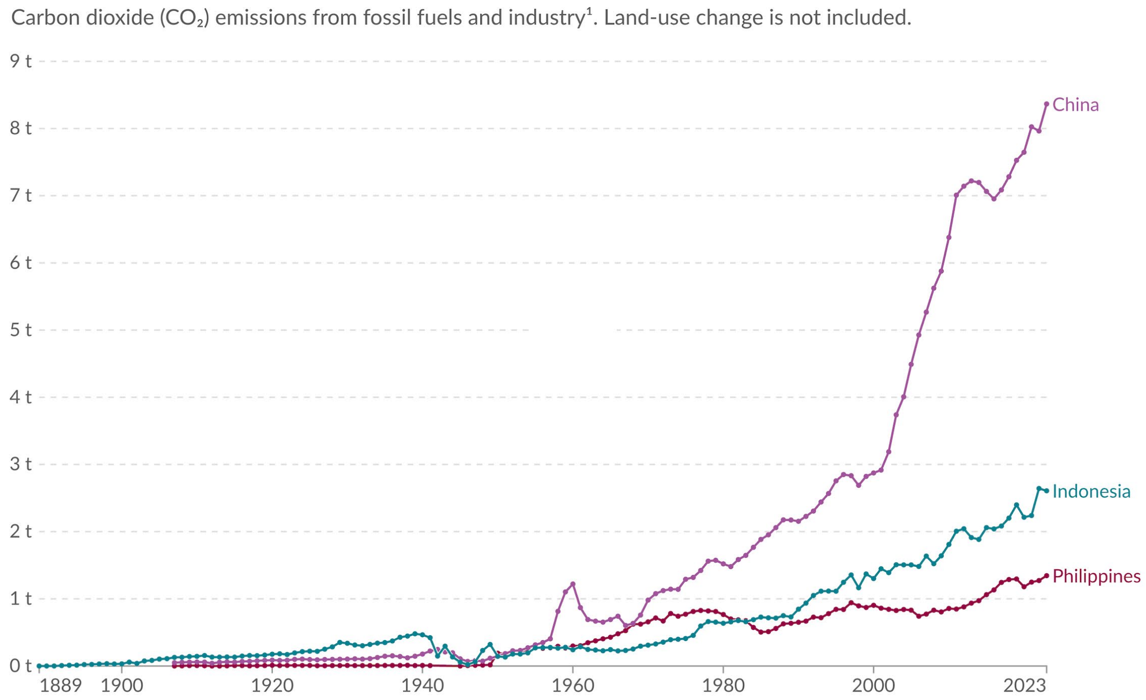
As outlined in Presidential Regulation 98/2021, the primary goal of carbon pricing instruments implementation is to support Indonesia in achieving its NDC (Nationally Determined Contributions), with a primary focus on the carbon trading, carbon tax, and result-based payments. The Ministry of Finance is tasked with overseeing the carbon tax, as detailed in both Presidential Regulation 98/2021 and Law 7/2021 on Tax Regulation Harmonization. Additionally, carbon trading is allowed directly and through carbon exchanges, with the Indonesian Financial Services Authority (OJK) issuing regulations and circulars regarding carbon trading through carbon exchange procedures. Further, the MoEF Regulation 21/2022 requires the creation of a carbon trading roadmap for various sectors and sub-sectors, coordinated by relevant ministries. This includes a wide range of areas from energy to agriculture, covering both existing and potentially new sectors that emerge from scientific advancements.

GoI intended to introduce carbon pricing instruments voluntarily from 2021 to 2024, with a shift to mandatory enforcement expected by 2025 (MEMR, 2021). The initial strategy included initiating a carbon tax for coal-fired power plants on April 1, 2022, at IDR 30,000 per ton of CO_2 equivalent, targeting GHG emissions exceeding a predetermined limit (a cap and tax system). With a cost of about $2 for every ton of CO_2 equivalent, this rate would be one of the lowest worldwide, as noted by the World Bank (2023) and OECD (2023). Despite its modest start, introducing this tax marks a considerable advancement in Indonesia, particularly given the few developing countries implementing a carbon tax. Indonesia will be the second country in Southeast Asia to adopt such a policy. However, the carbon tax implementation in Indonesia has been delayed due to inflationary pressures caused by rising fuel and food prices. Meanwhile, in early 2023, the GoI launched an ETS for the electricity generation sector, to be executed in three phases. The first phase, from 2023 to 2024, will focus solely on coal-fired power plants. The following plan is to extend the ETS to include oil and gas-fired power plants and additional coal-fired power plants not connected to the PLN grid during the second (2025-2027) and third (2028-2030) phases.

The utilization of carbon pricing to foster a decarbonized society is a significant policy instrument, yet it can lead to uneven burdens across different societal groups. These measures, while environmentally beneficial, may inadvertently promote inequality. If these disparities are not addressed, the push towards global decarbonization could be hindered, achieving less impact or imposing uneven costs. This project will develop data analytical tools for developing countries to improve the design of policies that can both deliver environmental goals while reducing the distribution burden, by ensuring a just transition.

Indonesia's energy transition presents a complex challenge as the country seeks to balance economic growth, energy security, and environmental sustainability while addressing rising CO_2 emissions. Global trends illustrate that Indonesia's per capita CO_2 emissions have steadily increased, surpassing those of the Philippines but remaining significantly lower than China, which has experienced a sharp rise due to rapid industrialization (Figure 1a). Given Indonesia's reliance on fossil fuels, particularly coal, the implementation of carbon tax and carbon trading mechanisms is crucial for overcoming the environmental costs of emissions while incentivizing cleaner energy alternatives. However, these policies must be carefully designed to ensure a Just Energy Transition (JET)—preventing excessive economic burdens on industries and low-income households. A well-structured carbon tax can generate revenue to support renewable energy investments and workforce retraining, whereas carbon trading can provide flexibility for businesses in meeting emission targets.

Figure 1.1. CO_2 emissions per capita in China, Indonesia, and the Philippines



Source: Global Carbon Budget (2024); Population-based on various sources (2024) – with major processing by Our World in Data

Data analytics, such as microsimulation models, are extensively used to craft social policies that address poverty and employment incentives. These models have become essential for policymakers. Although tools have been developed to gauge the social impact of straightforward environmental measures, comprehensive tools that can simultaneously devise environmental policies and compensatory strategies are scarce.

The Commitment to Equity Institute (CEQ Institute) has developed an analytical tool to assess the distributional impact of carbon pricing and other indirect fiscal instruments (taxes and subsidies) combined with direct taxes and social transfers that can assist in mitigating these instruments. To design more effective policies that meet both environmental and distributive objectives, CEQ Institute has developed an analytical tool utilizing microdata on household characteristics, behavioural science and a data analytical tool known as microsimulation modelling. The approach takes micro units such as households and simulates policy changes before policy implementation. It is an ex-ante policy planning tool that allows analysts to explore alternative policy solutions in a computer-based laboratory.

This study will adapt the framework to understand the distributional impact of actual and potential carbon prices as well as potential mitigation options in Indonesia.

1.2. Objective

The primary objective of this study is to estimate the welfare distributional impacts, specifically on poverty and inequality, of climate change mitigation policies that include both market-based and non-market-based instruments. Recognizing the diversity of social and economic contexts across Indonesia, this study aims to incorporate a nuanced assessment of the varied costs and impacts of these policies across different regions.

The core research question centers on identifying effective policies that simultaneously address environmental and distributional goals. This study will examine how carbon pricing and other indirect fiscal tools, such as taxes and subsidies, interact with direct taxes and social transfers to impact welfare distribution and environmental outcomes. By exploring the combined effects of these instruments, the study seeks to provide insights into policy frameworks that can support Indonesia's environmental commitments while ensuring fair and equitable outcomes for all social groups across its regions.

1.3. Approach

1.3.1. Theoretical Framework of Transmission Mechanisms of Carbon Tax Across Income Deciles

A carbon tax is an economic policy tool designed to reduce carbon emissions by increasing the cost of fossil fuel consumption. By assigning a price to carbon-intensive activities, the tax incentivizes businesses and households to shift toward cleaner alternatives. However, the burden of a carbon tax is not distributed equally across income groups. Lower-income households tend to experience a higher relative financial burden due to their greater dependence on carbon-intensive goods as a proportion of total income, their limited ability to switch to energy-efficient alternatives, and their higher vulnerability to rising costs of essential goods and services (Pizer & Sexton, 2019).

The impact of a carbon tax is transmitted through multiple economic channels, including direct energy price increases, indirect cost adjustments, labor market effects, and behavioral constraints. Each of these transmission mechanisms affects different income groups in distinct ways, with lower-income households being disproportionately affected due to structural limitations in their economic adaptability (Goulder & Hafstead, 2018).

The most immediate impact of a carbon tax is its effect on energy prices. Since fossil fuels remain a dominant source of energy, a carbon tax directly raises electricity, transportation, and heating costs.

Households in lower-income deciles allocate a significantly larger share of their total expenditures to energy, making them more vulnerable to price increases. According to empirical research, energy expenditures constitute between 10% and 15% of total household spending for the lowest-income groups, while in higher-income groups, this share is less than 5% (Sterner, 2012). This means that any increase in energy costs due to carbon taxation disproportionately affects low-income households, leading to a regressive burden.

In addition to direct energy costs, indirect price effects further widen the distributional impact of a carbon tax. Since energy is a crucial input in most industries, businesses that rely on fossil fuels tend to pass higher production costs to consumers. This results in higher prices for food, manufactured goods, and public services, which disproportionately affect low-income households, as they spend a larger share of their income on necessities (Gillingham & Stock, 2018). For instance, rising transportation costs due to higher fuel prices can increase food prices, affecting the affordability of basic goods. Since lower-income groups lack financial buffers, they have limited capacity to absorb these price shocks, which can lead to reduced consumption of essential goods or increased financial hardship.

Another critical transmission mechanism is the labor market effect of carbon taxation. Certain industries, particularly those that are carbon-intensive, such as coal mining, heavy manufacturing, and logistics, may experience reduced output, layoffs, or lower wages due to rising production costs. Since low-income workers are disproportionately employed in these sectors, they face greater risks of job losses and income instability (Böhringer, Rosendahl, & Storrøsten, 2021). Unlike higher-income workers who have greater mobility and access to education and retraining opportunities, low-wage earners often lack the financial flexibility to transition to new industries, exacerbating economic inequality.

Behavioral constraints and substitution limitations further explain why low-income groups are more vulnerable to carbon taxation. Higher-income households have the ability to invest in energy-efficient appliances, shift to public transportation, or adopt renewable energy sources, thereby reducing their long-term carbon tax burden. In contrast, lower-income households face high upfront costs and financing barriers that prevent them from making such adjustments (Davis & Knittel, 2019). For example, while an electric vehicle (EV) may reduce fuel expenses in the long run, the high initial cost makes it an unrealistic option for lower-income consumers. Similarly, access to clean cooking fuels, home insulation, and energy-efficient housing is often more restricted for low-income communities, leaving them with fewer options to adapt to rising energy prices.

The redistribution of carbon tax revenues plays a crucial role in mitigating its regressivity. If carbon tax revenues are returned to households through direct transfers or subsidies, they can offset the financial burden for lower-income groups. Studies show that a revenue-neutral carbon tax, where revenues are redistributed equally to all households, can make the policy progressive rather than regressive (Williams et al., 2015). However, in many cases, government spending from carbon tax revenues is directed toward infrastructure projects or corporate tax cuts, which may not directly benefit the most vulnerable households (Fawcett et al., 2019). Without targeted redistribution, lower-income groups bear the heaviest burden of carbon taxation while receiving little direct compensation.

In Indonesia, where income inequality remains high, and where energy subsidies have historically played a role in reducing economic disparities, the introduction of a carbon tax requires careful policy design. Without appropriate compensation mechanisms, carbon taxation could exacerbate poverty and economic inequality, particularly for communities reliant on subsidized energy sources (World Bank, 2022). However, progressive redistribution mechanisms—such as cash transfers to low-income households, energy efficiency subsidies, and public transport investments—can help mitigate the adverse effects and ensure a just transition to a low-carbon economy.

The overall impact of a carbon tax across income deciles is ultimately determined by the interaction between price effects, employment shifts, consumption behavior, and government compensation policies. Lower-income groups face higher relative financial burdens, greater employment risks, and fewer options for adaptation, making them the most vulnerable to carbon taxation. However, strategic revenue recycling and policy adjustments can help transform a carbon tax from a regressive policy into one that supports social equity while advancing climate goals.

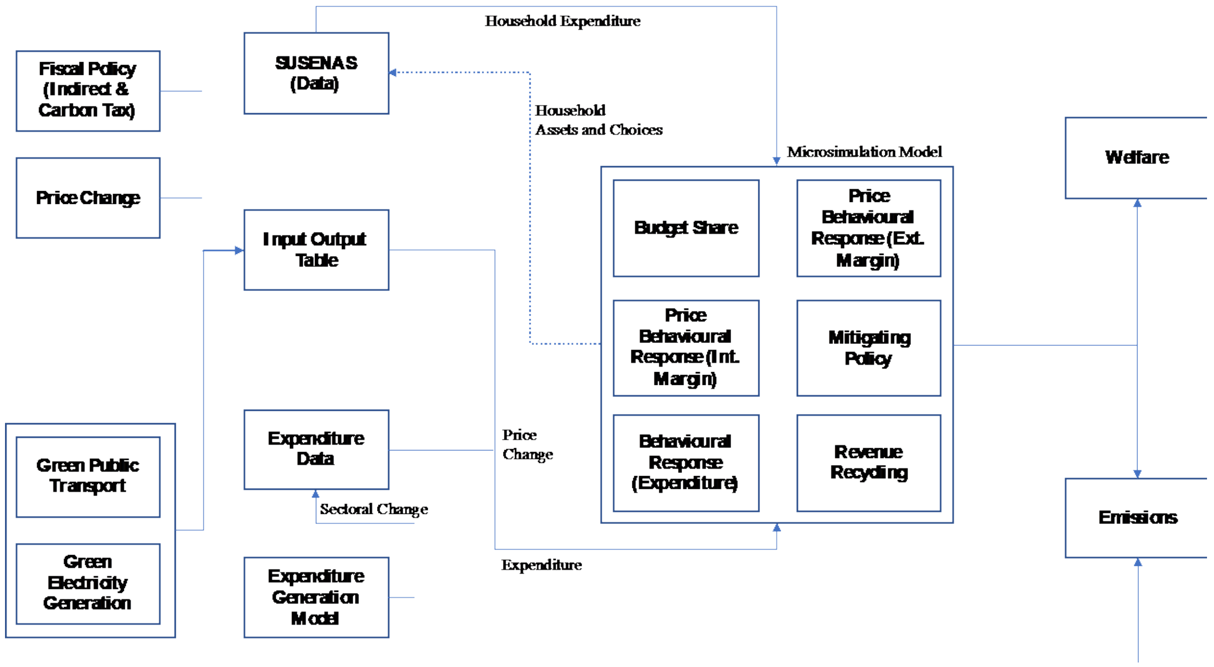
1.3.2. Methodology

To design more effective policies that meet both environmental and distributive objectives, CEQ-I have developed an analytical tool utilising micro data on household characteristics, behavioural science and a data analytical tool known as microsimulation modelling. The approach takes micro units such as households and simulates policy changes in advance of policy implementation. It is an ex-ante policy planning tool that allows analysts to explore alternative policy solutions in a computer-based laboratory.

The framework incorporates the following discrete analytical dimensions:

1. Methodological frameworks to model the distributional impact of fuel related fiscal policies
2. An Input-Output framework to track the indirect impact of carbon prices
3. Behavioural implications of alternative environmental challenges using a demand system
4. Identifying just transitions solutions using social protection instruments

Figure 1.1. Analytical Framework



Source: Author, adapted from CEQ Institute

1.4. Indonesia's inequality landscape

1.4.1. Regional and Socioeconomic Inequality in Indonesia

In 2023, the LPEM FEB UI estimated inequality variations in Indonesia using SUSENAS 2012, 2015, 2018, and 2021. Table 1.1 presents estimate of per capita mean and median expenditure across different population groups, categorized by household characteristics such as gender composition, education level of the household head, household size, employment type, urban-rural classification, and geographic region (Java vs. non-Java and across six main island groups). This analysis is adapted from the Inequality Trends in South Africa (2019) and Inequality Diagnostic for Ghana (2020), with necessary adjustments to reflect the Indonesian context.

Trends in Real Annual Mean and Median Expenditure Across Subgroups

Between 2012 and 2021, real mean and median per capita expenditures in Indonesia experienced significant growth. The real mean expenditure per capita nearly doubled over this period, increasing from IDR 651,403 (~USD 68) in 2012 to IDR 1,174,613 (~USD 81) in 2021, reflecting a broader trend of rising living standards and household spending capacity .

Examining the role of education, the findings indicate a strong correlation between the educational attainment of the household head and per capita expenditure. Households led by individuals with tertiary education report mean and median expenditures more than double the national average. In contrast, those headed by individuals with no formal schooling or only primary education have per capita expenditures of approximately one-third and one-half, respectively, of households led by those with tertiary education. This trend underscores the link between higher education and economic well-being. A slight anomaly is observed in 2018, where the mean expenditure for households led by primary school graduates falls marginally below that of households without formal schooling. Nevertheless, a general upward trajectory in expenditure is evident across all education levels over time.

Household size also plays a critical role in expenditure patterns. Per capita expenditures decline as household size increases, suggesting that larger households tend to have lower financial resources per member. Employment type further influences spending capacity, with households dependent on formal sector jobs exhibiting higher per capita expenditure than those relying on informal employment. From 2012 to 2021, per capita expenditures in both employment categories showed a rising trend, reinforcing broader economic growth patterns.

Urban areas consistently register higher per capita expenditure than rural regions, with the disparity widening over time. In 2012, the gap between urban and rural per capita expenditure was IDR 358,454 (~USD 37) which expanded to IDR 479,179 (~USD 33) by 2021. This growing divergence indicates that urbanization and economic opportunities remain concentrated in city centers, leaving rural communities at a relative disadvantage.

Both Java and non-Java regions experienced consistent increases in per capita expenditures from 2012 to 2021. Although Java exhibits slightly higher spending levels, differences arise when comparing mean and median expenditures. In both 2012 and 2021, the median per capita expenditure in Java was lower than in non-Java, suggesting that the average expenditure figure is skewed by extreme values. This phenomenon is largely attributed to DKI Jakarta, which significantly elevates Java’s mean expenditure, masking disparities within the island itself.

Among Indonesia’s major islands outside Java, Kalimantan stands out as the region with the highest per capita mean and median expenditure from 2012 to 2021. This suggests that Kalimantan contributes significantly to overall national spending, likely due to its resource-based economy. Other regions, including Sumatra, Bali and Nusa Tenggara, Sulawesi, and Maluku and Papua, also exhibit notable expenditures levels, though they are generally lower than those of Kalimantan. The varying levels of spending across Indonesia’s regions highlight the structural differences in economic development and resource distribution.

Table 1.1. Distribution of Real Monthly Mean and Median Expenditure (IDR)

Variable	Subgroup	Mean				Median			
		2012	2015	2018	2021	2012	2015	2018	2021
Total		**651,403**	**706,403**	**1,021,708**	**1,174,613**	**453,095**	**499,427**	**757,081**	**875,928**
Education level of the household head	No school	448,469	524,883	790,119	852,737	352,005	425,568	610,137	697,970
	Primary school	481,411	565,071	766,037	884,751	380,133	455,693	624,665	729,202
	Middle school	593,104	669,922	904,298	1,039,617	460,033	527,267	733,327	839,638
	High school	852,059	983,085	1,234,530	1,343,675	638,178	749,498	985,182	1,056,398
	Tertiary education	1,489,551	1,796,111	2,159,501	2,325,910	1,087,320	1,265,702	1,690,467	1,754,246
Number of members in household	1	1,248,113	1,231,746	1,862,903	2,154,333	861,986	824,047	1,423,753	1,638,115
	2	861,344	918,639	1,367,991	1,558,262	607,202	637,865	1,050,715	1,203,336
	3	721,275	782,585	1,161,936	1,326,947	536,688	581,818	919,605	1,042,851
	4	660,802	709,371	1,025,994	1,157,417	474,586	513,844	780,316	883,642
	>4	565,581	614,218	860,018	956,755	385,679	434,593	633,777	721,121
Job status	Formal	905,001	958,163	1,312,788	1,494,870	622,003	669,048	979,013	1,094,272
	Informal	536,757	589,139	895,305	1,038,960	401,798	449,685	694,790	818,817
Urban/Rural	Urban	830,528	873,756	1,226,834	1,381,506	570,123	607,207	892,137	1,001,756
	Rural	472,074	536,163	774,062	902,326	373,286	428,810	635,865	751,017
Java/Non-Java	Java	653,564	736,290	1,063,987	1,217,235	437,366	499,866	761,621	864,558
	Non-Java	648,529	667,090	966,811	1,119,981	473,448	498,682	750,306	887,737
Island	Sumatra	653,837	677,611	960,281	1,110,878	487,048	508,420	763,369	893,485
	Java	653,564	736,290	1,063,987	1,217,235	437,366	499,866	761,621	864,558
	Bali & Nusa Tenggara	595,110	593,808	882,509	1,064,857	400,389	422,068	641,408	803,708
	Kalimantan	774,428	774,918	1,134,088	1,299,758	582,716	614,132	879,777	1,042,552
	Sulawesi	574,164	597,403	904,798	1,014,897	399,959	428,967	672,820	775,723
	Maluku & Papua	643,715	682,907	982,406	1,186,239	452,405	506,014	773,911	914,048

Source: LPEM FEB UI, (2023)

National Trends in Inequality

Table 1.2 below depicts the heterogeneous picture of Indonesia's inequality. Indonesia experienced a gradual decline in its Gini coefficient over the past decade, indicating some improvement in income distribution. The national Gini coefficient was 0.409 in 2012, slightly decreased to 0.408 in 2015, before decreased more significantly to 0.389 in 2018 and reached 0.384 in 2021. These figures suggest that economic policies and social programs have contributed to narrowing income disparities. The decline between 2015 and 2018 aligned with government efforts to expand social protection programs, including the expansion of the conditional cash transfer program (PKH) and subsidies for energy, healthcare, and education (World Bank, 2020). However, the slower decline after 2018 suggests that structural inequalities, particularly those linked to labor markets and regional disparities, remain persistent challenges (ADB, 2022).

The declining trend is consistent with broader global patterns, where middle-income economies have seen modest reductions in inequality due to targeted welfare programs (OECD, 2019). However, Indonesia's inequality levels remain higher than those of peer Southeast Asian nations such as Thailand (0.36) and Vietnam (0.35), indicating that income concentration at the top remains an issue (ASEAN, 2021).

Inequality and Educational Attainment

Education plays a critical role in income distribution, as reflected in the differences in Gini coefficients across education levels. Households headed by individuals with tertiary education have the highest inequality, with a Gini coefficient of 0.426 in 2015, which slightly decreased to 0.397 in 2021. This high level of inequality is explained by the increasing wage premium for highly skilled workers in industries such as finance, technology, and services, compared with middle-income earners with similar education levels (ILO, 2021).

Conversely, households led by individuals with primary or no formal schooling have much lower inequality levels, with Gini coefficients ranging from 0.320 to 0.355. While these groups exhibit more uniform earnings, they also face limited upward economic mobility, meaning that their incomes remain concentrated in the lower-income brackets. The relationship between education and income disparity is consistent with findings in other emerging economies, where wage disparities widen as economies become more skills-intensive (UNDP, 2020).

The importance of education in addressing inequality is supported by the stylized fact that each additional year of schooling in Indonesia is associated with an 8–12% increase in earnings (World Bank, 2019). However, unequal access to quality education, particularly in rural and remote areas, continues to limit social mobility, reinforcing persistent income gaps (BPS, 2023).

Table 1.1 illustrates the strong nexus between education and welfare inequality in Indonesia concerning energy poverty, showing that higher educational attainment is associated with significantly better economic outcomes. In 2021, households headed by individuals with no formal education had a mean welfare level of 852,737, whereas those with tertiary education had a mean of 2,325,910—nearly 2.7 times higher. This disparity extends to median values, reinforcing the role of education in determining economic well-being. Over time, while all education groups saw increases in welfare, the gap between the least and most educated group persisted, signaling deep structural inequality.

This economic divide is particularly evident in the context of energy poverty, where low-income, low-educated households struggle to access reliable and affordable energy. Households with lower education levels often reside in rural or informal urban settlements, where electricity infrastructure is limited, and reliance on traditional biomass or costly unsubsidized fuels remains high. Limited economic means further exacerbate their energy insecurity, forcing them to allocate more of their income to basic energy needs and reducing their ability to invest in better education, healthcare, and income-generating activities. Moreover, households headed by more educated individuals benefiting from stable incomes and better employment opportunities are more likely to access modern, efficient energy sources, contributing to improved productivity and living standards.

Employment Status and Wage Disparities

Formal and informal employment structures significantly influence inequality patterns. Workers in formal employment consistently exhibit higher inequality, with a Gini coefficient of 0.428 in 2012, which gradually declined to 0.399 in 2021. This reflects substantial wage variation within the formal labor market, where professionals and managerial employees earn significantly more than lower-level workers. The expansion of digital economies and financial services in urban areas has further widened wage disparities within the formal sector (OECD, 2022).

In contrast, informal sector workers demonstrate lower and more stable levels of inequality, with the Gini coefficient fluctuating around 0.361 to 0.351 over the decade. This suggests that while informal jobs provide a more homogeneous income structure, they also trap workers in low-productivity, low-wage employment with limited benefits and social protections (ILO, 2022). Informal employment still dominates the Indonesian labor market, accounting for approximately 57% of total employment in 2022 (BPS, 2023).

The wage gap between formal and informal employment remains significant, with formal sector workers earning nearly 80% more than their informal counterparts on average (ADB, 2021). These findings indicate that addressing informal employment and improving labor regulations could be critical in reducing overall inequality.

Urban-Rural Inequality

The persistent gap between urban and rural inequality is another key structural challenge in Indonesia. Urban areas exhibit consistently higher levels of inequality, with a Gini coefficient of 0.428 in 2015, which stabilized at 0.401 in 2021. This high level of inequality reflects the dual nature of urban economies, where high-wage opportunities exist alongside a growing low-income service sector, particularly in informal employment (UN-Habitat, 2022).

By contrast, rural areas have significantly lower inequality, with the Gini coefficient declining from 0.329 in 2012 to 0.315 in 2021. The relatively lower rural inequality suggests that income distribution is more even, though average earnings remain substantially lower than in urban areas. This aligns with structural economic patterns where agricultural and rural-based economies tend to have lower wage disparities than do urban, service-driven economies (FAO, 2021).

Infrastructure and social service disparities further reinforce the urban-rural divide in Indonesia. Compared with rural households, urban households have nearly twice the degree of access to higher education and healthcare services, contributing to long-term income gaps (World Bank, 2022). Addressing these disparities through targeted rural investment and infrastructure development remains essential in narrowing Indonesia's economic inequality.

Regional Disparities: Java vs. Non-Java

Java remains the most unequal region in Indonesia, with a Gini coefficient of 0.423 in 2012, peaking at 0.429 in 2015, and slightly decreasing to 0.408 in 2021. The high inequality in Java is attributed to the concentration of economic activity in metropolitan areas like Jakarta, Surabaya, and Bandung, where wage disparities between high- and low-income workers remain pronounced (Bappenas, 2022). The presence of a large service economy and high-end professional jobs in Java has contributed to persistent income polarization.

In contrast, non-Java regions have experienced a more significant decline in inequality, with the Gini coefficient falling from 0.390 in 2012 to 0.350 in 2021. This suggests that economic decentralization and regional development efforts have helped improve income distribution in these areas. The reduction in inequality in Sumatra, Kalimantan, and Sulawesi can be linked to increased investment in infrastructure and resource-based industries, which have created more employment opportunities outside Java (OECD, 2023).

However, despite these improvements, income disparities between the Java and non-Java regions remain substantial, with Java maintaining higher average wages but also greater inequality. Policies aimed at dispersing economic activity beyond Java and strengthening regional economies will be essential in achieving a more balanced national income distribution (ADB, 2022).

Table 1.2. Multidimensional Picture of Inequality in Indonesia

Variable	***Subgroup***	***Year***	***Gini Coefficient***
Total Population		2012	0.409
		2015	0.408
		2018	0.389
		2021	0.384
Education of household head	No school	2012	0.324
		2015	0.325
		2018	0.355
		2021	0.320
	Primary school	2012	0.325
		2015	0.331
		2018	0.320
		2021	0.314
	Middle school	2012	0.345
		2015	0.344
		2018	0.331
		2021	0.332
	High school	2012	0.382
		2015	0.386
		2018	0.355
		2021	0.359
	Tertiary education	2012	0.408
		2015	0.426
		2018	0.378
		2021	0.397
Job satus	Formal	2012	0.428
		2015	0.425
		2018	0.397
		2021	0.399
	Informal	2012	0.361
		2015	0.362
		2018	0.360
		2021	0.351
		2012	0.422

Variable	Subgroup	Year	Gini Coefficient
Geographic area	Urban	2015	0.428
		2018	0.401
		2021	0.401
	Rural	2012	0.329
		2015	0.334
		2018	0.324
		2021	0.315
Regional group	Java	2012	0.423
		2015	0.429
		2018	0.408
		2021	0.408
	Non-Java	2012	0.390
		2015	0.375
		2018	0.361
		2021	0.350
Island	Sumatera	2012	0.368
		2015	0.363
		2018	0.339
		2021	0.330
	Java	2012	0.423
		2015	0.429
		2018	0.408
		2021	0.408
	Bali & Nusa Tenggara	2012	0.419
		2015	0.393
		2018	0.395
		2021	0.387
	Kalimantan	2012	0.378
		2015	0.343
		2018	0.350
		2021	0.332
	Sulawesi	2012	0.412
		2015	0.404
		2018	0.392
		2021	0.373
	Maluku & Papua	2012	0.416
		2015	0.386
		2018	0.372
		2021	0.368

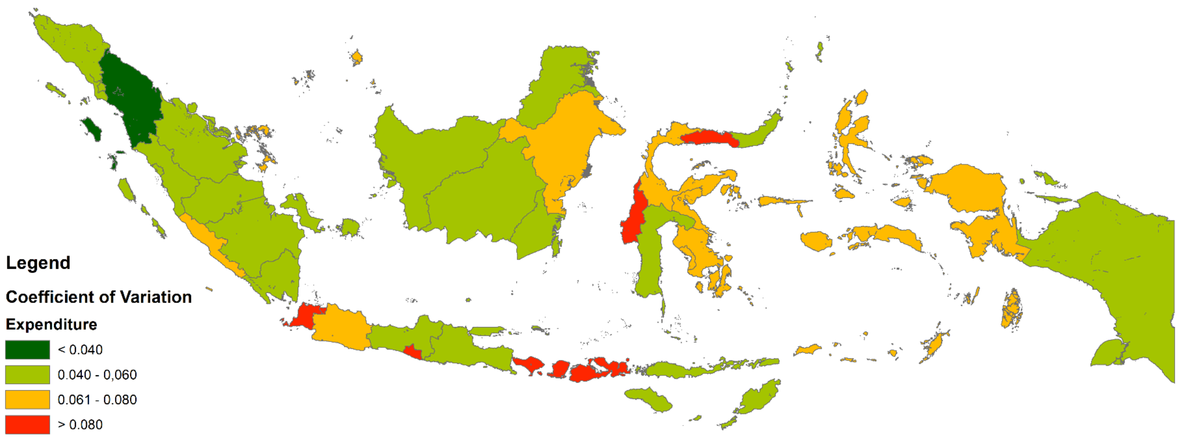
Source: LPEM FEB UI, (2023)

Economic Inequality by Province

Furthermore, this section assesses inequality among regencies and cities within a province. Consequently, the unit of analysis is the regency/city level, where all individuals within a given regency or city are assumed to have the same per capita expenditure and wage levels. Following the methodology proposed by Shifa and Ranchhod (2019), which builds upon Williamson's (1965) seminal work, the coefficient of variation (CV) is widely recognized as the standard metric for evaluating spatial or regional inequality. Therefore, this chapter will employ CV as the primary measure for analyzing regional economic inequality.

Per capita expenditure inequality reflects the uneven distribution of financial resources among individuals within a given population. It highlights disparities in income, wealth, and consumption patterns, illustrating differences in economic well-being across various regions. This inequality affects spending power and indicates unequal access to basic necessities, education, healthcare, and other essential services. Several factors contribute to per capita expenditure inequality, including income disparities, limited social mobility, government policies, and structural economic barriers. Addressing these disparities requires comprehensive policy interventions, such as income redistribution, enhanced social protection programs, and inclusive economic growth strategies to ensure a fairer allocation of resources and opportunities for all.

Figure 1.3. Per Capita Expenditure Inequality by Province, 2021



Source: LPEM FEB UI (2023

Figure 1.3 presents the distribution of per capita expenditure inequality across Indonesian provinces. The data reveals that the highest levels of inequality are concentrated in the eastern regions of Indonesia, where the coefficient of variation (CV) ranges between 5.5% and 9.5%. However, a closer examination indicates that the provinces with the highest per capita expenditure inequality are primarily located on the island of Java. The three provinces with the highest CV levels are Yogyakarta (15.33%), Banten (13.20%), and Bali (11.13%), indicating substantial disparities in spending power within these areas.

Conversely, the provinces with the lowest per capita expenditure inequality are North Sumatra (3.8%), South Sumatra (4.02%), and Central Java (4.08%), demonstrating more equitable distribution patterns in these regions. The difference in per capita expenditure inequality between Yogyakarta (the province with the highest CV at 15.33%) and North Sumatra (the province with the lowest CV at 3.8%) is 7.3 percentage points. Notably, all three provinces with the highest per capita expenditure inequality are located on Java Island, while two of the three provinces with the lowest inequality are in Sumatra. This regional variation suggests that economic structures, labor market conditions, and urbanization levels play a crucial role in shaping expenditure disparities across Indonesia's provinces.

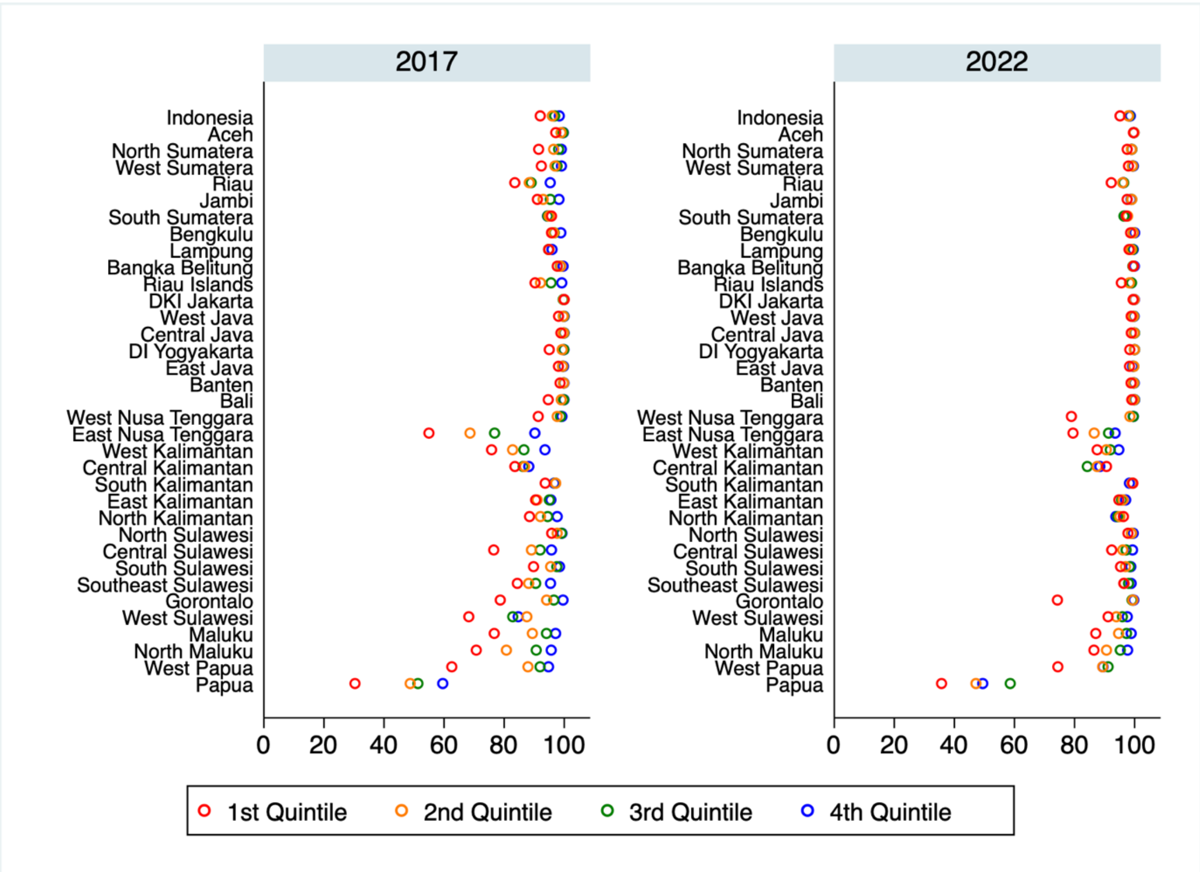
1.4.2. Energy Consumption Distribution in Indonesia

This sub-chapter examines Indonesia's energy consumption disparities by analyzing electricity, LPG, and fuel access across regions and expenditure groups from 2017 to 2022. It explores regional and expenditure-based differences, highlighting variations in infrastructure availability, affordability, and distribution challenges that shape energy access across provinces and expenditure quantiles. The analysis provides insights into progress in energy expansion efforts while identifying persistent inequalities affecting lower-expenditure households in underdeveloped areas.

Indonesia has made substantial progress in electricity access over the past five years, yet significant disparities remain across provinces and expenditure quintiles (Figure 1.4). The comparison between 2017 and 2022 shows an overall increase in electricity consumption across all expenditure quintiles, but the rate of improvement varies widely. Provinces in Java, Sumatra, and Bali already had high access rates in 2017, with consumption exceeding 90% in almost all quintiles, and saw only marginal increases by 2022. In contrast, provinces in eastern Indonesia, particularly Papua, West Papua, Maluku, North Maluku, and East Nusa Tenggara, continue to exhibit the lowest electricity access rates, especially among the poorest households. Papua, in particular, remains the most underdeveloped in terms of electrification. In 2017, electricity consumption among the lowest quintile in Papua was well below 50%, and despite some progress, the gap between Papua and more developed regions remains substantial in 2022.

The disparities in electricity consumption are also evident within provinces based on expenditure quintiles. In most provinces, wealthier households (fourth quintile) had near-universal access in both 2017 and 2022, whereas lower quintiles showed greater variation. In Java and Sumatra, even the poorest quintiles had electricity access rates above 80%, but in eastern Indonesia, significant inequalities persist. For instance, the first and second quintiles recorded some of the lowest access rates in Maluku and North Maluku, with only slight improvements over five years. These findings indicate that while electrification efforts have expanded across the country, progress remains uneven, with eastern Indonesia still facing significant challenges.

Figure 1.4. Progress on the Electricity Rate from 2017 to 2022 by Province and Expenditure Quintile



Source: SUSENAS, 2017 and 2022 (processed by author)

Liquefied petroleum gas (LPG) consumption follows a similar pattern, with Java, Sumatra, and Bali achieving widespread access across all expenditure quintiles, while eastern Indonesia lags behind (Figure 1.5). In 2022, West Java, Central Java, and East Java recorded over 90% LPG consumption in all expenditure groups, reflecting broad availability and affordability. In contrast, Papua, Maluku, North Maluku, West Papua, and East Nusa Tenggara exhibited notably lower consumption rates, particularly among lower-expenditure households. In 2017, LPG consumption in the first quintile was nearly non-existent in these provinces, and while modest improvements were observed by 2022, access remained significantly below national levels.

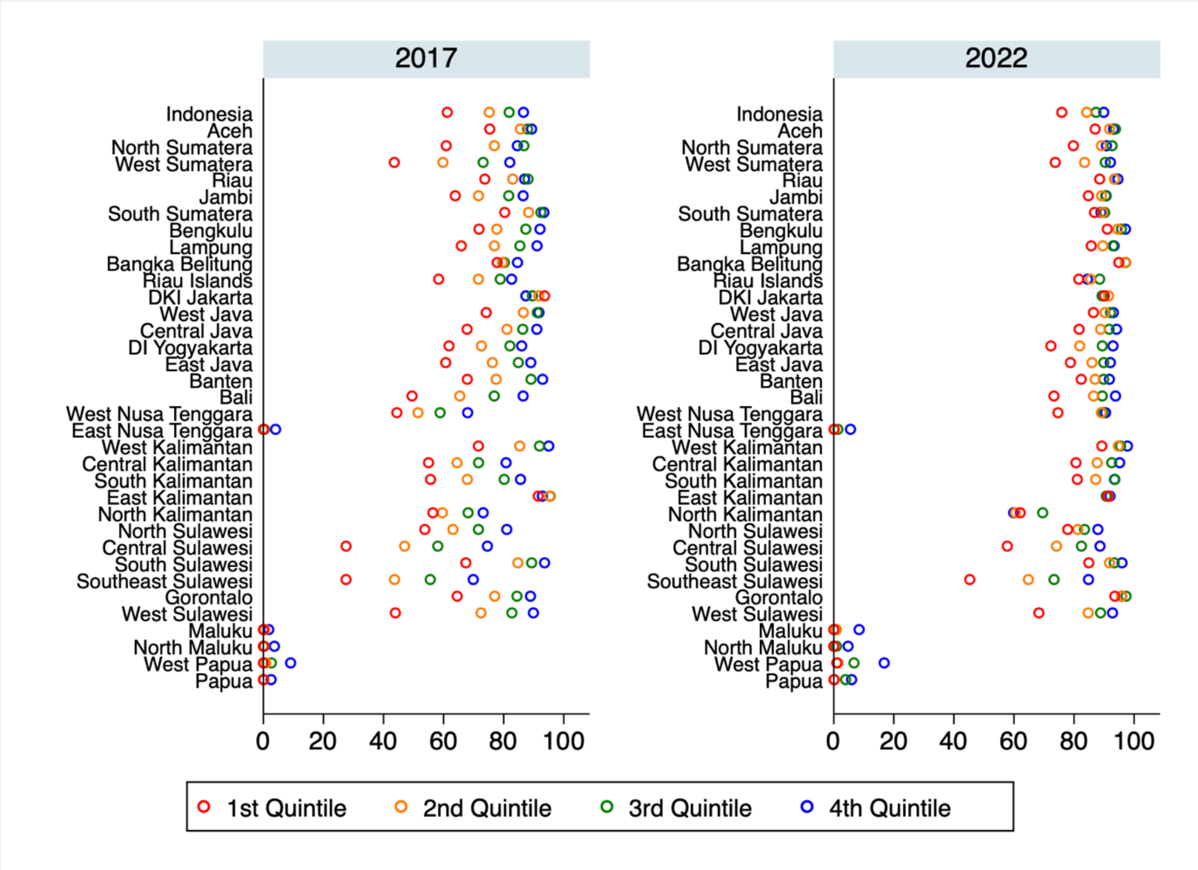
Although LPG access improved for higher-expenditure groups, lower-expenditure households in eastern Indonesia continued to see minimal progress. While lower-quintile households in Java and Sumatra had relatively high consumption rates in 2022, many households in Maluku, North Maluku, and West Papua remained far behind. The slow expansion of LPG adoption reflects persistent affordability challenges and weak supply networks, preventing equitable energy access for lower-income groups.

Moreover, concerning energy access of the subsidised 3-kg LPG, Appendix 1 highlights the stark reality that Maluku, North Maluku, West Papua, and Papua had zero adoption of 3-kg LPG in both 2017 and 2022, despite the government's stated intention to expand access to these regions, as noted in Thoday et al. (2018). While many provinces across Indonesia experienced increased LPG usage over time, the easternmost regions remain entirely excluded, indicating that logistical, infrastructural, and economic barriers have effectively prevented any 3-kg LPG conversion program penetration in these areas. This is particularly concerning given that the program was originally designed to transition households away from kerosene and towards cleaner energy sources. Yet, Maluku and Papua remain dependent on traditional fuels.

This failure to implement the conversion program in eastern Indonesia underscores the persistent inequality in energy access. While western and central parts of Indonesia have seen wider LPG adoption across all income quintiles, households in Maluku and Papua—especially the poorest—continue to be left out entirely. This suggests that government plans and policies have not translated into effective action on the ground. The continued absence of 3-kg LPG in these provinces raises critical questions about infrastructure investments, policy execution, and the feasibility of extending subsidies to Indonesia's most remote and underdeveloped parts. Without targeted interventions to address these barriers, these provinces will remain locked out of the LPG subsidy system, perpetuating regional energy disparities.

Given the lack of LPG access, households in these left-behind regions have relied on traditional cooking fuels such as kerosene (Appendix 2) and biomass (firewood, charcoal, and agricultural waste), as noted in Kusumawardhani et al. (2017). This substitution trend is evident in national surveys, which indicate that kerosene remains the dominant cooking fuel in Maluku and Papua, while biomass usage is still widespread in rural and lower-income households. The persistence of these alternative fuels raises concerns about household air pollution, health risks, and environmental sustainability. Additionally, while the government has reduced kerosene subsidies and promoted a nationwide transition to LPG, these regions have effectively been excluded, leaving households without access to cleaner and more efficient energy sources.

Figure 1.2. Progress on the LPG Consumption from 2017 to 2022 by Province and Expenditure Quintile

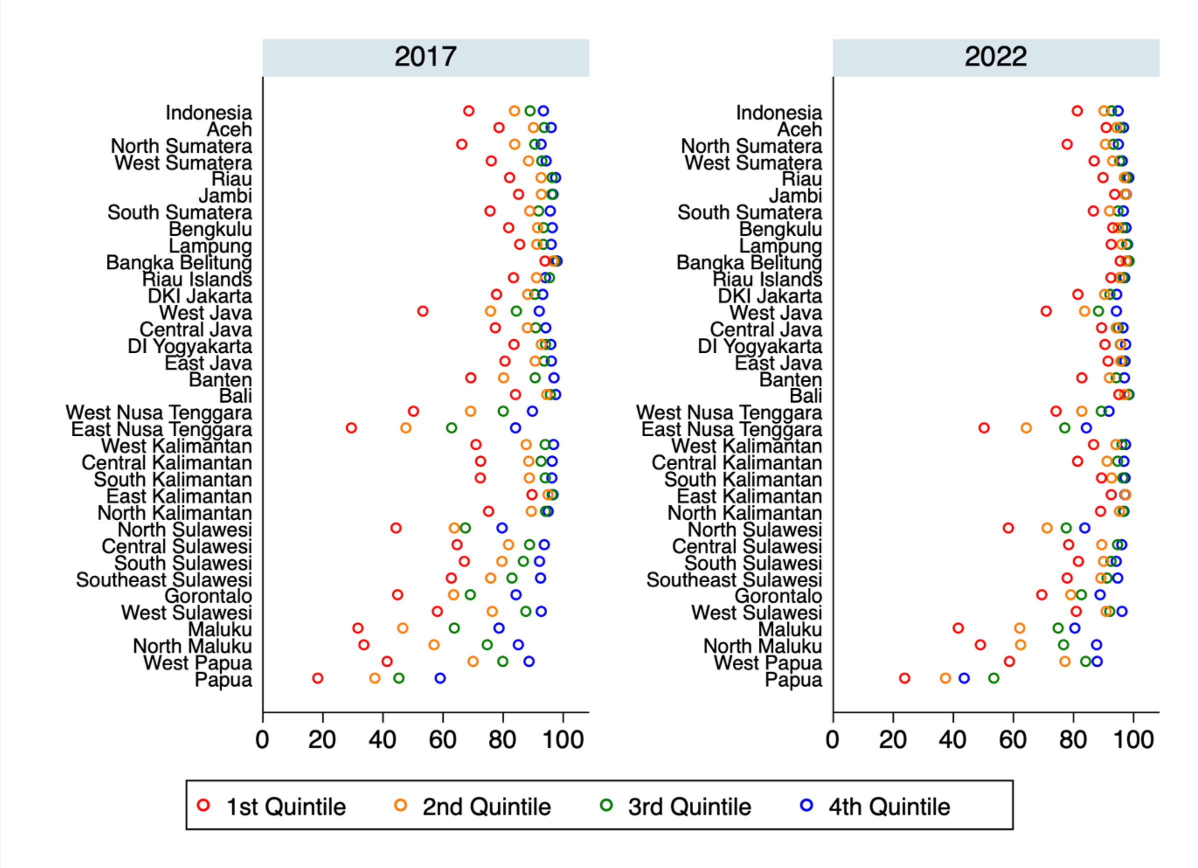


Source: SUSENAS, 2017 and 2022 (processed by author)

Fuel consumption patterns further illustrate regional and expenditure-based disparities, with Java, Sumatra, and Bali maintaining high access rates across all groups, while eastern provinces remain behind. Fuel consumption in these regions was already high in 2017, particularly among higher-expenditure households, and showed further increases by 2022. Most provinces in these regions had fuel consumption rates exceeding 90% in the third and fourth quintiles, demonstrating widespread access. In contrast, eastern Indonesia, particularly Papua, Maluku, and East Nusa Tenggara, exhibited the lowest fuel consumption levels, especially among households in the first and second expenditure quintiles. In Papua, for instance, fuel consumption for the lowest quintile was below 20% in 2017 and, despite some progress, remained the lowest in the country in 2022. While higher-expenditure groups in Papua experienced improvements, lower-expenditure households saw only marginal gains over five years.

Fuel access differences within provinces also reflect strong expenditure-based disparities, particularly in underdeveloped regions. While in Java, Sumatra, and Kalimantan, lower-expenditure households had significantly increased access over five years, in Papua and Maluku, the first-quintile households recorded some of the lowest consumption rates in both years, with little progress. By 2022, while fourth-quintile households in nearly all provinces had near-universal access, first-quintile households in eastern Indonesia remained far below the national average. This trend highlights that while fuel consumption has expanded nationwide, poorer households in remote regions still struggle with affordability and infrastructure access, further reinforcing existing economic and energy inequalities.

Figure 1.3. Progress on the Fuel Consumption from 2017 to 2022 by Province and Expenditure Quintile



Source: SUSENAS, 2017 and 2022 (processed by author)

Despite overall improvements in energy access, significant disparities persist across regions and expenditure groups. Java, Sumatra, and Bali have largely achieved universal access to electricity, LPG, and fuel, while eastern Indonesia continues to experience the most severe energy inequalities. Infrastructure expansion has contributed to broader energy access, but affordability and supply chain limitations remain key barriers for lower-expenditure households. Without further intervention, the most vulnerable populations will continue to experience restricted access to essential energy resources, limiting their ability to fully benefit from Indonesia's energy development.

2. Indonesia's green policy vision and energy policy landscape

2.1. Stakeholder mapping

Achieving Indonesia's green policy vision requires strong collaboration, coordination, and cooperation among ministries, agencies, and other relevant stakeholders. In Indonesia, energy policies are managed by several key actors, including:

Ministry of Energy and Mineral Resources (MEMR)

In the energy sector, the MEMR's main role is to administer governmental affairs in the fields of energy and mineral resources. MEMR issues all regulations and ministerial decisions that support the achievement of the green policy vision in Indonesia's energy sector. Furthermore, MEMR contributes to Indonesia's green vision by creating a long-term model projecting Indonesia to reach peak emissions by 2040 and achieve net-zero emissions by 2060 (Sekaringtias et al., 2023).

Ministry of Finance (MoF) and Fiscal Policy Agency

Indonesia's Ministry of Finance (MoF) also plays a significant role in the country's energy sector. The MoF oversees the overall pricing within the energy sector, including tax and subsidy matters. Additionally, under the MoF is the Fiscal Policy Agency (Badan Kebijakan Fiskal/BKF), which houses a center dedicated to supporting Indonesia's green vision: the Center for Climate Change Financing and Multilateral Policy (Pusat Kebijakan Pembiayaan Perubahan Iklim dan Multilateral/PKPPIM). The PKPPIM is tasked with analyzing, formulating recommendations, and evaluating climate change policies, as well as coordinating, implementing, monitoring, and evaluating economic and financial cooperation in various multilateral forums. However, in the upcoming administration, BKF will be merged with the MoF's Directorate General of Economic and Fiscal Strategy (Karina, 2024).

National Electricity Company (Perusahaan Listrik Negara/PLN)

PLN is a state-owned enterprise responsible for generating, transmitting, and distributing electricity across Indonesia. The company is also key to advancing energy transition objectives, including increasing renewable energy capacity and reducing dependence on fossil fuels. PLN manages extensive infrastructure projects, facilitates rural electrification, and works to improve grid reliability and efficiency. As the largest power provider, PLN plays an essential role in meeting national electrification goals and ensuring energy access for the country's diverse and geographically dispersed population.

PT Pertamina

As a state-owned oil and gas company, Pertamina's main role is to oversee the exploration, production, refining, and distribution of petroleum products, ensuring energy security and meeting domestic demand for fuel and liquefied petroleum gas (LPG). Pertamina provides several types of subsidized energy products to support affordable energy access in Indonesia, including: (1) Subsidized Fuel, such as Pertalite (RON 90 gasoline) and Solar (subsidized diesel); (2) Subsidized Liquefied Petroleum Gas (LPG), specifically 3-kg LPG cylinders; and (3) Kerosene Subsidies. These subsidies are part of the government's broader energy subsidy program, with Pertamina as the primary distributor.

2.2. Green policy vision of the Indonesian government

In alignment with its commitment to the Paris Agreement, Indonesia's ultimate goal is to achieve full decarbonization in the energy sector. Progress toward this objective has begun, with the country gradually increasing its renewable energy capacity and reducing its reliance on fossil fuels.

The energy policy landscape has been quite dynamic in the last decades. Between 2014 and 2019, Indonesia embarked on ambitious energy transition reforms, including reducing energy subsidies, promoting biofuels, encouraging renewable energy investment through tariff reforms, and achieving full electrification (Suharsono, 2024). Indonesia also raised its renewable energy target, with a 2060 net zero goal. Furthermore, the government partially reduced subsidies on premium gasoline and implemented a new pricing mechanism, resulting in budget savings of approximately IDR 211 trillion. (Suharsono, 2024). However, energy subsidies tripled in 2022, reaching 502 trillion rupiah from the initial budget allocation (VoA, 2022).

The increase in international oil and gas prices has prompted the government to adjust subsidy levels to protect low-income households. Energy subsidies are a central part of Indonesia's direct fiscal support policy, designed primarily to keep retail prices affordable. Notably, a significant portion of these subsidies is directed toward LPG (Suharsono et al., 2022). Thus, the government decided not to raise subsidized fuel prices in 2022, despite surging international oil prices. It was influenced by several key economic, political, and social considerations.

Controlling inflation was a key factor in the decision to maintain subsidized fuel prices. Given the significant role fuel prices play in transportation and logistics, raising subsidized fuel prices would likely have led to higher inflation, impacting the broader economy. For a country with a high dependency on fuel for public and commercial transportation, a fuel price hike would have translated directly into increased costs for food, goods, and services, disproportionately affecting low- and middle-income households.

Maintaining social stability was also a central consideration in the government's decision on fuel prices, given the sensitivity of fuel costs and the potential for public unrest. Fuel prices are a politically sensitive issue in Indonesia, with past price hikes often triggering public protests. In 2022, the government was cautious about the potential for social unrest, particularly as Indonesia was still in the economic recovery phase following the COVID-19 pandemic. The public's purchasing power was still recovering, and a sudden increase in fuel prices could have exacerbated poverty and inequality, undermining public sentiment and trust.

As part of its fiscal strategy, the government opted to increase the allocation for fuel subsidies instead of raising prices, thereby absorbing the increased cost. This approach aimed to prevent short-term economic shock and shield consumers. The government's budget in 2022 included significant subsidy allocations not only for fuel but also for electricity and other basic needs. This approach was viewed as a way to support economic recovery, particularly for lower-income groups.

Moreover, the decision to keep fuel prices stable can be understood in the context of political timelines. With the 2024 general election on the horizon, maintaining public support was a priority. The government aimed to avoid potentially unpopular measures that could impact voters' sentiments.

The decision to sustain fuel subsidies was also supported by increased revenue from rising global prices of key commodities like coal and palm oil. This revenue provided some fiscal space to support fuel subsidies, even if temporarily.

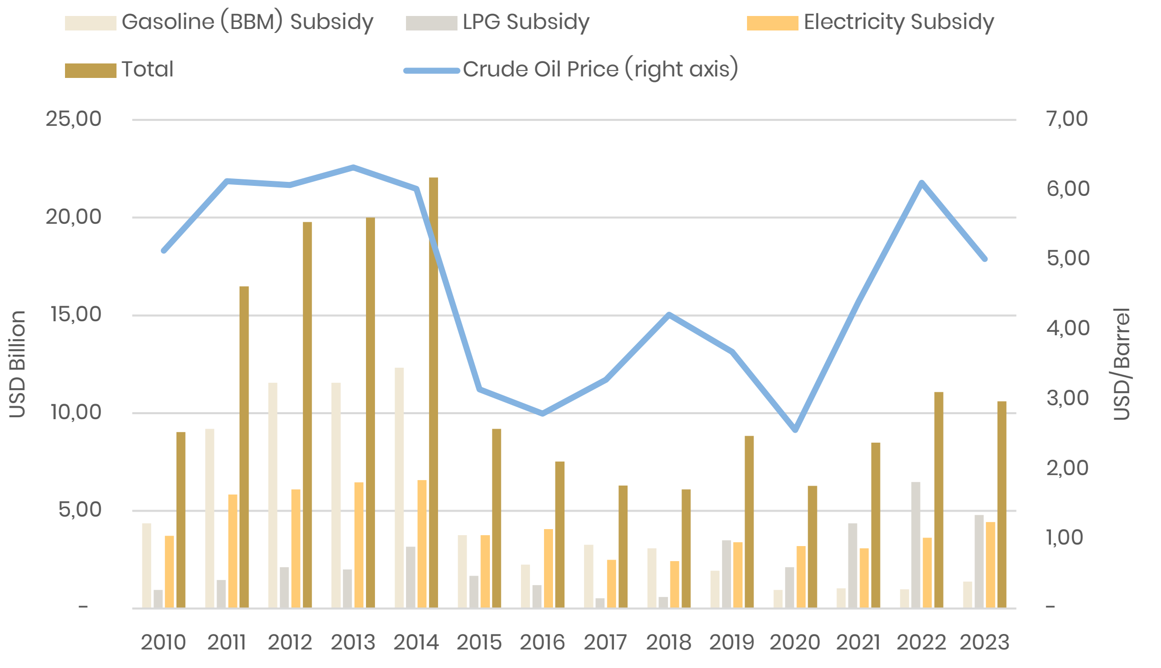
Despite the slight slowing effect of energy subsidies on Indonesia's transition away from fossil fuels, the country is making strides toward decarbonization through carbon pricing policies, with a focus on the carbon tax and Emission Trading System (ETS). In July 2022, Indonesia introduced an emissions-based carbon tax for coal-fired power plants, imposing a rate of IDR 30 per ton of CO_2 equivalent (tCO_2e) for emissions above a designated cap. To support ETS development, the Financial Services Authority (OJK) launched IDXCarbon on the Indonesian Stock Exchange. However, both the carbon tax and ETS face significant implementation challenges. Detailed regulations for carbon tax enforcement have yet to be issued, stalling its progress. ETS implementation, limited so far to the power generation subsector, also encounters multiple systemic and infrastructural barriers. These challenges include the absence of a comprehensive carbon trading roadmap, insufficient collaboration among ministries and between public and private sectors, and infrastructure gaps such as limited innovation, inadequate industry recognition through carbon exchange and green taxonomy, restricted access to information and training on the carbon market, insufficient facilitation for industry engagement, limitations in the SRN-PPI national registry, and a lack of incentives for current and potential market participants (IBC, 2023).

2.3. Fueling the nation: Indonesia's energy subsidy landscape

2.3.1. The Financial Tug-of-War between Energy Subsidies and Crude Oil Prices

Figure 2.1 displays the relationship between Indonesia's energy subsidies (broken down into gasoline (BBM), LPG, and electricity) and global crude oil prices from 2010 to 2023. The primary y-axis (left) shows the subsidy values in Indonesian Rupiah (IDR) trillion, while the secondary y-axis (right) represents the crude oil price in USD per barrel. This visual illustrates how changes in global crude oil prices impact Indonesia's total subsidy expenditures, particularly for gasoline, LPG, and electricity.

Figure 2.4. Energy Subsidy Expenditures by Type and Crude Oil Price Trend



Source: Indonesian State Budget

From 2010 to 2014, Indonesia experienced high crude oil prices, which ranged from about $80 to over $100 per barrel. Correspondingly, during this period, Indonesia's total energy subsidies were also at their peak, reaching IDR 300 trillion in 2013 and 2014. The high subsidies were largely driven by gasoline, which consistently represented a significant portion of the subsidy expenditure. This alignment suggests that the government maintained substantial subsidies to shield consumers from high global oil prices. High oil prices increase the cost of gasoline and LPG, and the government's subsidies during these years were essential to maintain affordability for the population. According to the International Monetary

Fund (IMF, 2014), many developing countries, including Indonesia, resorted to high energy subsidies during this period to stabilize their economies amid volatile oil prices.

In 2015, however, there was a noticeable decline in crude oil prices, which dropped below $50 per barrel. This drop coincides with a sharp reduction in Indonesia's total energy subsidies, which fell from IDR 300 trillion in 2014 to about IDR 150 trillion in 2015. This reduction in subsidies was also influenced by Indonesia's policy shift toward subsidy reform. In 2015, Indonesia began reducing subsidies for gasoline and diesel, moving from a fixed subsidy model to a managed price system that adjusts according to global prices (World Bank, 2015). This policy change marked a significant step towards fiscal sustainability and reflected Indonesia's attempt to reduce the burden of energy subsidies on the national budget.

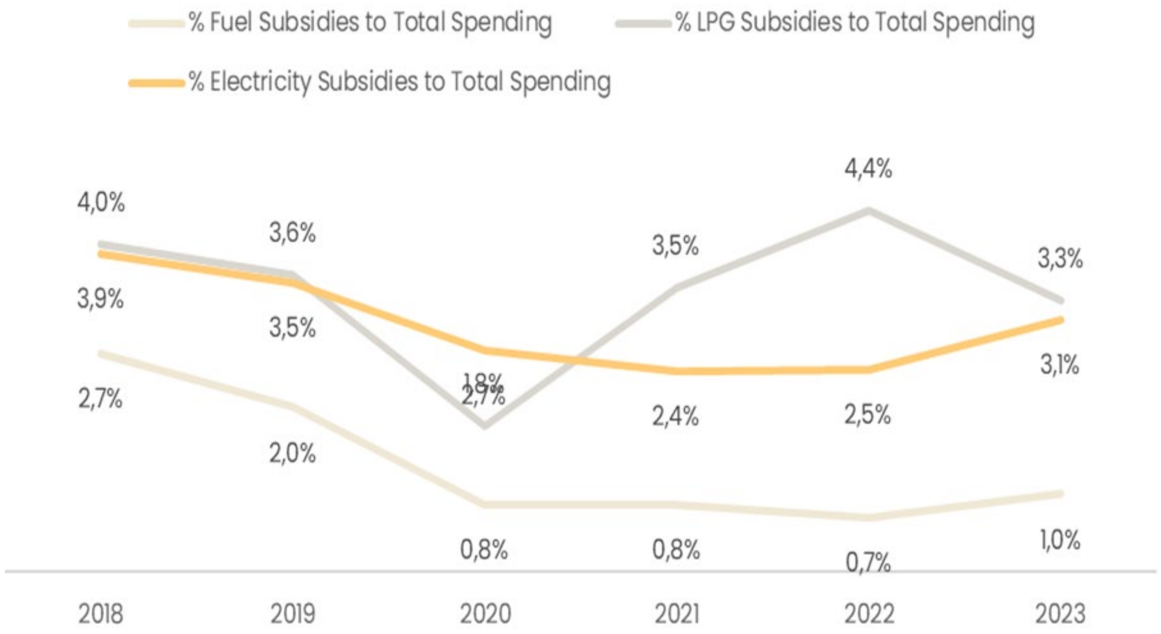
Between 2016 and 2020, crude oil prices remained relatively low, fluctuating between $40 and $70 per barrel. During this period, Indonesia's total energy subsidies stabilized at a lower level, ranging from approximately IDR 100 trillion to IDR 150 trillion annually. Although the government continued to subsidize LPG and electricity, the reduction in gasoline subsidies allowed for a more sustainable allocation of resources. Electricity subsidies remained relatively steady, indicating a continued commitment to making electricity affordable for lower-income households, particularly in rural and remote areas. The Asian Development Bank (ADB, 2020) notes that electricity subsidies are essential in Indonesia to ensure energy access for all citizens, especially given the geographical challenges posed by Indonesia's archipelagic structure.

The year 2021 marked the beginning of a new trend as crude oil prices started to climb again, reaching over $70 per barrel by the end of the year and further spiking to over $100 per barrel in 2022. This increase in oil prices is mirrored by a rise in Indonesia's total subsidy expenditures, which approached IDR 250 trillion in 2022. The government responded to the surge in global oil prices by reinstating or increasing fuel subsidies to mitigate the impact on households and businesses. This return to higher subsidy levels highlights Indonesia's continued reliance on subsidies as a tool to manage energy affordability during periods of global price volatility (International Energy Agency, 2022).

By 2023, although crude oil prices showed some decline, dropping below $80 per barrel, Indonesia's total subsidy expenditure remained elevated, at around IDR 200 trillion. This suggests that the government maintained significant support for energy subsidies, likely due to inflationary pressures and the socioeconomic impact of the COVID-19 pandemic, which left many households vulnerable to energy price increases. The allocation among gasoline, LPG, and electricity subsidies remains relatively balanced, reflecting a diversified approach to energy support. According to the Ministry of Finance, the sustained subsidy levels in recent years are part of Indonesia's broader strategy to stabilize prices and support economic recovery, especially in light of recent global and domestic economic challenges (Ministry of Finance, Indonesia, 2023).

While in terms of realization, the Figure 2.2 shows the percentage of Indonesia's total government spending allocated to three types of energy subsidies—fuel, LPG, and electricity—between 2018 and 2023. This visualization offers insights into the government's shifting priorities and responses to global and domestic economic conditions over the years.

Figure 2.5. Realized Energy Subsidies as a Percentage of Total Government Spending



Source: Indonesian State Budget

In 2018, fuel subsidies constituted approximately 2.7% of total government spending, while LPG and electricity subsidies accounted for 4.0% and 3.9% of total spending, respectively. This substantial allocation reflects Indonesia's reliance on energy subsidies to maintain energy affordability, given the fluctuating global oil prices at the time. The high allocation for LPG and electricity subsidies, in particular, underscores the government's focus on supporting household energy costs, as LPG is primarily used for cooking and electricity access remains critical for both urban and rural households. According to the Asian Development Bank (2019), these subsidies play a vital role in shielding low-income households from energy price volatility, thus contributing to social stability.

In 2019, all three subsidy allocations saw a reduction, with fuel subsidies dropping to 2.0% of total spending, LPG subsidies declining to 3.6%, and electricity subsidies to 3.5%. This decrease is likely due to the Indonesian government's ongoing subsidy reforms, which aim to make subsidies more targeted and reduce fiscal pressure. By gradually lowering the subsidy levels, the government sought to encourage more efficient energy consumption among consumers. Furthermore, global oil prices were relatively stable in 2019, reducing the need for substantial fuel subsidies. As reported by the World Bank (2020), Indonesia has been incrementally reforming its subsidy policy to enhance fiscal sustainability and encourage investment in cleaner energy sources.

In 2020, the impact of the COVID-19 pandemic resulted in further decreases in subsidy allocations, with fuel subsidies dropping sharply to 0.8% of total spending, LPG subsidies to 2.7%, and electricity subsidies to 1.8%. This substantial reduction aligns with the pandemic's economic disruptions, which affected both demand and government revenues. With lower global oil prices due to reduced demand, the government had an opportunity to reduce fuel subsidies significantly. Additionally, resources were likely redirected towards other critical areas, such as healthcare and economic recovery measures. The International Monetary Fund (IMF, 2021) noted that many governments in developing countries, including Indonesia, had to reallocate funds during the pandemic to address immediate public health and economic challenges, resulting in reduced budget shares for energy subsidies.

By 2021, while the percentages allocated to fuel and LPG subsidies remained low at 0.8% and 3.5% respectively, electricity subsidies increased slightly to 2.4% of total spending. This increase suggests a targeted approach to support household electricity access as the country continued to recover from the pandemic. The government maintained its cautious approach to fuel subsidies, likely due to global oil prices remaining relatively low and the ongoing focus on budget optimization. However, maintaining a higher share for electricity subsidies indicates the government's recognition of the need for accessible and affordable electricity as households faced economic hardships post-pandemic.

In 2022, a significant shift occurred with global energy prices surging due to geopolitical tensions and supply chain disruptions. The percentage of spending on LPG subsidies rose sharply to 4.4%, while electricity subsidies increased to 2.5%. Fuel subsidies, although still low, rose slightly to 0.7%. The government's increased allocation to LPG and electricity subsidies reflects its commitment to alleviating the financial burden on households facing rising living costs amid global inflationary pressures. LPG, being a primary cooking fuel, is essential for household energy security, especially for lower-income families. The heightened subsidy allocation for LPG and electricity shows the government's prioritization of essential household needs over fuel, which may be seen as a discretionary expense for some households. According to the Ministry of Finance, Indonesia's policy response in 2022 included an emphasis on social protection and price stabilization measures to support vulnerable communities (Ministry of Finance, Indonesia, 2023).

In 2023, the percentages allocated to LPG and electricity subsidies showed a slight reduction to 3.3% and 3.1% of total spending, respectively, while fuel subsidies rose marginally to 1.0%. This decrease in LPG and electricity subsidies, compared to the previous year, may indicate the government's intention to gradually return to pre-crisis subsidy levels as global energy prices stabilize. However, the sustained higher percentage for electricity and LPG subsidies compared to fuel suggests a continued focus on supporting basic household energy needs. The slight increase in fuel subsidies to 1.0% reflects a cautious approach, possibly as a hedge against potential fluctuations in global oil prices. The World Bank (2023) highlights that Indonesia's energy subsidy policy remains adaptive, with allocations adjusted to balance fiscal sustainability with social welfare needs.

2.3.2. Energy Subsidies for Households in Indonesia: Policy, Regulatory Frameworks, and Timelines

Energy subsidies are a fundamental aspect of Indonesia's strategy to ensure affordable access to essential energy sources for households, especially those in lower-income brackets. These subsidies cover three main areas: fuel, liquefied petroleum gas (LPG), and electricity, each serving a specific purpose to alleviate household expenses, enhance social equity, and support economic stability. The Indonesian government has introduced various regulatory frameworks and timelines to guide these subsidies, balancing between immediate support for vulnerable populations and long-term sustainability.

Fuel Subsidy for Households

Fuel subsidies have been a cornerstone of Indonesia's energy policy for decades, primarily covering Pertalite (gasoline), Solar (diesel fuel), and *minyak tanah* (kerosene). These subsidies ensure stable prices for fuel products that are critical for household transportation, small businesses, and cooking in rural areas. Over the years, Indonesia's fuel subsidy policies have evolved in response to economic and political factors. The primary regulatory framework governing fuel subsidies was introduced through Presidential Regulation No. 191/2014, which provides guidelines on the supply, distribution, and pricing of fuel types eligible for subsidies. This regulation defines fuel subsidies for particular types of fuel used by households, small businesses, and the transportation sector.

In response to economic pressures from global oil price increases, the Indonesian government has periodically adjusted its subsidy policies. In 2022, despite surging international oil prices, the government made the strategic decision not to raise subsidized fuel prices. This decision, influenced by inflation control and social stability concerns, was backed by an increased allocation for fuel subsidies in the national budget. The government's commitment to fuel subsidies, even in times of high fiscal strain, reflects the priority it places on shielding households from economic shocks. However, the fuel subsidy system remains a significant budgetary expense, and discussions on further reforms continue as Indonesia seeks to balance affordability with fiscal responsibility.

LPG Subsidy for Households

The LPG subsidy for households, particularly for the 3-kilogram cylinders used in cooking, is part of a larger energy transition strategy. In 2007, the Indonesian government launched the Kerosene-to-LPG Conversion Program under Presidential Regulation No. 104/2007, which aimed to shift household cooking fuel from kerosene to LPG. This conversion not only reduced government spending on kerosene subsidies but also promoted cleaner cooking options with lower emissions. Through this program, low-income households receive subsidized LPG to replace kerosene, which is more polluting and less efficient.

In recent years, the government has made efforts to improve the targeting of LPG subsidies, as only low-income households are intended to benefit from the subsidized 3-kilogram LPG canisters. These targeting efforts were reinforced in 2018 with the issuance of Minister of Energy and Mineral Resources Regulation No. 26/2018, which outlines measures to restrict LPG subsidies to verified low-income households. Despite these efforts, there remain challenges in accurately reaching target households, particularly in remote and underserved areas where LPG distribution is less reliable. The World Bank has observed that LPG subsidies contribute significantly to reducing household energy costs, but notes that improvements in subsidy targeting would enhance the policy's effectiveness and fiscal sustainability.

Electricity Subsidy for Households

Electricity subsidies are designed to make electricity affordable for lower-income households and reduce energy poverty. These subsidies are regulated under Law No. 30/2007 on Energy, which mandates government support for electricity affordability and access. Additionally, Presidential Regulation No. 39/2014 on Government Assistance for Electricity for Poor Households formalized the subsidy structure for eligible households. This regulation sets consumption thresholds based on income levels and region, allowing only households with limited electricity consumption to receive subsidized rates.

In 2017, the government introduced a new targeting framework under Minister of Energy and Mineral Resources Regulation No. 31/2017 to improve subsidy efficiency. This regulation linked electricity subsidies to the integrated social welfare database (*Data Terpadu Kesejahteraan Sosial* or DTKS), enabling better identification of low-income households that qualify for subsidies. This data-driven approach was implemented as part of a larger government effort to ensure that subsidies benefit only the most vulnerable populations, reducing fiscal strain while supporting social equity goals. The *Asian Development Bank* (ADB) has highlighted that these targeted electricity subsidies contribute to economic stability, allowing low-income families to allocate more resources toward essential needs like food and healthcare.

Timeline of Subsidy Reforms and Policy Adjustments

Indonesia's energy subsidy policies have undergone significant changes over time, shaped by both domestic needs and global economic conditions. Key milestones in the development of these policies include:

- 2007: Launch of the Kerosene-to-LPG Conversion Program, introducing subsidized LPG to replace kerosene for household cooking.
- 2014: Issuance of Presidential Regulation No. 191/2014, which set clear guidelines for fuel subsidies, and Presidential Regulation No. 39/2014, which structured electricity subsidies for low-income households.
- 2017: Implementation of Minister of Energy and Mineral Resources Regulation No. 31/2017, introducing data-based targeting for electricity subsidies through the DTKS social welfare database.

- 2018: Reinforcement of targeted LPG subsidies with Minister of Energy and Mineral Resources Regulation No. 26/2018, aiming to restrict subsidized LPG access to low-income households.
- 2022: Government decision to increase subsidy allocations for fuel, electricity, and LPG in response to global price spikes, without raising domestic prices for consumers.

While these energy subsidies remain vital for social and economic stability, they also present fiscal and environmental challenges. The high cost of subsidies strains the national budget, particularly during periods of rising global energy prices, as seen in recent years. Furthermore, these subsidies can lead to overconsumption and discourage energy conservation, which is counterproductive to Indonesia's climate goals. The artificially low cost of gasoline, for example, has driven national consumption above the global average, increasing emissions and exacerbating urban air pollution.

To address these challenges, the Indonesian government is actively pursuing subsidy reforms aimed at improving targeting mechanisms, reducing fiscal burdens, and supporting environmental goals. One approach under consideration is a gradual shift toward targeted cash transfers or digital voucher systems, which would allow subsidies to reach only the intended low-income households. Additionally, the government is exploring ways to phase out broad subsidies in favor of more sustainable, targeted assistance. These reforms are essential as Indonesia seeks to fulfil its commitment to a just transition, balancing economic support for vulnerable populations with fiscal and environmental sustainability.

Redistributive actions (BLT BBM)

Over the years, the Indonesian government has faced challenges in managing the fiscal and social impacts of rising global fuel prices, which have driven up domestic fuel costs and placed significant pressure on the national subsidy budget. In response, the government has gradually implemented measures aimed at both reducing fuel subsidies and cushioning vulnerable populations from the negative economic effects of these changes. One key strategy has been the introduction and scaling of direct cash assistance (*Bantuan Langsung Tunai*/BLT), which provides targeted support to lower-income households. This approach has allowed the government to control fuel subsidies while providing financial relief to the most affected populations, thereby balancing fiscal sustainability with social welfare.

The first major wave of BLT was introduced in 2005 in response to a drastic reduction in fuel subsidies, which was necessitated by rising global oil prices that threatened Indonesia's fiscal stability. The BLT program was designed as a temporary compensation mechanism to mitigate the impact of the fuel subsidy cuts on low-income households. Each recipient received a predetermined amount of cash, distributed over several months, to offset the increased costs of essential goods and services due to higher fuel prices. This initial program laid the foundation for future direct cash assistance initiatives, demonstrating the effectiveness of targeted support in reducing the adverse effects of subsidy reduction on vulnerable populations.

In 2008, Indonesia faced another round of fuel price hikes as a result of the global financial crisis, which disrupted oil supplies and led to higher fuel prices globally. The government responded by expanding the BLT program to reach a broader segment of the population, especially those at risk of falling into poverty due to rising living costs. According to a study by World Bank (2012), this expanded BLT program successfully alleviated immediate economic pressures on low-income households, helping to stabilize household consumption during a period of economic volatility. The 2008 BLT program served as a crucial intervention, demonstrating the government's commitment to protecting social stability through targeted financial support during periods of economic strain.

In 2013, as part of a larger fuel subsidy reform effort, the Indonesian government again adjusted domestic fuel prices and reintroduced BLT as a compensatory measure. This subsidy reduction aimed to reallocate funds towards infrastructure, health, and education, areas considered more productive for long-term economic growth. By providing direct cash assistance to low-income households, the government sought to address immediate economic hardships while pursuing a more sustainable fiscal policy. Academic research by Beaton and Lontoh (2013) highlights that direct cash transfers such as BLT are effective in targeting subsidies to the populations most affected by fuel price adjustments, thereby mitigating social backlash and helping to foster acceptance of subsidy reform.

The COVID-19 pandemic in 2020 brought new economic challenges, with sharp declines in economic activity and disruptions in global oil prices. In response, the government provided additional social protection measures, including BLT and other direct cash transfers, to support households facing income loss and rising costs of living. The BLT distributed during the pandemic was part of the larger Program Bantuan Sosial Tunai (BST) and was intended to provide immediate economic relief to those most affected by the pandemic, including informal workers and low-income families. According to Sumarto and Bazzi (2020), the use of BLT during this period helped stabilize household consumption and provided a safety net for millions of Indonesians impacted by the economic downturn.

In September 2022, faced with a global surge in energy prices following geopolitical tensions and supply chain disruptions, the Indonesian government raised domestic fuel prices by approximately 30%. To mitigate the adverse effects of this price hike on low-income households, the government launched a new wave of BLT, targeting 20.65 million low-income households (Ministry of Finance, Indonesia, 2022). This BLT program allocated around IDR 12.4 trillion, providing each recipient household with monthly payments to cushion the immediate effects of higher transportation and commodity costs. This approach allowed the government to redirect funds from fuel subsidies to targeted cash assistance, thereby controlling the fiscal impact while addressing social welfare needs.

This most recent BLT program was part of a broader set of measures, which also included wage subsidies for 16 million workers earning below IDR 3.5 million per month and additional funding for regional governments to stabilize local economic conditions. According to a policy brief by the Asian Development Bank (ADB, 2022), this layered approach reflects Indonesia's strategy to balance short-term social protection with long-term fiscal goals, allowing for a gradual reduction in fuel subsidies without causing widespread economic distress.

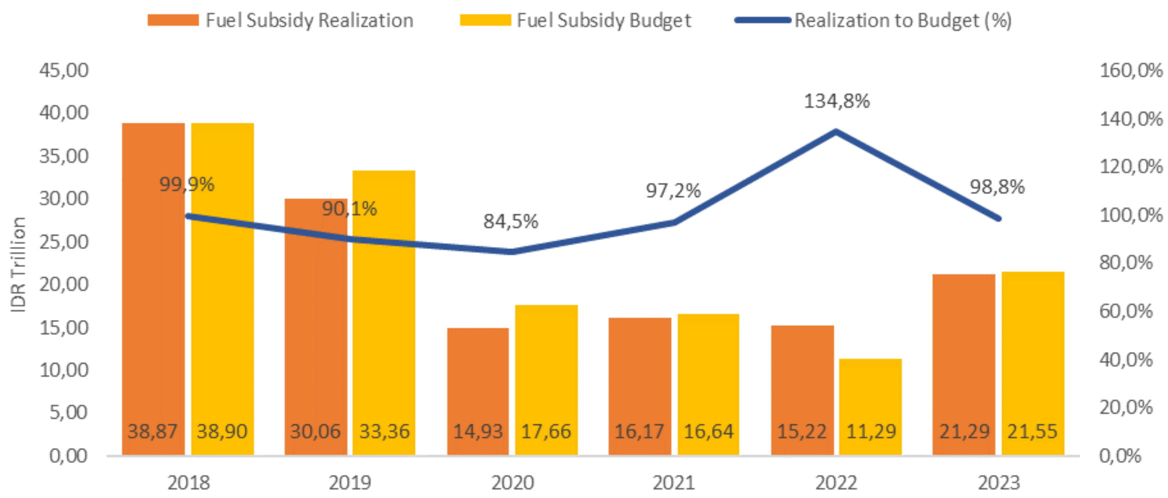
The BLT programs implemented over the years demonstrate a shift in Indonesia's subsidy policy, from broad-based fuel subsidies to more targeted financial support for those most affected by price increases. Research indicates that BLT has been effective in protecting household consumption and reducing poverty levels during periods of fuel price adjustments (Hastuti et al., 2021). However, challenges remain in accurately targeting beneficiaries, particularly in remote and underserved areas, and ensuring that BLT funds are distributed efficiently and transparently.

2.3.3. Data Insights and Analysis of Energy Subsidies for Households in Indonesia

Fuel Subsidy

Figure 2.3 depicts Indonesia's fuel subsidy expenditures, comparing the "Fuel Subsidy Realization" (actual spending) to the "Fuel Subsidy Budget" (planned budget) from 2018 to 2023. Additionally, it presents the percentage of budget realization, showing how actual spending compares to the budgeted amounts each year. This data highlights both the volatility of fuel subsidy spending and the challenges the Indonesian government faces in managing these subsidies amid fluctuating economic conditions, particularly in global oil markets.

Figure 2.6. Fuel Subsidy Realization vs Budget



Source: Indonesian State Budget

In 2018, the actual fuel subsidy spending (IDR 38.87 trillion) closely matched the budget allocation (IDR 38.90 trillion), achieving a 99.9% realization rate. This reflects the government's successful alignment of fuel subsidies with its planned expenditures. In 2019, however, the realization rate dropped to 90.1%, with the actual subsidy amount (IDR 30.06 trillion) below the budgeted amount (IDR 33.36 trillion). This slight underspending may indicate either lower-than-expected fuel costs or efforts to reduce subsidy spending amid fiscal constraints (International Energy Agency, 2021).

The trend continued into 2020, where subsidy realization fell sharply to 84.5%, with IDR 14.93 trillion spent against a budget of IDR 17.66 trillion. This reduced spending is likely linked to the COVID-19 pandemic, which led to decreased fuel demand and lower global oil prices. As the Asian Development Bank (ADB) notes, the pandemic caused a temporary decline in energy consumption globally, reducing the fiscal pressure on fuel subsidies in many countries, including Indonesia (ADB, 2021).

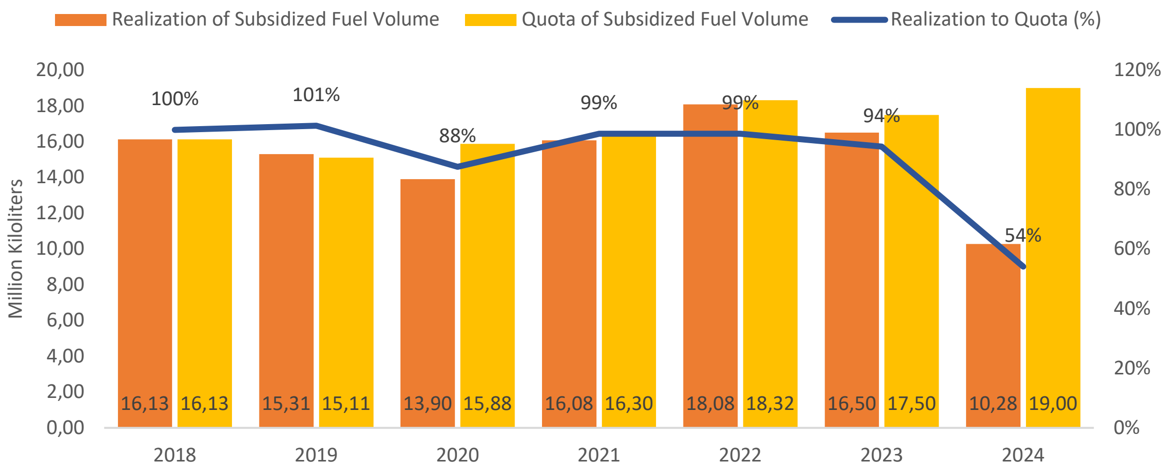
In 2021, fuel subsidy realization improved slightly, reaching 97.2% with IDR 16.17 trillion spent, just below the allocated budget of IDR 16.64 trillion. This near-full realization may suggest a return to pre-pandemic demand levels as economic activities resumed, leading to a more stable alignment between planned and actual subsidy expenditures.

The year 2022, however, marked a significant shift, with actual subsidy spending (IDR 15.22 trillion) far exceeding the budget (IDR 11.29 trillion) and reaching a realization rate of 134.8%. This overrun can be attributed to the global surge in oil prices, which placed unexpected pressure on the government's subsidy budget. With rising crude oil prices driven by geopolitical tensions and supply chain disruptions, many countries faced increased costs for fuel subsidies. Indonesia was no exception, as the government sought to protect consumers from the full brunt of these price hikes by increasing its subsidy spending (World Bank, 2022).

In 2023, the realization rate normalized to 98.8%, with actual spending (IDR 21.29 trillion) closely matching the budget (IDR 21.55 trillion). This alignment reflects the government's adjustment to the global energy market's volatility, suggesting a refined budgeting approach that accounts for recent price trends. The World Bank emphasizes the importance of fiscal resilience in managing energy subsidies, particularly as emerging economies like Indonesia face pressures from global economic fluctuations (World Bank, 2023).

While Figure 2.4 illustrates Indonesia's subsidized fuel volume, comparing the actual consumption against the government-imposed from 2018 to 2024. Additionally, it shows the percentage of realization to quota, highlighting the extent to which the actual consumption aligns with the allocated quota each year. This data sheds light on the government's fuel subsidy management, showing how actual consumption fluctuates in response to economic changes, policy adjustments, and subsidy availability.

Figure 2.7. Fuel Subsidy Volume Realization vs Quota



Source: Indonesian State Budget

In 2018, both the quota and the realized volume were equal at 16.13 million kiloliters, achieving 100% realization. This perfect alignment suggests effective management, where the actual subsidized fuel demand matched the government's budget allocation. In 2019, the realization slightly exceeded the quota by about 1% (15.31 million kiloliters realized against a quota of 15.11 million kiloliters), likely indicating an increased demand due to economic growth or limited enforcement of quota restrictions (International Energy Agency, 2021).

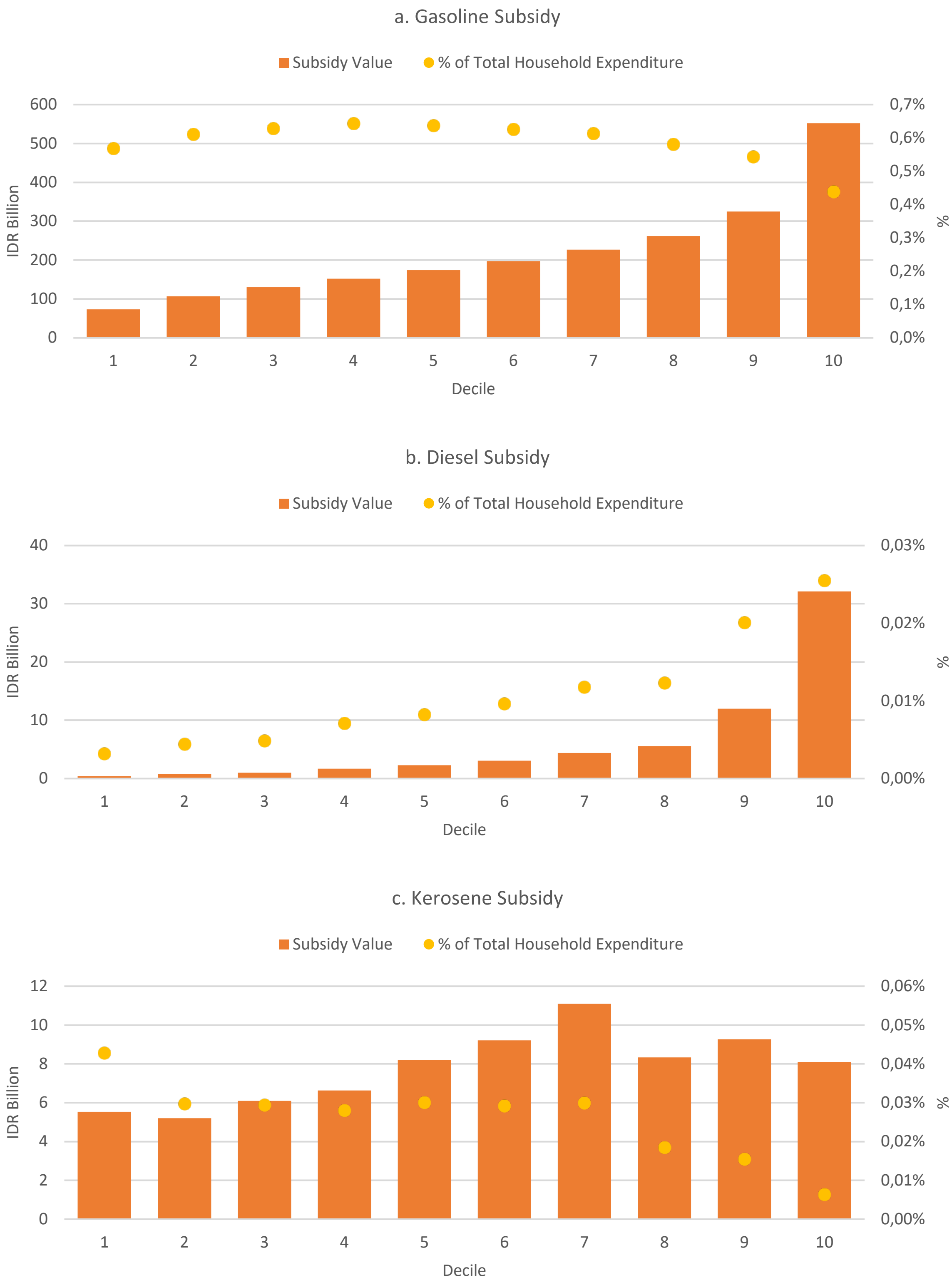
A more significant variance appeared in 2020, where realization fell to 88% of the quota, with only 13.90 million kiloliters consumed out of an allocated 15.88 million kiloliters. This decline is likely attributable to the COVID-19 pandemic, which reduced fuel demand globally due to lockdowns and decreased economic activity (Asian Development Bank, 2021). With reduced mobility and industrial activity, the lower fuel consumption aligned with broader energy trends observed during the pandemic period.

In 2021 and 2022, consumption levels returned to pre-pandemic figures, with realization rates close to or just below 100%. Specifically, in 2021, the realization rate was 99%, with actual consumption of 16.08 million kiloliters compared to a quota of 16.30 million kiloliters. This close alignment continued in 2022, where realization was also 99% (18.08 million kiloliters realized out of an 18.32 million kiloliters quota). These years marked a recovery in fuel demand as economic activities resumed, with the government's quotas closely matching the needs of the recovering economy (World Bank, 2022).

The year 2023 showed a slight drop in realization at 94%, with 17.50 million kiloliters consumed out of an allocated 18.50 million kiloliters. This reduction might reflect government measures to contain fuel consumption amid fiscal concerns or potential price adjustments aimed at encouraging more efficient fuel use. However, the situation drastically changes in 2024, where realization drops significantly to just 54%, with 10.28 million kiloliters consumed against a quota of 19.00 million kiloliters. This steep decline could indicate a policy shift or stricter enforcement of fuel quotas to control subsidy costs or address environmental targets by limiting fossil fuel consumption (OECD, 2023).

On the other hand, figures below showcase the distributional impact of three types of fuel subsidies—gasoline, diesel, and kerosene—across different income deciles of households in Indonesia. Each chart presents two metrics: the total value of subsidies received by each decile (in billion Rupiah, shown in blue bars) and the proportion of each decile's total household expenditure accounted for by these subsidies (represented by orange dots as a percentage). These figures illustrate that gasoline and diesel subsidies are skewed towards wealthier households in terms of total subsidy value received, highlighting a regressive distribution of benefits that favors higher-income groups. This trend aligns with findings in subsidy studies, which show that universal fuel subsidies often disproportionately benefit wealthier households due to their higher consumption levels (International Monetary Fund, 2013). Kerosene subsidies, however, appear to be more equitably distributed, benefiting lower-income households proportionately more.

Figure 2.8. Distribution of Fuel Subsidy Value and Its Share of Total Household Expenditure by Decile, 2023



Source: SUSENAS (2023)

In the gasoline subsidy chart, subsidy benefits increase significantly with income, as shown by the much higher subsidy values received by the top income deciles. The highest income decile (10th decile) receives the largest share of gasoline subsidies, exceeding IDR 500 billion. This trend indicates that wealthier households benefit more from gasoline subsidies, likely due to higher vehicle ownership and gasoline consumption, a trend commonly observed in fuel subsidy distributions in developing economies (World Bank, 2022). However, when considering the percentage of total household expenditure, gasoline subsidies make up a relatively small fraction across all deciles, indicating that while wealthier households receive larger absolute subsidies, they do not depend on these subsidies as a major portion of their expenses.

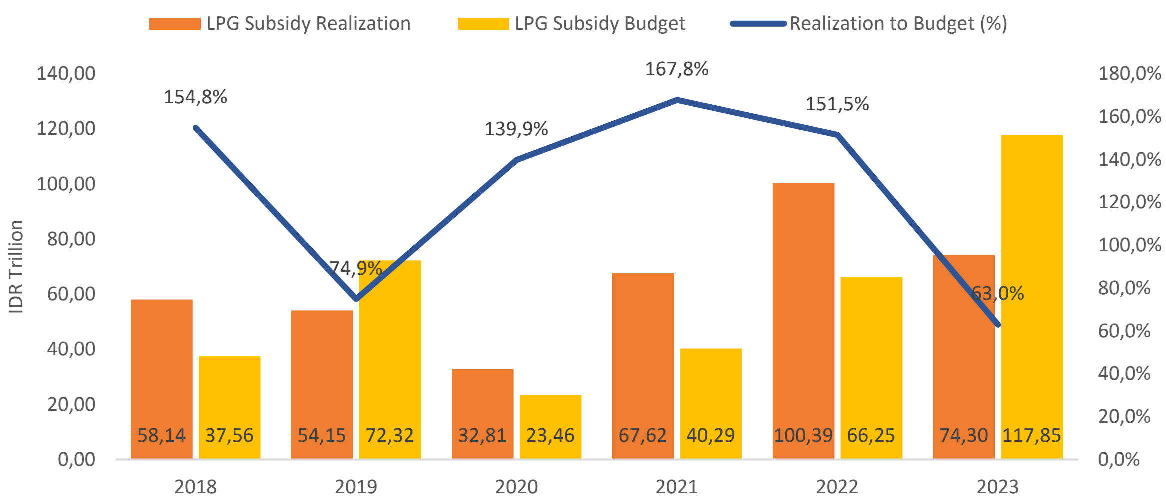
The diesel subsidy chart follows a similar pattern, where the subsidy values increase with income. The top income decile receives significantly more in subsidies than the lower deciles, with nearly IDR 30 billion allocated to the 10th decile. The percentage of total household expenditure attributed to diesel subsidies remains low across all deciles, suggesting that diesel subsidies benefit wealthier households more in absolute terms. This pattern likely reflects the fact that diesel is commonly used by businesses and higher-income households for transportation and industrial purposes (International Energy Agency, 2021). Consequently, diesel subsidies may not reach lower-income households effectively, raising questions about their equity and efficiency.

Unlike gasoline and diesel, the distribution of kerosene subsidies is more evenly spread across income deciles, with relatively less disparity between the lowest and highest deciles. Deciles 1 through 7 receive similar amounts, ranging from IDR 6 to 8 billion, while the top deciles (9 and 10) receive slightly less. This pattern suggests that kerosene subsidies are better targeted toward lower-income households, which traditionally use kerosene for cooking and heating. The proportion of kerosene subsidies in total household expenditure is also relatively higher in the lower deciles, implying that kerosene subsidies play a more substantial role in supporting household expenses for lower-income groups (Asian Development Bank, 2021).

LPG Subsidy

Next, the Figure 2.6 illustrates the budgeted versus actual expenditures (realization) for Indonesia's liquefied petroleum gas (LPG) subsidies from 2018 to 2023, as well as the realization-to-budget ratio (in percentage terms). This data highlights the fluctuations in LPG subsidy management in response to changing economic conditions and demand.

Figure 2.9. LPG Subsidy Realization vs Budget



Source: Indonesian State Budget

In 2018, the actual LPG subsidy spending was significantly higher than budgeted, with a realization of IDR 58.14 trillion compared to the allocated budget of IDR 37.56 trillion, resulting in a realization-to-budget rate of 154.8%. This substantial overrun suggests either an underestimation of the initial budget or an unexpected surge in LPG demand, potentially due to economic pressures or policy adjustments aimed at increasing household access to affordable cooking fuel (World Bank, 2022).

In 2019, the budget for LPG subsidies increased to IDR 72.32 trillion, reflecting a more accurate alignment with the prior year's demand. However, the actual expenditure was IDR 54.15 trillion, yielding a realization rate of only 74.9%. This lower-than-expected spending might indicate improved subsidy targeting or reduced demand as economic conditions stabilized. According to the Asian Development Bank (2021), underutilization of subsidies could also result from the government's efforts to manage fiscal pressures by tightening eligibility or promoting more efficient LPG use among households.

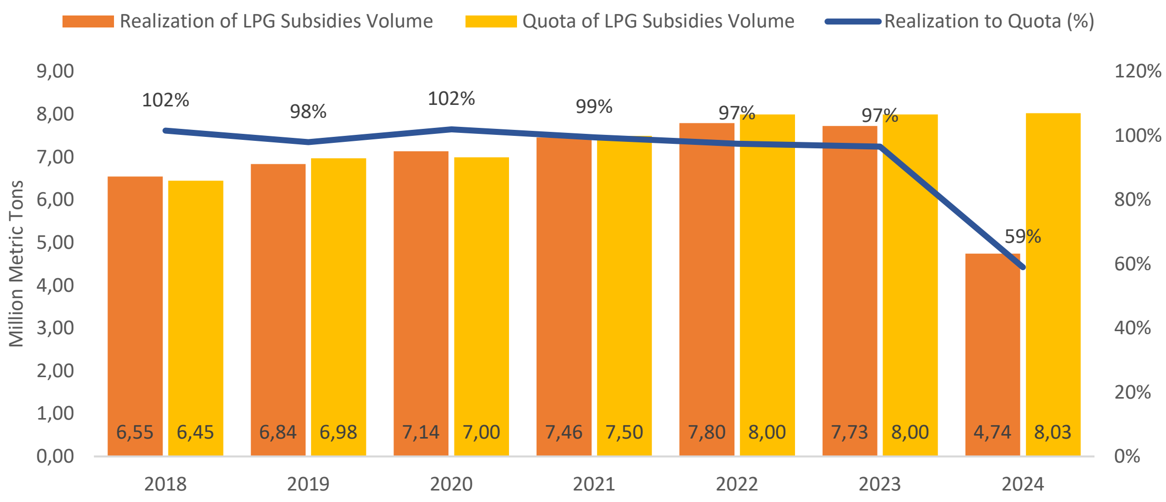
The impact of the COVID-19 pandemic is evident in the 2020 figures, where the budget and actual realization dropped sharply, with actual spending at IDR 32.81 trillion against a budget of IDR 23.46 trillion, achieving a high realization-to-budget rate of 139.9%. This increase in the realization percentage, despite the reduced absolute spending, likely reflects heightened LPG demand as households relied more on cooking at home during lockdowns, while also revealing budget constraints during the pandemic (International Energy Agency, 2021).

In 2021 and 2022, LPG subsidy spending increased significantly. In 2021, the actual realization (IDR 67.62 trillion) exceeded the budget of IDR 40.29 trillion, reaching a 167.8% realization-to-budget rate, which may indicate a sustained rise in domestic LPG consumption. By 2022, the subsidy increased further, with actual expenditures reaching IDR 100.39 trillion against a budget of IDR 66.25 trillion, resulting in a realization rate of 151.5%. These increases are likely due to rising international energy prices, which put pressure on the Indonesian government to support domestic LPG costs to mitigate the impact on households. The World Bank (2022) notes that such measures are common as governments try to cushion the economic impact of global price spikes on lower-income households.

In 2023, the budget for LPG subsidies surged dramatically to IDR 117.85 trillion, yet the actual spending was slightly lower at IDR 74.30 trillion, with a realization rate of 63.0%. This drop in realization suggests that the government either overestimated the subsidy needs or successfully implemented measures to contain consumption, possibly through improved targeting or encouraging alternative energy sources. The drastic increase in budget allocation in 2023 also indicates the government's continued commitment to protecting households from global price fluctuations while potentially preparing for volatility in energy markets (International Monetary Fund, 2023).

While in terms of LPG Subsidy Volume Realization vs Quota, Figure 2.7 illustrates the volume of LPG subsidies in Indonesia, comparing the actual subsidized LPG consumed (realization) against the allocated quota from 2018 to 2024, along with the realization-to-quota ratio in percentage terms. This data provides insight into the alignment between planned LPG subsidy volumes and actual consumption, reflecting the effectiveness of the government's subsidy distribution and the impact of external factors on LPG demand.

Figure 2.10. LPG Subsidy Volume Realization vs Quota



Source: Indonesian State Budget

In 2018, the realization of LPG subsidies slightly exceeded the quota, with 6.55 million metric tons consumed compared to the quota of 6.45 million metric tons, resulting in a realization-to-quota rate of 102%. This overrun suggests a higher demand for subsidized LPG than anticipated, possibly due to the government's efforts to encourage LPG use over other, more polluting fuels. A similar pattern emerged in 2020, where actual consumption (7.14 million metric tons) once again surpassed the quota (7.00 million metric tons), maintaining a realization rate of 102%. According to the International Energy Agency (2021), such trends are common as governments in developing economies work to balance subsidy quotas with growing demand for cleaner energy sources.

In 2019, however, LPG consumption fell slightly below the quota, with a realization rate of 98% (6.84 million metric tons realized versus a quota of 6.98 million metric tons). This slight underconsumption may indicate improved subsidy targeting or temporary reductions in demand, possibly influenced by stabilized economic conditions and consumer behavior adjustments. The Asian Development Bank (2021) highlights that minor fluctuations in subsidy realization rates often reflect the government's attempts to regulate demand and manage budget constraints effectively.

The effects of the COVID-19 pandemic are evident in the 2021 data, where LPG consumption closely aligned with the quota, achieving a 99% realization rate with 7.46 million metric tons consumed out of a 7.50 million metric ton allocation. The pandemic's impact on household behavior, including increased home cooking, likely stabilized LPG demand, as households relied more heavily on subsidized LPG for domestic energy needs (World Bank, 2022).

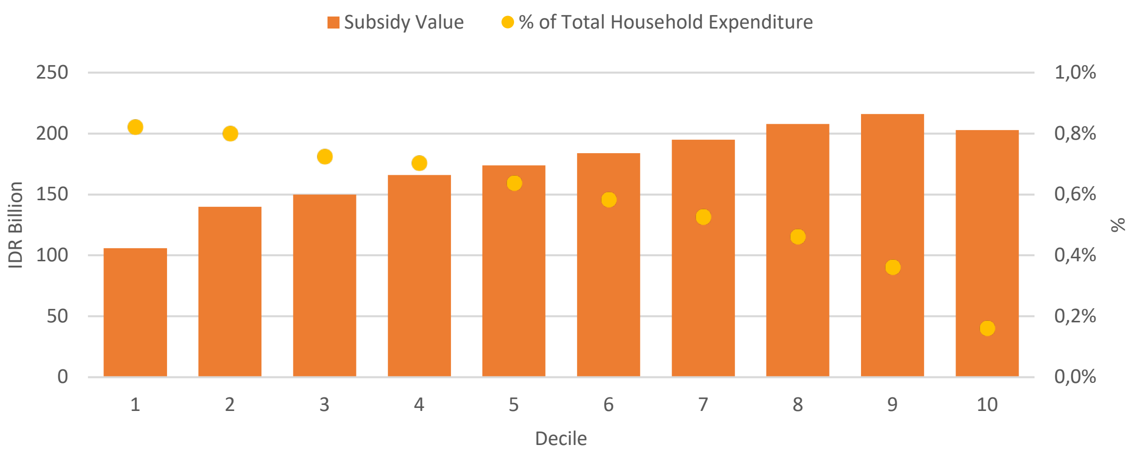
By 2022 and 2023, the government maintained a steady LPG subsidy quota of 8.00 million metric tons. However, actual consumption slightly undershot the quota in both years, with realization rates of 97%. This marginal shortfall suggests that LPG demand was nearing saturation or that the government had implemented more stringent measures to contain subsidy volumes. Rising international LPG prices may have prompted efforts to control domestic consumption, as countries worldwide faced increased energy costs due to global supply chain disruptions (International Monetary Fund, 2023).

A significant change appears in 2024, with a sharp drop in realization to only 4.74 million metric tons against an increased quota of 8.03 million metric tons, resulting in a realization rate of just 59%. This drastic decline could indicate a major policy shift, such as subsidy reduction or increased eligibility restrictions aimed at curbing LPG consumption. It may also reflect government initiatives to promote alternative energy sources or reduce dependency on LPG subsidies to alleviate budgetary pressure.

According to the International Monetary Fund (2023), reducing fossil fuel subsidies can help governments address fiscal constraints while encouraging cleaner energy adoption.

Figure 2.8 provides an analysis of LPG subsidies across different income deciles in Indonesia, showing both the subsidy value (in billion Rupiah, represented by blue bars) and the percentage of total household expenditure attributed to the subsidy (indicated by orange dots). This dual representation offers insights into the distributional impact of LPG subsidies, reflecting both the absolute amount of subsidy received by each income group and its relative significance in household spending.

Figure 2.11. Distribution of LPG Subsidy Value and Its Share of Total Household Expenditure by Decile, 2023



Source: SUSENAS (2023)

The chart reveals a relatively consistent distribution of LPG subsidies across all income deciles. The subsidy values gradually increase from the first decile to the tenth decile, with the higher-income households (deciles 8, 9, and 10) receiving slightly more in absolute terms, around IDR 200 billion each. Lower-income households in the first few deciles receive between IDR 100 billion and IDR 150 billion, which indicates a less pronounced but still progressive distribution of subsidies.

Despite higher-income households receiving more in absolute terms, the proportion of the subsidy in terms of total household expenditure decreases with income. For the lower-income deciles (especially deciles 1 and 2), the LPG subsidy constitutes nearly 1% of total household expenditure. This proportion diminishes as income increases, with the top decile having a subsidy value that makes up only around 0.4% of their expenditure. This pattern underscores the greater relative importance of the LPG subsidy for lower-income households, as it constitutes a more significant portion of their budget. The World Bank (2022) emphasizes that, in low-income households, subsidies for essential items like LPG can substantially reduce household expenses, thereby supporting welfare and consumption stability.

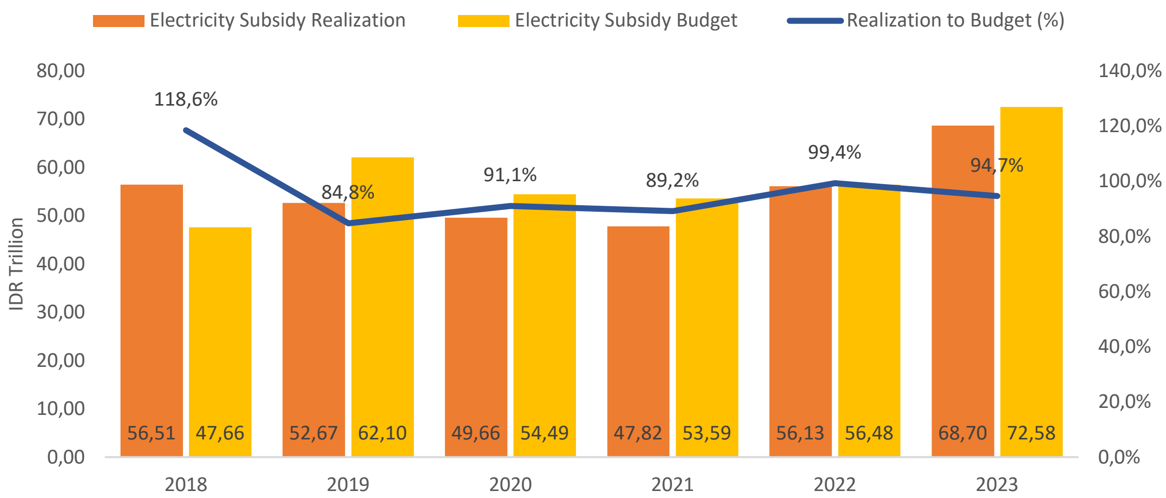
This relatively equitable distribution of LPG subsidies is notable, as LPG is often considered a cleaner and more accessible cooking fuel compared to alternatives like kerosene. By maintaining subsidy support across income levels, the Indonesian government is likely aiming to encourage the adoption of LPG as a primary cooking fuel. However, the slight skew towards higher absolute subsidies for wealthier households could indicate inefficiencies in subsidy targeting, a common issue noted by the International Energy Agency (2021), which reports that universal energy subsidies often benefit wealthier households more in absolute terms due to higher consumption levels.

The regressive nature of the percentage impact (higher percentage of household expenditure in lower-income groups) supports arguments for targeted subsidy reforms. A more focused subsidy scheme could ensure that the most economically vulnerable households gain maximum benefit. Research from the Asian Development Bank (2021) suggests that improving the targeting of LPG subsidies could reduce overall subsidy costs while preserving essential support for low-income families.

Electricity Subsidy

Moving on to the electricity subsidy, the Figure 2.9 provides a comparison between the actual electricity subsidy expenditures (realization) and the allocated budget for electricity subsidies in Indonesia from 2018 to 2023. It also shows the percentage of budget realization, which indicates how closely the actual spending aligns with the government's budgeted figures each year. This data reflects the challenges the Indonesian government faces in managing electricity subsidies amidst fluctuating demand and economic conditions.

Figure 2.12. Electricity Subsidy Realization vs Budget



Source: Indonesian State Budget

In 2018, the actual electricity subsidy realization exceeded the budget by 18.6%, with IDR 56.51 trillion spent against a budget of IDR 47.66 trillion. This overrun could be attributed to unforeseen demand pressures or a lack of accurate demand forecasting. According to the International Energy Agency (2021), developing countries often struggle with subsidy budgeting due to the volatility in electricity demand and prices, which can lead to unanticipated expenditure increases.

In 2019, the actual expenditure was IDR 52.67 trillion, which fell short of the budgeted amount of IDR 62.10 trillion, resulting in an 84.8% realization rate. This under-expenditure could suggest an improvement in subsidy targeting or an overestimated initial budget. Such fluctuations are not uncommon, as the World Bank (2022) notes that governments frequently adjust their subsidy programs to manage fiscal pressures and respond to changing economic conditions.

In 2020, the COVID-19 pandemic affected electricity demand and subsidy needs, as economic activity slowed, and consumption patterns shifted. The subsidy realization rate increased to 91.1%, with IDR 49.66 trillion spent out of a budget of IDR 54.49 trillion. The government's efforts to maintain support for low-income households during the pandemic likely contributed to the high realization rate, as many households became more dependent on subsidized electricity amid economic challenges.

By 2021, the realization rate had slightly declined to 89.2%, with IDR 47.82 trillion in actual spending compared to a budget of IDR 53.59 trillion. This slight reduction in spending could indicate an effort by the government to curb subsidy expenditures, potentially by enhancing targeting mechanisms or encouraging energy efficiency to reduce dependency on subsidized electricity. The Asian

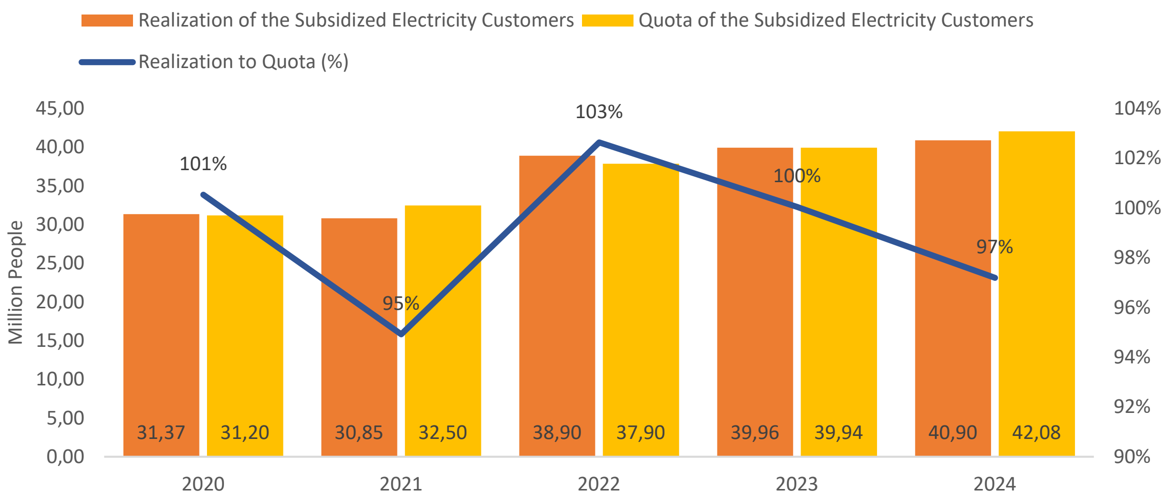
Development Bank (2021) highlights that improving subsidy targeting can help governments balance fiscal responsibility with the goal of supporting vulnerable households.

In 2022, subsidy spending and the budget were closely aligned, with a realization rate of 99.4% (IDR 56.13 trillion realized against a budget of IDR 56.48 trillion). This near-perfect alignment suggests that the government's budgeting for electricity subsidies was highly effective in matching actual demand, possibly due to more accurate forecasting and stabilization in electricity consumption as the economy recovered post-pandemic.

In 2023, both the budget and actual expenditure increased significantly, with IDR 68.70 trillion spent against a budget of IDR 72.58 trillion, yielding a realization rate of 94.7%. This increase could be due to rising energy prices globally or heightened domestic demand as economic growth accelerated. The International Monetary Fund (2023) reports that many emerging economies, including Indonesia, faced increased subsidy pressures due to rising energy costs in global markets. This trend may continue to challenge Indonesia's fiscal management of electricity subsidies in the coming years.

While in units, the Figure 2.10 depicts the number of subsidized electricity customers in Indonesia from 2020 to 2024, comparing the realized number of customers receiving subsidies with the government's quota for each year. Additionally, the chart shows the percentage of realization to quota, which indicates the alignment between the actual number of customers and the targeted quota.

Figure 2.13. Electricity Customers Numbers Realization vs Quota



Source: Indonesian State Budget

In 2020, the number of subsidized electricity customers was 31.37 million, slightly exceeding the quota of 31.20 million, resulting in a realization-to-quota rate of 101%. This indicates that the actual demand for subsidized electricity slightly surpassed the government's expectations, likely reflecting an increase in households requiring support during the early stages of the COVID-19 pandemic. According to the Asian Development Bank (2021), the pandemic led to increased financial strain on households, prompting governments across Asia, including Indonesia, to provide subsidies to a broader population segment.

In 2021, the realization dropped slightly below the quota, with 30.85 million subsidized electricity customers compared to a target of 32.50 million, resulting in a 95% realization rate. This decrease might indicate an improvement in subsidy targeting as the economy gradually stabilized after the initial pandemic shock. The Indonesian government may have tightened eligibility criteria or refined the subsidy mechanism to manage fiscal costs more effectively. The World Bank (2022) notes that many governments reduced broad-based subsidies post-pandemic in favor of more targeted support to better allocate resources to those in need.

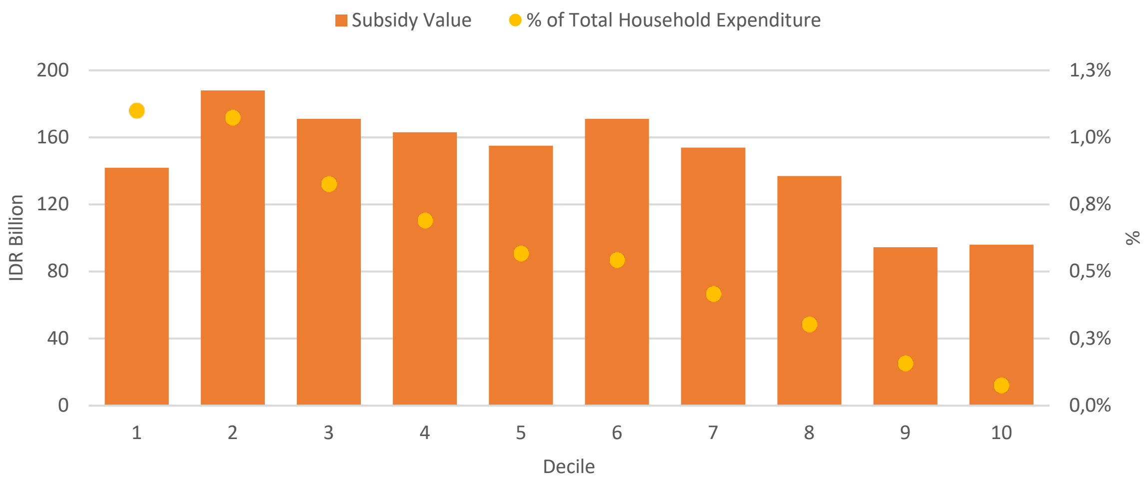
In 2022, the number of subsidized customers increased sharply to 38.90 million, surpassing the quota of 37.90 million, yielding a realization-to-quota rate of 103%. This rise could reflect a response to economic recovery efforts as the government aimed to support a larger population base amid global economic uncertainties and inflationary pressures. The International Energy Agency (2021) highlights that rising energy costs can lead to increased reliance on subsidies, particularly in emerging economies, as households face higher electricity bills and reduced purchasing power.

The realization-to-quota rate stabilized in 2023, reaching exactly 100%, with 39.96 million subsidized customers, matching the quota. This alignment suggests effective demand forecasting and allocation by the government, reflecting a balance between the budgeted target and actual needs. Such accuracy indicates improvements in subsidy planning and targeting mechanisms, potentially supported by data-driven approaches to identify eligible households accurately. According to the International Monetary Fund (2023), aligning subsidy policies with actual demand helps governments optimize resource allocation while maintaining social stability.

In 2024, however, there is a slight shortfall, with the realization rate dropping to 97% (40.90 million customers versus a quota of 42.08 million). This decrease could indicate efforts to gradually phase out subsidies or further refine targeting to ensure that only the most economically vulnerable households benefit from the support. The Indonesian government may be transitioning towards a more sustainable approach to subsidies, possibly in response to fiscal pressures or shifting energy policy priorities. As global energy prices fluctuate, many governments are revisiting subsidy frameworks to manage budget constraints while balancing social welfare goals (World Bank, 2022).

The electricity subsidies across different income deciles in Indonesia is broken down in Figure 2.11, displaying both the subsidy value (in billion Rupiah, represented by blue bars) and the percentage of total household expenditure attributed to the subsidy (shown as orange dots). This data highlights how electricity subsidies are distributed among various income groups and the relative importance of these subsidies for household spending.

Figure 2.14. Distribution of Electricity Subsidy Value and Its Share of Total Household Expenditure by Decile, 2023



Source: SUSENAS (2023)

The chart reveals that lower-income households (especially the first and second deciles) receive substantial benefits from electricity subsidies, with values around IDR 160-180 billion. The subsidy percentage relative to total household expenditure is also notably higher in these deciles, with the first decile reaching nearly 1.2% and the second decile around 1%. This indicates that electricity subsidies play a significant role in reducing the cost burden for low-income households, supporting their access to affordable energy. According to the World Bank (2022), electricity subsidies are crucial for alleviating energy poverty, particularly among low-income households that depend on affordable energy to meet basic needs.

As income levels increase, the subsidy value decreases, and the percentage of household expenditure covered by subsidies diminishes. Middle-income deciles (3 to 7) still receive a substantial portion of subsidy support, but the relative importance in terms of household expenditure begins to taper off. This indicates a shift in the dependency on subsidies as household income rises; while the subsidy amounts remain relatively high, the share of expenditure they cover becomes less significant. The International Energy Agency (2021) notes that universal subsidy programs often lead to middle-income groups receiving similar benefits as lower-income households, which can dilute the subsidy's impact on poverty reduction.

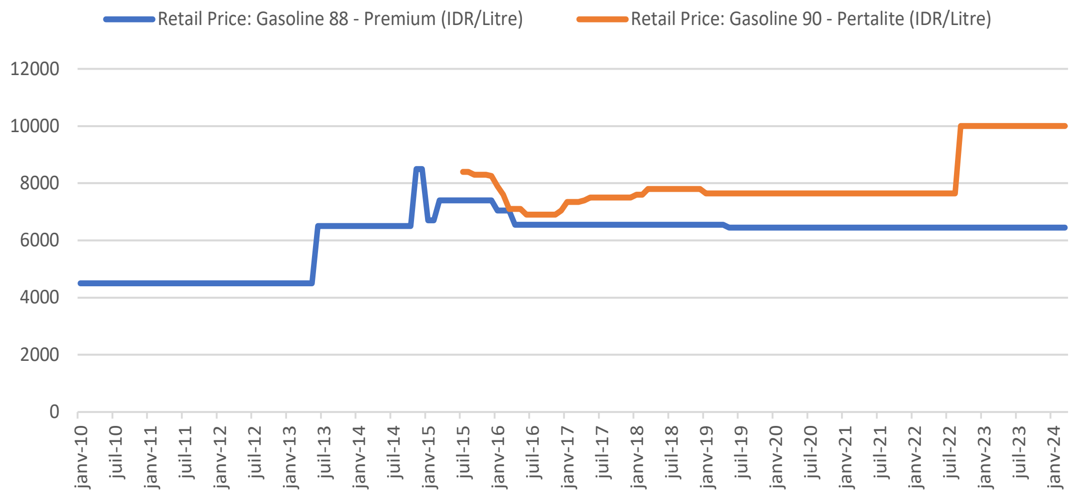
In the highest-income deciles (9 and 10), both the absolute subsidy value and the percentage of total household expenditure covered by subsidies are significantly lower. The 9th and 10th deciles receive around IDR 80-100 billion in subsidy value, with subsidies constituting only 0.3% to 0.4% of their total household expenditure. This pattern indicates that wealthier households benefit less from electricity subsidies, both in absolute and relative terms, as their electricity costs represent a much smaller portion of their overall budget. The Asian Development Bank (2021) suggests that electricity subsidies become less effective in supporting social equity when high-income households also receive benefits, as they have a lower need for financial assistance with energy costs.

The distribution pattern shown in this chart suggests that, while Indonesia's electricity subsidies are somewhat progressive, they may benefit from further refinement to ensure that low-income households receive the maximum possible support. By reducing subsidies for higher-income groups and directing more funds toward vulnerable households, the government could enhance the subsidy program's impact on poverty alleviation and social equity. Targeted subsidy programs have been shown to be more effective in reducing energy poverty without incurring excessive fiscal costs (International Monetary Fund, 2023).

Redistributive actions

The retail price trends of BBM (fuel) in Indonesia, as depicted in the Figure 2.12, show significant increases during key periods, such as 2013, 2014, and 2022. These price hikes correspond to government interventions aimed at protecting the purchasing power of low-income households. For example, in 2013, the retail price of Premium (Gasoline 88) rose sharply, and similar upward trends were observed for Pertalite (Gasoline 90) in later years, particularly in 2022. These increases reflect the economic pressures caused by global fuel price fluctuations and domestic policy adjustments, necessitating redistributive measures to shield the most vulnerable segments of the population.

Figure 2.15. The Retail Price Trends of Gasoline in Indonesia



Source: PT Pertamina

To mitigate the impact of these fuel price hikes, the government implemented targeted cash assistance programs (*Bantuan Langsung Tunai*/BLT), including the Temporary Direct Assistance for Communities (*Bantuan Langsung Sementara Masyarakat*/BLSM) in 2013, the Family Welfare Savings Program (*Program Simpanan Keluarga Sejahtera*/PSKS) in 2014, and the BLT BBM in 2022 (see Table 2.1). The BLSM program, launched after the June 2013 price increase, allocated IDR 9.3 trillion to reach over 15.5 million households with IDR 600,000 per household for four months. This program effectively reached 97.2% of its target beneficiaries, demonstrating a well-executed response to a sudden economic shock. Similarly, the PSKS program in 2014, though shorter in duration (two months), provided higher monthly assistance of IDR 400,000 per household to address the economic strain caused by another fuel price adjustment.

The BLT BBM program in 2022 marked a significant expansion in both budget and coverage. With a budget of IDR 12.39 trillion, the program targeted 20.65 million households, significantly more than the previous programs. Although the total assistance per household remained IDR 600,000 for four months, this program demonstrated the government's commitment to protecting more families during a period of heightened economic volatility. The larger scale of this program underscores the increasing economic challenges faced by households due to fuel price hikes and the government's evolving strategy to address them effectively.

Table 2.1. Government Social Assistance Programs to Mitigate Fuel Price Impact on Vulnerable Households

	2013[1]	2014[2]	2022[3]
Program Name	*Bantuan Langsung Sementara Masyarakat* (BLSM)	*Program Simpanan Keluarga Sejahtera* (PSKS)	BLT BBM
Budget (IDR)	9,318,538,200,000	6,200,000,000,000	12,390,000,000,000
Budget Realization (IDR)	N/A	N/A	12,390,000,000,000
Budget Achievement	N/A	N/A	100%
Target Beneficiary Households	15,530,897	15,500,000	20,650,000
Realized Beneficiary Households	15,097,799	N/A	20,650,000
Beneficiary Achievement	97.2%	N/A	100%
Total Amount per Beneficiary Household (IDR)	600,000	800,000	600,000
Allocation Period (months)	4	2	4
Amount per Beneficiary Household per Month (IDR)	150,000	400,000	150,000
Responsible Authority	Ministry of Social Affairs	Ministry of Social Affairs	Ministry of Social Affairs

Source: 1Office of the Vice President of the Republic of Indonesia; 2National Team for the Acceleration of Poverty Reduction (TNP2K); 3Ministry of Social Affairs

Overall, the redistributive actions of the Indonesian government through these programs illustrate a consistent commitment to protecting vulnerable populations during periods of economic stress caused by rising fuel prices. By providing targeted cash assistance, the government has managed to sustain the purchasing power of low-income households, reducing the adverse effects of inflation and maintaining social stability. The progressive scaling of these programs, both in terms of budget and coverage, highlights the importance of adaptive policy measures in responding to fluctuating economic conditions.

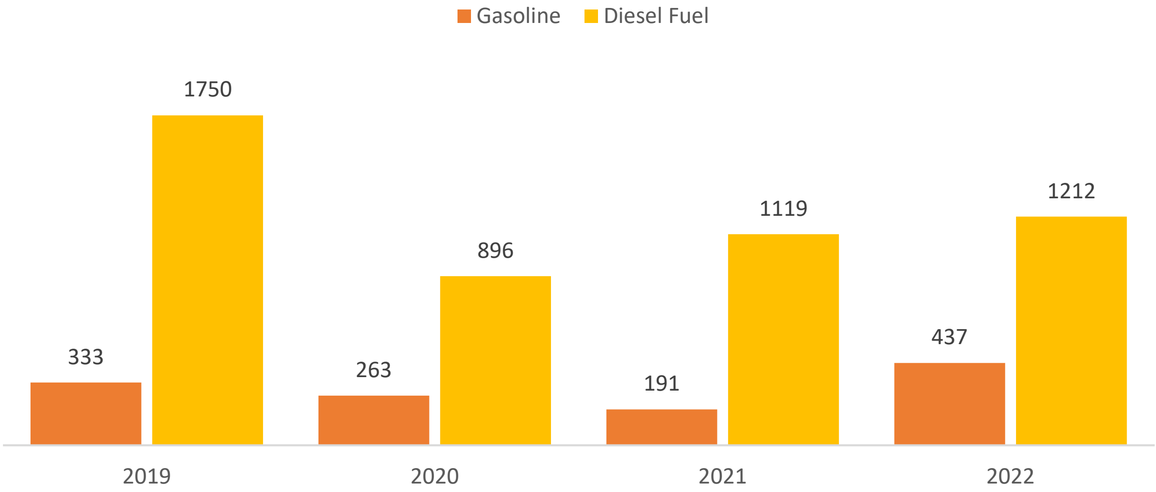
2.3.4. Energy Subsidies for Industry in Indonesia: Policy, Regulatory Frameworks, and Timelines

Fuel Subsidy for Industry

Fuel for industry comprises of gasoline and diesel fuel. There are several types of gasoline product sold by Pertamina. The lowest quality, Premium (RON 88), used to be classified as a subsidized commodity but it has since been changed to an unsubsidized one. Furthermore, Premium has been gradually replaced by Pertalite (RON 90) which is not classified as a subsidized commodity. Nevertheless, Pertalite's retail price is highly regulated and set to below the cost of supply incurred by Pertamina. The resulting losses is compensated by the government which makes it as an implicit subsidy for gasoline.

Diesel is categorized as a subsidized commodity. The subsidy for diesel consists of two components: explicit and implicit. The explicit part of diesel subsidy comes from the fixed per litre allocation that is used to cover the difference between the diesel's retail price and the cost of supplying it. This part is reported as a subsidy in the budget law (APBN). The implicit part comes from the transfer that the government make to Pertamina to cover the remaining gap between retail price and the cost of supply after accounting for the per-litre subsidy. As this budgetary transfer does not get reported in the budget law, it is considered as an implicit subsidy.

Figure 2.16. Volume of Gasoline and Diesel Fuel Consumption for Industry (Million Liter)



Source: Large and Medium Manufacturing Industry Survey

LPG Subsidy for Industry

The nationwide kerosene-to-LPG conversion program launched in 2007 primarily targeted household cooking but also considered LPG use by micro-industries. The scope of beneficiaries eligible for the subsidized 3-kilogram LPG expanded twice: first, in 2015, to include fishermen for fueling their fishing boats, and then in 2019, to include farmers for powering water pump engines.

Several issues hinder the implementation of LPG subsidies in Indonesia. First, there is a price disparity between subsidized and non-subsidized LPG in the market, leading to widespread adulteration and hoarding for arbitrage purposes. Second, instances of mistargeting are common, as the government lacks a reliable mechanism to identify eligible 3-kilogram LPG users.

Electricity Subsidy for Industry

Certain categories of consumers, including business and industry, can accessed electricity at a subsidized rate, which is regulated via the government regulation on electricity tariff. The gap between the regulated tariff and the production cost plus margin for the producer will be covered by the government subsidy.

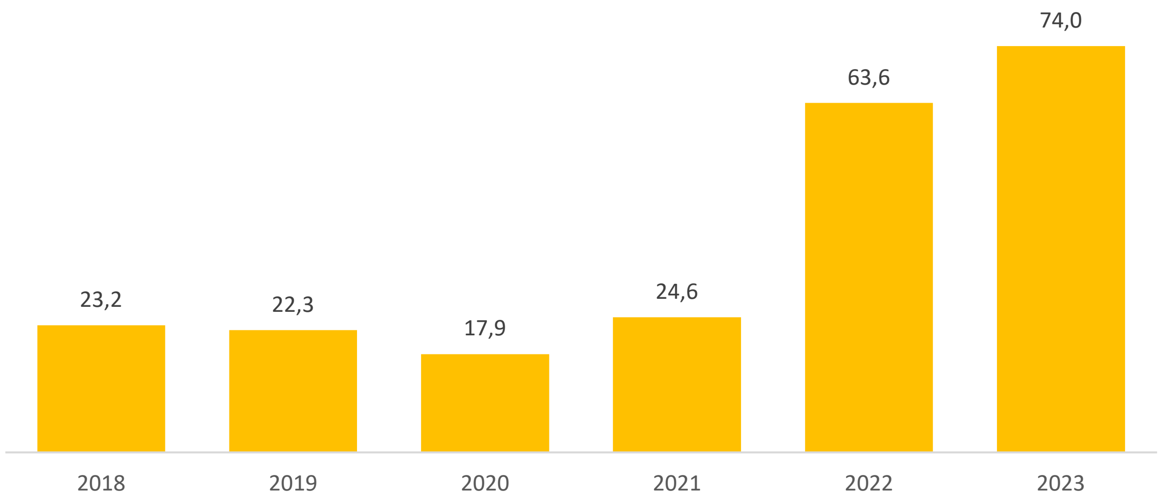
The Indonesian electricity tariff schedule is classified into six consumer categories: households, business, industry, social, government, and street. These six categories are further classified into several groups to make up 36 tariff groups in total. To account for the dynamic nature of electricity production, the government stipulated the tariff adjustment mechanism where the tariff for each group can be automatically adjusted every three months based on several indicators such as global oil price and exchange rate. However, there are 12 tariff groups that are excluded from this mechanism. In other words, these 12 groups are effectively receiving subsidies from the government. Ten out of 12 groups are from business and industry consumer category. In practice, since all tariffs remain below PLN's average supply cost, all consumer categories enjoy some degree of implicit subsidy.

By regulation, there are two types of subsidies channelled to PLN by the government: 1) A public service obligations (PSO) for vulnerable groups and two groups of households, that is those with a connection up to 450 VA and those with a connection up to 900 VA who are also in the government integrated welfare recipient list (DTKS); and 2) A compensation transferred to PLN to cover the difference between PLN's cost of services and its total revenue from all tariff categories.

From 2018 to 2023, the amount of government compensation to PLN showed a fluctuating trend with a significant increase in recent years. Between 2018 and 2021, the compensation remained relatively stable with minor fluctuations, starting at Rp23.2 trillion in 2018, slightly decreasing to Rp22.3 trillion in 2019, and then dropping more significantly to Rp17.9 trillion in 2020 due to the COVID-19 pandemic. In 2021, there was a slight increase to 24.6 trillion.

Since then, the amount of compensation given to PLN by the government rose significantly. In 2022, compensation surged to Rp63.6 trillion, nearly tripling from the 2021 level, likely reflecting increased support for electricity subsidies along with other government-mandated programs amidst economic recovery efforts. his upward trend continued in 2023, with compensation reaching its peak at Rp74.0 trillion. The significant rise in the last two years suggests that the government has intensified its financial support to PLN, possibly due to rising costs or efforts to ensure affordable electricity access amid economic challenges.

Figure 2.17. Government Compensation to PLN (Trillion IDR)

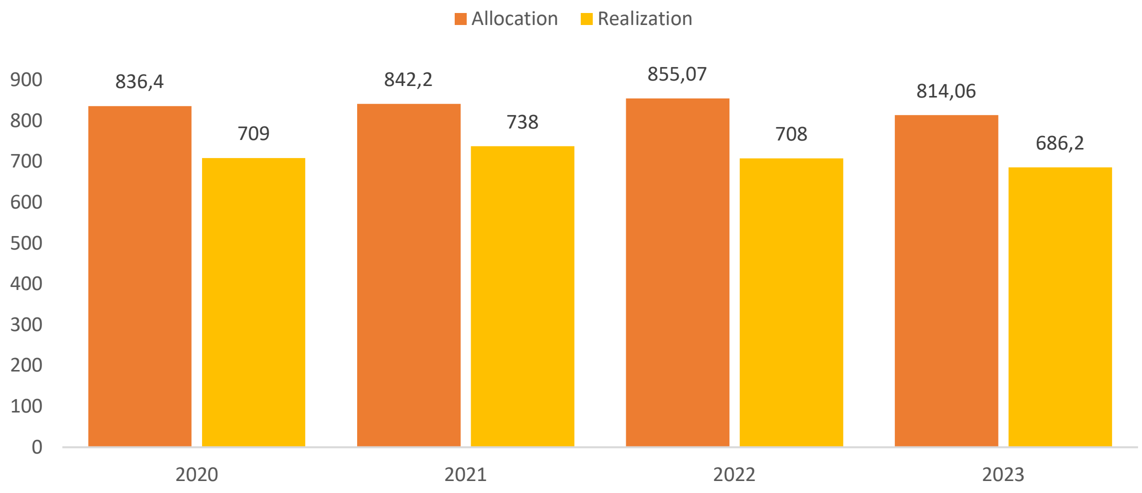


Source: PLN Financial Statements

Industrial Gas Subsidy for Industry

In 2020, the Indonesian government offered a subsidized natural gas at USD6 per MMBTU to seven industries: fertilizer, petrochemical, steel, ceramic, glass, oleochemical, and rubber. This policy aims to support economic growth and improve domestic industry's competitiveness by increasing the use of natural gas and ensuring the effectiveness and efficiency of natural gas distribution to industry. Companies in these categories may submit applications to the MEMR to receive this subsidized gas. The government then issued a regulation that set the allocation of a subsidized gas for each company.

Figure 2.15. Volume of Subsidized Industrial Gas (BBTUD)



Source: MEMR (2024)

2.4. Indonesia vs. the World: energy policy and subsidy comparisons

2.4.1. Understanding Selected Advanced Markets

Germany's Energy Subsidies

Germany has been a global leader in renewable energy policy, driven by its ambitious "Energiewende," or energy transition, which aims to reduce greenhouse gas emissions, phase out nuclear power, and promote renewable energy sources. Germany's approach to energy subsidies reflects this commitment to sustainability, balancing economic growth with environmental protection through a carefully structured subsidy program.

Germany's timeline for energy subsidies dates back to the early 2000s. In 2000, the Renewable Energy Sources Act (EEG) introduced feed-in tariffs (FiTs) for renewable energy producers, guaranteeing fixed prices for solar, wind, and other renewable energy sources. This provided a stable and attractive market for renewable investments, spurring rapid growth in the sector. By 2011, following the Fukushima nuclear disaster in Japan, Germany accelerated its nuclear phase-out and intensified support for renewable energy, channelling more resources into FiTs for solar and wind energy. In 2014, the government reformed the EEG, replacing feed-in tariffs with an auction-based system to control rising subsidy costs as renewable technology matured. The most recent shift came in 2021 with the Climate Action Law, which set ambitious targets for carbon neutrality by 2045, further restructuring subsidies to support energy efficiency and emissions reductions, while introducing carbon pricing for sectors like heating and transportation (Federal Ministry for Economic Affairs and Climate Action, 2021).

Germany's subsidy program covers a range of energy types. Renewable energy sources, including wind, solar, biomass, and hydropower, receive the majority of subsidies. Initially, these sources were supported through FiTs, but since 2014, they have been subsidized through competitive auctions, where energy producers bid for support. This shift helped reduce subsidy costs and align them with market conditions as renewable technology became more competitive. In the past, Germany also subsidized fossil fuels, particularly coal. However, by 2018, subsidies for hard coal mining were phased out to meet climate commitments. Today, Germany offers subsidies for energy efficiency as well, promoting building insulation, efficient heating systems, and electric vehicles to reduce overall energy demand. This comprehensive approach supports Germany's commitment to an environmentally sustainable energy sector (International Energy Agency, 2022).

In terms of budget allocation, Germany's renewable energy subsidies represented approximately 3% of the federal budget in the early 2010s, equating to around €25 billion annually. When considering the overall government spending, these renewable energy subsidies accounted for about 0.8% of Germany's GDP at the time, a significant investment in the country's energy transition. With the introduction of the auction system and other cost-control measures, the subsidy expenditures became more sustainable. By 2021, the total energy subsidies, including funds allocated for energy efficiency programs and carbon pricing revenues, accounted for about 1.5% of Germany's GDP and approximately 4% of the government's total budget. This allocation underscores the importance Germany places on environmental sustainability and long-term economic stability as it transitions toward renewable energy.

Germany's subsidy schemes have also evolved to enhance cost-effectiveness. From 2000 to 2014, feed-in tariffs provided fixed prices for renewable energy production, encouraging rapid growth in renewable energy. However, as these subsidies placed a growing burden on consumers through increased electricity prices, the government transitioned to a competitive auction system. This shift helped reduce costs by fostering competition among producers, allowing the government to allocate subsidies more efficiently. In 2021, Germany introduced a national carbon pricing system on sectors not covered by the EU Emissions Trading System, specifically targeting heating and transportation. Revenue from carbon pricing is directed towards further renewable and efficiency subsidies, creating a cycle of reinvestment in sustainable energy (Federal Ministry for Economic Affairs and Climate Action, 2021).

Germany's energy subsidy programs target both households and industries. Household subsidies primarily focus on energy efficiency improvements, such as grants for retrofitting buildings, installing solar panels, and upgrading heating systems. By making homes more energy-efficient, the government reduces overall energy demand and lowers carbon emissions from the residential sector. For industry, Germany provides subsidies for sectors like steel and chemicals, which face significant challenges in reducing emissions. Industrial subsidies help these sectors adopt green technologies, such as hydrogen production, to achieve carbon neutrality. This dual-target approach ensures that Germany's energy transition supports both social and economic goals.

Over the years, Germany has developed a renewable energy sector that accounts for more than 45% of its electricity generation as of 2020, driven by its consistent support and strategic subsidy policies. However, as the costs of subsidies increased, Germany restructured its subsidy model, transitioning from guaranteed prices to competitive auctions to ease the financial burden on consumers. Recent developments include increased support for green hydrogen and energy storage technologies, which are essential for Germany's carbon neutrality goals by 2045. These ongoing adjustments reflect Germany's commitment to sustainable growth, balancing cost management with environmental and economic objectives (World Bank, 2022).

Japan's Energy Subsidies

Japan's energy subsidy framework is primarily shaped by its energy security concerns and the impact of the 2011 Fukushima nuclear disaster. Japan's approach to energy subsidies reflects a need to ensure stable energy supplies while transitioning towards renewable energy to meet climate commitments. The government's strategy has been to maintain subsidies for fossil fuels, especially *Liquefied natural gas* (LNG), while gradually increasing support for renewables like solar energy.

Japan's energy subsidy timeline has distinct phases. The country began subsidizing oil and coal in the 1970s following the oil shocks, focusing on fossil fuel subsidies to stabilize prices and support economic growth. During the 2000s, Japan introduced renewable energy incentives as part of its climate commitments under the Kyoto Protocol, with an initial focus on solar power. In 2011, the Fukushima disaster significantly altered Japan's energy policy, leading to a reduction in nuclear energy reliance and an increased emphasis on renewables and fossil fuels like LNG. To accelerate renewable adoption, Japan introduced a feed-in tariff (FIT) scheme in 2012, which provided guaranteed high prices for renewable energy producers, particularly in the solar sector. In 2020, Japan announced a carbon neutrality target for 2050, marking a shift towards subsidies for new technologies like hydrogen and offshore wind to diversify its energy sources and reduce emissions (Ministry of Economy, Trade and Industry, Japan, 2021).

The types of energy that Japan subsidizes include a mix of fossil fuels and renewables. While the country has gradually reduced fossil fuel subsidies, LNG and coal remain important for energy security, especially as nuclear energy has declined. Subsidies for LNG help stabilize prices, ensuring a consistent supply for electricity generation. Renewable energy, particularly solar, has received substantial support through the FIT scheme, which incentivized rapid growth in solar installations across Japan. Wind and geothermal energy also receive subsidies, though on a smaller scale than solar energy does. Additionally, Japan has begun investing heavily in hydrogen as a clean energy source, with subsidies aimed at establishing a hydrogen economy that could eventually replace a significant portion of fossil fuel use.

In terms of budget allocation, Japan's subsidies for renewable energy reached about 0.5% of GDP at their peak in the mid-2010s, driven largely by the FIT scheme. For the Japanese government's total budget, renewable subsidies accounted for approximately 1.2% of the total budget in those peak years, a substantial amount considering Japan's heavy reliance on imported fossil fuels. As of 2020, the Japanese government allocated approximately ¥800 billion (around $7 billion USD) per year to support renewable energy, particularly solar, as well as energy efficiency projects. Fossil fuel subsidies, though reduced over the years, still receive notable support, especially for LNG, which remains a critical component of Japan's energy mix post-Fukushima.

Japan's subsidy schemes are structured to encourage both energy security and renewable adoption. The FIT scheme, introduced in 2012, offered high guaranteed prices for renewable energy, spurring rapid growth in solar energy. This scheme was particularly effective in promoting small- and medium-scale solar installations, which contributed significantly to Japan's renewable capacity. In 2021, Japan launched the Green Innovation Fund, a ¥2 trillion fund dedicated to advancing technologies like hydrogen, offshore wind, and battery storage. This fund represents Japan's commitment to carbon neutrality by 2050 and aims to support the development of next-generation energy technologies that can meet the country's unique energy challenges. Additionally, Japan has implemented energy efficiency programs that provide subsidies for energy-efficient appliances, electric vehicles, and building upgrades to lower energy consumption.

Japan's subsidy targets are divided between households and industries. Household subsidies focus on solar panel installations for residential properties and energy-efficient appliances, aiming to reduce household electricity costs and support renewable adoption. For industries, Japan provides subsidies to high-energy sectors like manufacturing and transportation, encouraging them to adopt low-carbon technologies. The Green Innovation Fund also supports industrial projects focused on hydrogen and other clean technologies, which are critical for Japan's industrial decarbonization goals. This targeted approach ensures that both residential and industrial sectors contribute to Japan's carbon neutrality objectives.

Japan's developments in energy subsidies reflect a gradual transition from nuclear and fossil fuels to renewables and innovative energy sources. Solar power now contributes approximately 9% of Japan's electricity generation, largely due to the FIT program. However, the high costs associated with FIT led to adjustments, such as reducing guaranteed prices for new solar installations to control subsidy expenditures. Japan is also positioning itself as a leader in hydrogen technology, with a goal to produce 10 million tons of hydrogen annually by 2030. In addition, Japan is expanding offshore wind capacity to diversify its renewable energy sources. These developments illustrate Japan's balanced approach to energy subsidies, focusing on both energy security and long-term sustainability (OECD, 2021).

2.4.2. Gaining Insights into Peer Countries

Energy Subsidies in Thailand

Thailand's approach to energy subsidies reflects the nation's balancing act between ensuring affordable energy for its population and fostering economic stability, especially given its reliance on imported energy sources. Initially focused on fossil fuels, Thailand has gradually shifted its energy subsidy policies towards supporting renewable energy and energy efficiency. This evolution aligns with Thailand's goals of reducing dependency on imported fuels, achieving greater energy security, and addressing environmental concerns.

Historically, Thailand's energy subsidies primarily supported fossil fuels. Starting in the 1970s and continuing through the early 2000s, the government implemented subsidies for oil and natural gas to stabilize domestic prices and protect consumers from global oil price volatility. These subsidies were crucial for supporting both the industrial sector and household energy consumption, as oil and gas prices are sensitive to international market changes. In 2015, Thailand introduced the Alternative Energy Development Plan (AEDP) 2015-2036, a comprehensive roadmap aiming to increase the share of renewable energy in the country's energy mix. This plan marked a pivotal shift from traditional fossil fuel subsidies towards a more sustainable approach, with the government setting ambitious targets to reduce fossil fuel dependency and promote renewables. Recently, in 2022, in response to the surge in global energy prices due to international crises, the Thai government reinstated short-term fuel subsidies to cushion households and industries from rising energy costs (Ministry of Energy, Thailand, 2021).

Thailand's current subsidy structure encompasses both fossil fuels and renewable energy. Diesel and liquefied petroleum gas (LPG) are heavily subsidized, primarily to support transportation and household cooking. Diesel, in particular, is crucial for Thailand's logistics and transportation sectors, so maintaining low diesel prices helps stabilize the cost of goods and services across the country. Meanwhile, renewable energy sources such as solar, biomass, and biogas have also started receiving government support. Through feed-in tariffs and other incentives, Thailand aims to promote investment in renewables, especially from independent power producers (IPPs) who play a significant role in Thailand's energy landscape. Additionally, subsidies for energy efficiency are provided, especially for industrial and commercial sectors, encouraging businesses to adopt energy-saving equipment and technologies (International Energy Agency, 2022).

The financial commitment to energy subsidies in Thailand is substantial. During peak periods of fossil fuel subsidies, particularly when global oil prices spiked, fossil fuel subsidies represented approximately 1% of Thailand's GDP. Renewable energy subsidies, while less prominent, have grown in recent years, amounting to around 0.5% of the government's total budget. This allocation demonstrates Thailand's commitment to increasing renewable energy's share in the energy mix, which the government has set at 30% by 2036. The transition in subsidy allocation reflects the government's strategic shift towards sustainable energy sources while maintaining critical support for fossil fuels as needed during economic downturns.

Thailand employs a range of subsidy schemes to manage its energy market. The Oil Fund is one of the most prominent, serving as a financial buffer to stabilize fuel prices, particularly for LPG and diesel. When global oil prices rise, the Oil Fund steps in to subsidize these fuels, mitigating the immediate impact on consumers. Interestingly, the Oil Fund also finances renewable energy projects, although a significant portion is still allocated to fossil fuel subsidies. For renewable energy, the government has established feed-in tariffs to incentivize small-scale solar and biomass projects, allowing IPPs to contribute to Thailand's energy supply. In response to the 2022 energy crisis, the government also introduced short-term subsidies for fuel and electricity to provide immediate relief to low-income households (World Bank, 2022).

Thailand's energy subsidy policies target both households and industries. For households, LPG subsidies are specifically designed to support low-income families by making cooking fuel affordable.

Additionally, temporary fuel subsidies are occasionally directed towards household electricity costs to shield families from sudden price hikes. For industries, diesel subsidies are crucial for the logistics and transportation sectors, ensuring that operational costs remain manageable. Energy efficiency subsidies are also available for industries adopting energy-saving technologies, reducing operational costs while supporting environmental goals.

In recent years, Thailand has made significant strides in increasing its renewable energy share. As of 2020, renewables contributed about 10% of the country's energy mix. The government's ongoing commitment to transitioning its subsidy approach under the AEDP targets a renewable energy share of 30% by 2036. The Oil Fund remains a cornerstone of Thailand's energy policy, balancing short-term fossil fuel support with long-term investments in renewables. This strategic approach reflects Thailand's dual objectives of ensuring energy affordability and moving towards a cleaner, more sustainable energy future (Ministry of Energy, Thailand, 2021).

Energy Subsidies in the Philippines

The Philippines faces distinct energy challenges, stemming largely from its archipelagic geography, which complicates energy distribution and increases costs. The government's energy subsidy policies aim to address energy poverty, stabilize prices, and encourage renewable energy development, particularly in remote and off-grid areas where conventional energy access is limited. The Philippines' approach to subsidies has evolved over the years, reflecting a growing focus on energy inclusivity and sustainability.

The Philippines' energy subsidy timeline began in the 2000s, with fossil fuel subsidies introduced to support the transportation sector and reduce the cost of imported oil. These subsidies were particularly important in a country where a large portion of the population relies on public transportation. In 2008, the Philippines enacted the Renewable Energy Act, which established incentives for renewable energy development and set ambitious renewable energy targets. This legislation marked a shift towards cleaner energy sources, with subsidies and incentives introduced for solar, wind, geothermal, and hydropower projects. In 2022, facing a global energy crisis and soaring fuel prices, the Philippine government implemented temporary subsidies for the transportation and power sectors to mitigate the impact on consumers and stabilize energy costs (Department of Energy, Philippines, 2021).

The Philippine government subsidizes a variety of energy sources, focusing on both fossil fuels and renewables. Fossil fuel subsidies, particularly for diesel and gasoline, are critical for stabilizing transportation costs. Diesel, in particular, is essential for public transportation, which is the backbone of mobility for millions of Filipinos. On the renewable energy side, the Renewable Energy Act has spurred the development of solar, wind, geothermal, and hydropower by providing feed-in tariffs and tax incentives for renewable energy producers. Additionally, through the Universal Charge for Missionary Electrification (UCME), the government subsidizes electricity in remote and off-grid areas, where electricity generation is often more costly due to logistical challenges and dependence on diesel generators.

In terms of budget allocation, fossil fuel subsidies have historically accounted for around 1% of the national budget, although this figure fluctuates depending on global oil prices. During periods of crisis, such as in 2022, additional budget allocations are made to cover temporary fuel subsidies, adding to the government's fiscal burden. Renewable energy incentives under the Renewable Energy Act represent about 0.3% of the government's total budget. This funding supports the expansion of renewable energy infrastructure, particularly in rural and remote areas, where conventional electricity access remains limited.

The Philippines has implemented various subsidy schemes to achieve its energy goals. The Universal Charge for Missionary Electrification (UCME) is a critical mechanism, funded by a small charge on electricity bills nationwide, which is then used to subsidize the cost of electricity in off-grid areas. Additionally, fuel subsidies for public transportation stabilize the cost of diesel and gasoline, keeping fares affordable for the public. The Renewable Energy Act also established feed-in tariffs and tax breaks for renewable energy developers, particularly in the solar, wind, and hydropower sectors. These long-term incentives encourage private sector investment in clean energy production (World Bank, 2022).

The Philippines' subsidy policies are designed to benefit both households and industries. For households, the UCME ensures that even remote communities have access to affordable electricity. This subsidy has been instrumental in reducing energy poverty, particularly in rural and island communities. Temporary fuel subsidies also indirectly benefit low-income households by stabilizing transportation costs, which are a significant expense for many Filipinos. On the industry side, renewable energy subsidies encourage private companies to invest in clean energy projects, while fossil fuel subsidies help industries dependent on transportation manage costs amid price volatility.

As a result of these policies, renewable energy accounted for approximately 21% of the Philippines' electricity mix in 2020, driven by incentives from the Renewable Energy Act. The government continues to prioritize solar projects in off-grid regions to reduce energy poverty and improve resilience against fuel price shocks. Future plans include expanding microgrid solutions to remote islands and reducing the Philippines' reliance on imported fossil fuels, which will enhance energy security and sustainability (Department of Energy, Philippines, 2021).

Energy Subsidies in Malaysia

Malaysia's energy subsidy policies have traditionally aimed to reduce energy costs for both households and industries, initially through extensive fossil fuel subsidies. In recent years, however, Malaysia has started shifting towards more targeted subsidies and increasing support for renewable energy as part of its sustainable energy strategy. This evolution in policy is part of Malaysia's broader efforts to reduce dependency on fossil fuels and transition to a cleaner energy mix.

Malaysia's energy subsidies date back to the 1970s, when fossil fuel subsidies for gasoline, diesel, and electricity were introduced as a way to keep energy prices affordable and support economic growth. The subsidy structure remained largely unchanged until 2008, when the government initiated subsidy reforms to reduce the financial burden on the state. These reforms included a gradual reduction in gasoline and diesel subsidies and an increase in electricity subsidies specifically for low-income households. In 2019, Malaysia launched its third Renewable Energy Transition Roadmap, aiming for 20% renewable energy by 2025. This roadmap introduced new subsidies and incentives for solar and biomass energy, marking a shift towards renewable support (Ministry of Energy and Natural Resources, Malaysia, 2020).

Malaysia continues to subsidize both fossil fuels and renewable energy. Gasoline and diesel remain heavily subsidized, particularly for low-income households and the public transportation sector. These subsidies are vital for controlling the cost of living and stabilizing the cost of goods and services. Renewable energy subsidies, although still limited, focus primarily on solar energy, which is well-suited to Malaysia's climate. Biomass and small-scale hydropower projects also receive government support, aligning with Malaysia's target of 20% renewable energy by 2025. Electricity subsidies are another key component, targeting low-income households to make energy more affordable and reduce energy poverty.

The financial impact of Malaysia's energy subsidies is significant. Fossil fuel subsidies have constituted approximately 2-3% of the annual national budget in recent years, reflecting the high cost of gasoline and diesel. Renewable energy subsidies, while smaller, represent about 0.4% of the government's budget. This allocation is expected to grow as Malaysia works towards its renewable energy goals. The budgetary focus on fossil fuels reflects the current dependency on these fuels, though the increase in renewable subsidies demonstrates Malaysia's commitment to a gradual transition.

Malaysia's subsidy schemes include the Fuel Subsidy Program, which provides direct subsidies for gasoline and diesel to low-income households. The amount of subsidy fluctuates based on international oil prices, ensuring that lower-income groups are shielded from price shocks. For renewable energy, Malaysia has established a Net Energy Metering (NEM) scheme that encourages residential and commercial solar adoption. Through NEM, solar users can sell excess energy back to the grid, effectively reducing their electricity costs. Additionally, feed-in tariffs support biomass, biogas, and small-scale hydropower projects, with long-term fixed rates for producers to stimulate investment in these sectors.

Malaysia's subsidies target both households and industries. For households, fuel subsidies provide direct relief for gasoline and diesel, while electricity subsidies benefit those with lower consumption levels by offering discounts on electricity bills. Industrial sectors also benefit indirectly from fuel subsidies, as stable transportation costs help keep production expenses manageable. Renewable energy subsidies, especially feed-in tariffs, incentivize private sector investment in clean energy production, with many industries exploring biomass as an alternative energy source (OECD, 2022).

In recent years, renewable energy has grown to constitute around 8% of Malaysia's total energy mix as of 2020. The Renewable Energy Transition Roadmap outlines plans to increase this share, particularly through solar installations supported by NEM and feed-in tariffs for biomass. However, due to budget constraints, Malaysia has gradually reduced broad fuel subsidies, focusing instead on targeted subsidies for low-income households while expanding support for renewable energy. This transition reflects Malaysia's strategy to balance fiscal sustainability with the need to achieve energy security and environmental objectives (Ministry of Energy and Natural Resources, Malaysia, 2020).

3. From data to insights: the method behind the analysis

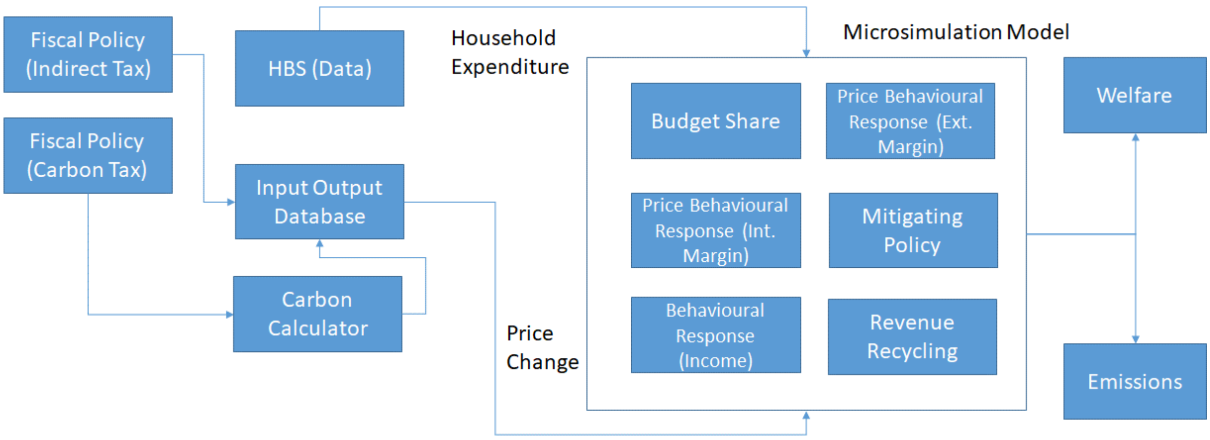
3.1. The analytical model: framework for policy simulation

In this report our aim is to assess the distributional implications of a variety of different energy related carbon tax options for Indonesia incorporating revenue recycling. Doing this requires a methodological framework (Figure 3.1) that contains

- the distribution of fuel expenditures in order to calculate direct carbon emissions
- a macro framework such as an Input-Output model that incorporates the energy usage in the production of other goods and services consumed by households
- a carbon calculator to model the direct and indirect carbon emissions of these energy expenditures
- a policy module that can allow for the simulation of existing indirect taxation, new carbon taxation and mitigation policies utilising recycled revenue
- a behavioural module that can simulate the behavioural response to both price changes induced by changes in carbon and indirect taxation and income changes resulting from revenue recycling.

Modelling the distributional impact of a carbon tax therefore requires both micro units and a simulation framework, known as a microsimulation model (Hynes and O'Donoghue, 2014; O'Donoghue, 2021).

Figure 3.18. Microsimulation Model Framework



Source: Authors (2024).

3.1.1. Modelling Carbon Emissions

In order to model carbon emissions, we have to convert fuel expenditures expressed in value terms to volume terms. This requires information on both the emissions per unit of energy (measured in kilowatt-hours) and the cost per kilowatt-hour. Drawing upon data from the OECD Effective Carbon Rates (ECRs) database , we calculate the Excise Duty per Turkish Lira and per tCO_2 for different fuels in Indonesia. Effective carbon rates account for implicit fossil fuel subsidies offered through preferential excise or carbon tax rates, ensuring that total ECRs are always non-negative. Table 3.1 provides the calculation for Indonesia. Solid fuels produce higher emissions per kWh compared to liquid fuels, and liquid fuels have higher emissions than gaseous fuels. However, wood is the cheapest per kWh, while petrol and diesel has the highest cost per kWh. After the conversion, firewood and then coal incurs the highest carbon tax per unit of expenditure due to its high emission factor and low cost per kWh. Petrol, despite not having the lowest emission factor, has the lowest carbon intensity per unit of expenditure because of its already high price per kWh. Excise duties are currently only levied on petrol, diesel and natural gas, albeit the natural gas excise duty is a fraction of the petrol and diesel rates.

3.1.2. PRICES Model

This paper utilizes the PRICES model (Prices, Revenue Recycling, Indirect Taxation, Carbon, Expenditure Simulation model), which is consistent with the theoretical framework outlined in Figure 1.2 (O'Donoghue et al., 2024). The model is structured into four primary components, each represented in a column. The first column on the left highlights changes external to the model, such as fiscal policy, inflation, or energy policy. The second column contains the three datasets that the model uses to simulate the effects of these external changes on the population. The third column, which is framed, includes modules that adjust the input microdata to account for the external changes. The fourth and final column presents the main outputs of the model. Each column's elements are distinguished by color: light blue represents the datasets, mid-shade blue indicates components currently implemented in the model, grey marks components not yet implemented, and dark blue represents the model's outputs.

The PRICES model employs an Input-Output model to assess the indirect effects of carbon pricing on consumer goods, capturing the overall impact of the carbon price. After determining price changes for various expenditure categories, data from the Household Budget Survey (HBS) is used to calculate household-specific tax payments. By aggregating these tax payments across households, the revenue available for funding mitigation strategies through revenue recycling is estimated. Additionally, information on direct tax liabilities and benefit payments from income data allows for further exploration of possible mitigation measures.

Table 3.3. Calculating a Carbon Emissions per LCU of Fuel Expenditure in Indonesia (2021)

Fuel	tCO_2 per kW	Excise Duty Rate (000) per tCO_2	Price per kWh	Price LCU per tCO_2	Excise Duty Rate per LCU 000	VAT rate	tCO_2 per unit (local currency 000)
Liquid Fuel	0.00026	0.0	1,122.272	4335.8	0.000	0.10	0.00023
Natural Gas	0.00020	0.0	475.417	2354.0	0.000	0.10	0.00042
Coal	0.00040	0.0	232.408	576.4	0.000	0.10	0.00172
Wood	0.00011	0.0	62.691	155.5	0.000	0.10	0.00175
Petrol	0.00027	96.7	988.759	3706.5	0.026	0.10	0.00027
Diesel	0.00025	142.2	826.829	3314.2	0.043	0.10	0.00030

Source: OECD ECR (2021) adjusted by CPI.

To incorporate household behavioural responses to changes in price and income, the PRICES model features a basic demand system. Price variations affect consumption behaviour through own-price and cross-price effects (intensive margin), while revenue recycling and mitigation measures influence consumption through income effects (income behavioural response). The parameters derived from the demand system are used to evaluate the welfare impacts and changes in emissions.

Moreover, changes in prices motivate households, businesses, and governments to adapt their behaviour and invest in new assets, such as electric vehicles, energy-efficient heating systems, and solar panels. However, modelling general equilibrium (GE) effects and changes at a broader level requires specialized models. The discussion section provides an overview of the role of GE models and explains how these effects, as well as models of technology adoption, will be incorporated into the PRICES model.

3.1.3. Data

The PRICES model relies on two primary data sources: the World Input-Output Database (WIOD) and the Household Budget Survey (HBS) or SUSENAS. When complex mitigation strategies are simulated, a third dataset is used to provide detailed information on incomes, taxes, and benefits. For simpler assessments focused solely on changes in consumer prices, as in the analysis presented in this paper, Consumer Price Index (CPI) data is sourced from national statistical agencies.

HBS datasets offer granular details on household expenditures by item, along with demographic, socioeconomic, and income information. This particular application uses the 2021 HBS data from Indonesia. For applications that require insights into inter-industry relationships, the model uses the 2016 WIOD data and its environmental extension, which includes industry-specific CO_2 emissions (as outlined by Corsatea et al., 2019). The WIOD covers monetary flows across 56 industries in 44 countries and is supplemented with environmental and socioeconomic accounts. The PRICES model utilizes the environmental extension from Corsatea et al. (2019), which includes a vector of CO_2 emissions for each industry and country, or it calculates industry-specific emissions based on energy consumption data from UNIDO MINSTAT. Further details are provided in section 3.3. However, the application presented here does not incorporate the Input-Output (IO) component of the model.

Modelling the effects of energy price changes on household living costs involves both direct impacts (changes in the prices of energy consumed by households) and indirect impacts (price changes in inputs used to produce other goods and services that households consume). A change in input prices can influence the production costs of goods and services, which may then be partially passed on to consumers. The PRICES model can simulate energy price fluctuations resulting from carbon pricing and assess their direct and indirect effects on the prices of goods and services consumed by households.

To capture the indirect effects of producer price changes and carbon taxes, the model uses an input-output (IO) table to trace how price changes propagate through the economy and affect households. The IO modelling approach, originally developed by Leontief (1951), is thoroughly discussed in Miller and Blair (2009). Early examples of distributional impact analyses of carbon taxation using IO models include O'Donoghue (1997) for Ireland, Gay and Proops (1993) for the UK, and Casler and Rafiqui (1993). More recent analyses using Multi-regional IO (MRIO) models include Sager (2019) and Feindt et al. (2021).

By incorporating environmental extensions, IO and MRIO models can track the environmental effects of production through global supply chains, creating Environmentally Extended-MRIO (EE-MRIO) models. These extensions link emissions or resource use to the production of each sector in each region. In the context of carbon emissions, EE-MRIO models allow for the assessment of indirect emissions embedded in the production of goods and services.

The central equation of an IO model, also called a Leontief quantity model, is the Leontief inverse matrix $(\boldsymbol{I} - \boldsymbol{A})^{-1}$, where $\boldsymbol{I}$ is the identity matrix and $\boldsymbol{A}$ is the technology matrix. The Leontief inverse gives the direct and indirect inter industry requirements for the economy:

$$x = (\boldsymbol{I} - \boldsymbol{A})^{-1}.\boldsymbol{d} \qquad (1)$$

Where d is a vector of final demand.

To convert an Input-Output (IO) model into an Environmentally Extended Input-Output (EE-IO) model, a carbon intensity vector is required. This vector captures the amount of carbon emissions produced by an industry per monetary unit of its output. By multiplying this vector with the Leontief inverse, we derive a new vector that represents the carbon intensity of each monetary unit of industry output ($\boldsymbol{E}_{indHH}$). This accounts for emissions produced directly by the industry as well as those emitted by all upstream industries involved in the supply chain.

Using input-output bridging techniques, we can translate the carbon emissions tied to industry outputs into the indirect emissions associated with products consumed by households ($\boldsymbol{E}_{indHH}$). To calculate total emissions at the household level, we combine data on household fuel consumption with the carbon intensity of each fuel type, generating a vector that represents the household's direct carbon emissions ($\boldsymbol{E}_{dirHH}$). By summing the direct and indirect emissions, we obtain the total carbon emissions related to household consumption ($\boldsymbol{E}_{HH}$):

$$\boldsymbol{E}_{HH} = \boldsymbol{E}_{dirHH} + \boldsymbol{E}_{indHH} \qquad (2)$$

This approach provides a comprehensive measure of the carbon footprint associated with household consumption, considering both the direct emissions from fuel use and the indirect emissions from the production of consumed goods and services.

The PRICES framework calculates CO_2 emissions produced by energy industries in each country and tracks energy usage across various industries. This method specifically addresses energy-related emissions, allowing for the simulation of carbon taxes based on energy consumption.

To estimate household carbon footprints, the model combines data from the World Input-Output Database (WIOD) and the Household Budget Survey (HBS). The HBS provides detailed expenditure data categorized by consumption purposes (COICOP), while the WIOD offers information on inter-industry flows and final consumption based on industry classifications (ISIC rev. 4 or NACE rev. 2).

3.1.4. Behavioural Estimates

Modelling household behaviour requires a demand system that connects the consumption of a specific good to its price, the prices of other goods, household income, and household characteristics. For a foundational overview of this field, see Deaton and Muellbauer (1980b).

The goal of a demand system is to analyze household spending patterns on related groups of items, which allows for the estimation of price and income elasticities and consumer welfare. This approach has been widely used since Stone's (1954) linear expenditure system (LES). Typically, the expenditure share serves as the dependent variable in such models. However, due to limited price variability, some adjustments to the approach are necessary.

Two widely used demand system methods include the translog system of Christensen et al. (1975) and the Almost Ideal Demand System (AIDS) developed by Deaton and Muellbauer (1980a), with the QUAIDS extension by Banks et al. (1997). In our application, we adopt a simpler method based on Stone's Linear Expenditure System, as described in Creedy (1998). Instead of estimating a complex system of demand equations, Creedy (1998) builds on a method by Frisch (1959), which expresses own and cross-price elasticities (η_i), budget shares (w_j) and the Frisch marginal utility of income parameter (ξ) for directly additive utility functions in terms of total expenditure elasticities. This approach offers a more straightforward way to analyze consumption behaviour and estimate the impacts of price changes on household expenditure. Own-and cross-price elasticities can be described as follows:

$$\eta_{ij} = -\eta_i w_j \left(1 + \frac{\eta_j}{\xi}\right) + \frac{\eta_i \delta_{ij}}{\xi}, \qquad (6)$$

where $\delta_{ij} = 1$ if $i = j$, 0 otherwise.

The total expenditure elasticity (η_i) can be defined:

$$\eta_i = 1 + \frac{dw_i}{dC}\frac{C}{w_i} = 1 + (\beta_i + 2\gamma_i \ln C)/w_i \qquad (7)$$

where C is total consumption expenditure. We estimate β_i and γ_i using OLS regression and the same specification as in equation (5). Further, to allow for differences in behaviour across population groups, we calculate w_i and C f for 10 population groups[1]. We omitted subscripts for population groups in equation (7) to improve readability. The Frisch parameter (ξ), can be defined as the elasticity with respect to total per capita nominal consumption spending of the marginal utility of the last dollar optimally spent.

Table 3.2 presents the budget and price elasticities obtained from the Linear Expenditure System (LES) using our dataset. The results show that for essential goods such as food, fuel, and clothing, as well as for tobacco and recreation, the budget elasticities are lower. This indicates that expenditures on these items are less responsive to changes in income (or total expenditure), suggesting they are necessities. Similarly, health and communication services have budget elasticities below 1, implying that spending on these items does not increase significantly as income rises. In contrast, most other consumption categories exhibit a budget elasticity close to 1, indicating a proportional relationship with changes in income.

On the other hand, expenditures on private education and durable goods show budget elasticities well above 1. This suggests that spending on these categories is more heavily concentrated among households with higher levels of expenditure, making them more of a luxury rather than a necessity.

There is a direct relationship between budget and price elasticities, resulting in a strong correlation between imputed own-price elasticities and budget elasticities. Goods with low budget elasticities, such as necessities like heating fuels, tend to be relatively insensitive to price changes. Although cross-price elasticities are not included in the report, they are generally smaller in magnitude compared to own-price elasticities, indicating that the substitution effects between different categories of goods are less pronounced.

Table 3.2 details the budget and price elasticities as well as the budget shares for the main energy sources and uses. Heating Fuels (with a budget share of 6.5%) have a budget elasticity of less than 1 and thus increases at a lower rate than total expenditure, reflecting relatively higher budget shares at the bottom of the income distribution. Motor fuels (with a budget share of 1%) (which has a very low budget share) have slightly higher budget elasticities of about 1, which means that the average budget share is relatively constant across the income distribution. Price elasticities relatively typical at -0.43 to -0.58. Heating fuels are slightly less press elastic that motor fuels.

Table 3.2. Budget and Own Price Elasticities for Energy and Transport

Energy Types	Budget Elasticities	Budget Shares (%)	Own Price Elasticities
Heating Fuels	0.77	6.53	-0.45
Electricity	0.77	0.04	-0.43
Motor Fuels	0.86	1.01	-0.48

Source: Authors' calculation (2024).

3.1.5. Energy Price Elasticities

To triangulate the PRICE model estimation presented in Table 3.2, Table 3.3 provides information on the price elasticities of various energy items in Indonesia for the first, fifth, and tenth expenditure deciles and the overall sample using the QUAIDS approach. These figures are calculated using SUSENAS 2022 data. Indonesian households generally are highly responsive to price changes for all energy items, with

[1] The ten population groups represent five population groups for two income groups. The population groups are singles, single person with children, couple without children, couples with children, and other households. The two income groups are below and above median income.

most own-price elasticities close to the unitary elastic, suggesting a more elastic nature of own-price energy consumption than the figures obtained from the PRICE model.

Among the four energy items, kerosene exhibits the strongest response to price changes, with price elasticity consistently above 2 for each decile. This figure warrants further discussion. The Government of Indonesia's kerosene-to-LPG conversion program, initiated in 2007, significantly reduced kerosene consumption nationwide, except in the easternmost region as discussed above. By 2022, most of the kerosene was consumed in these left-behind regions in Indonesia, primarily by low-income households who could not afford to switch to LPG, making them highly sensitive to any price change.

For electricity and fuel, the response to price changes is close to unitary elastic, with the price elasticity of electricity being slightly stronger than that of fuel. For LPG, price elasticity is above one for each decile and increases with income, indicating that higher-income households are more responsive to LPG price changes.

Table 3.3. Own and Cross Price Elasticities for Energy Items

Decile	Item	Price			
		Electricity	**Fuel**	**Kerosene**	**LPG**
1	Electricity	**-1.07**	0.11	0.01	0.15
	Fuel	-0.19	**-0.81**	-0.09	-0.58
	Kerosene	0.21	-0.16	**-2.33**	1.62
	LPG	0.25	-0.36	0.32	**-1.17**
5	Electricity	**-1.09**	0.13	0.02	0.21
	Fuel	-0.08	**-0.86**	-0.05	-0.25
	Kerosene	0.25	-0.29	**-2.64**	1.98
	LPG	0.36	-0.58	0.48	**-1.26**
10	Electricity	**-1.08**	0.06	0.02	0.17
	Fuel	-0.08	**-0.79**	-0.05	-0.21
	Kerosene	0.42	-0.86	**-3.91**	3.46
	LPG	0.60	-1.10	0.81	**-1.46**
Overall	Electricity	**-1.09**	0.11	0.02	0.19
	Fuel	-0.09	**-0.84**	-0.05	-0.26
	Kerosene	0.26	-0.32	**-2.73**	2.09
	LPG	0.37	-0.59	0.49	**-1.27**

Source: Authors' calculation (2024).

4. Unveiling the Impact of Policy Outcomes

4.1. Expenditure Drivers of Carbon Pricing

Figure 4.1 details the share of fuel expenditure across the equivalised household expenditure distribution. The budget share of the bottom of the distribution is about two thirds higher than the top of the distribution reflecting a frequently higher budget share of energy consumption at the bottom of the distribution. This driven in particular by heating fuels, both in terms of importance as measured by share, by the lower budget elasticity and the much bigger differential between the top and bottom of the distribution.

In Indonesia, liquid fuels have the highest budget share amongst heating fuels, followed by natural gas and coal (Figure 4.2). There is relatively little difference across the distribution, except for the higher share of coal at the bottom of the distribution.

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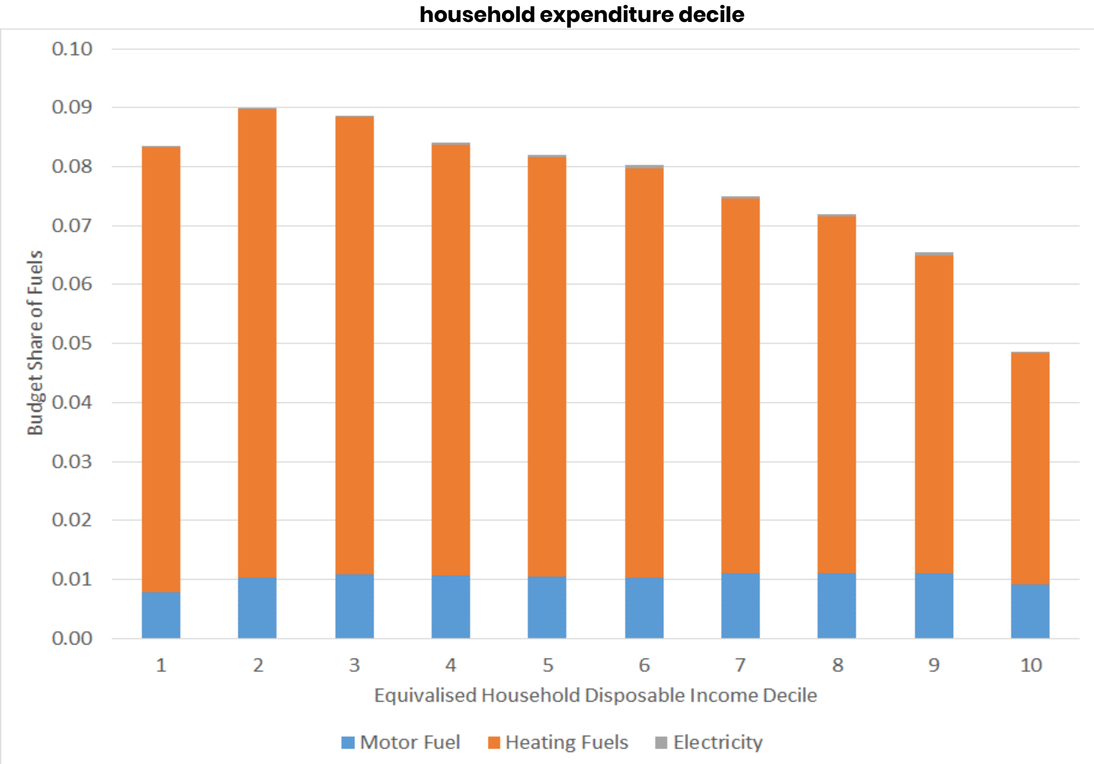
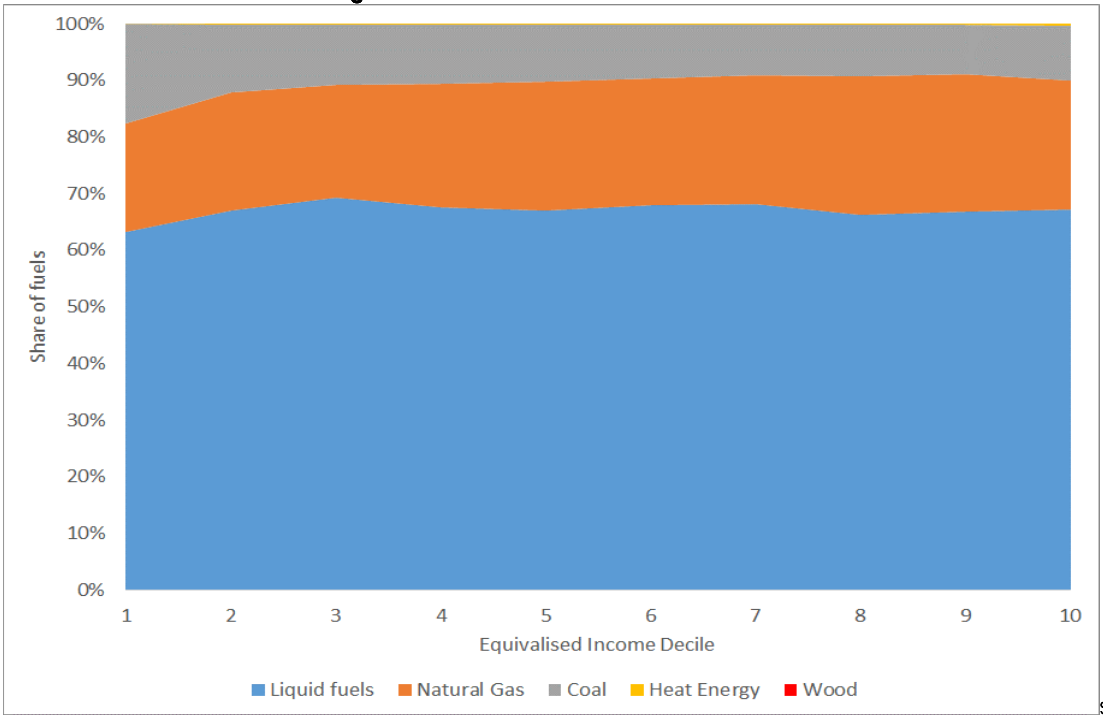
In Indonesia, liquid fuels have the highest budget share amongst heating fuels, followed by natural gas and coal (Figure 4.2). There is relatively little difference across the distribution, except for the higher share of coal at the bottom of the distribution.

Figure 4.19. Household expenditures on fuel and other energy, as a percentage of income, by equivalised household expenditure decile



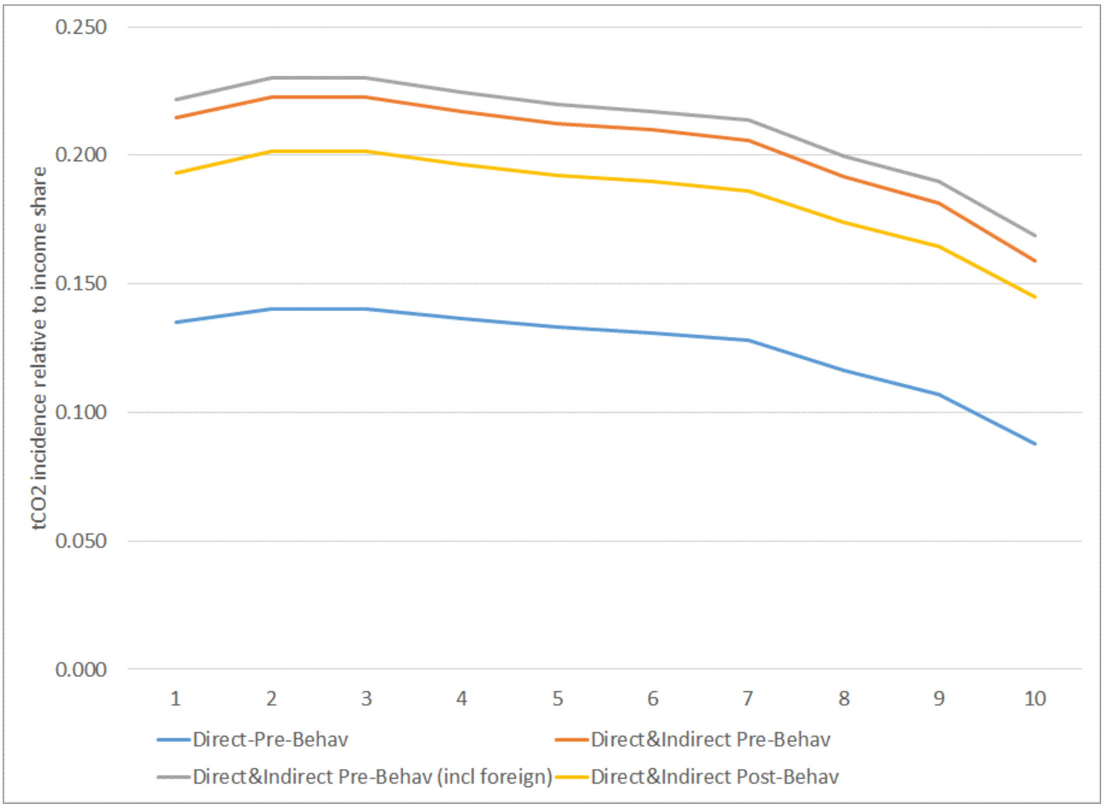
Source: Authors' calculation (2024).

Figure 4.20. Share of Fuels over the distribution



Source: Authors' calculation (2024).

Figure 4.21. Direct and Indirect Carbon Emissions tCO_2 relative to Decile Expenditure to Mean Ratio



Note: Each measure is calculated as the average decile tCO_2 divided by the ratio of the mean expenditure of the decile relative to the national mean expenditure.

Source: Authors' calculation (2024).

4.2. Distribution of carbon emissions

Carbon prices influence household budgets in both direct and indirect manners. On a direct level, they affect how much households spend on fuel for personal use, including heating and transportation. Indirectly, these prices raise the costs of goods and services by increasing the expenses linked to CO_2 emissions produced during their manufacturing. Figure 4.3 expresses the resulting emissions per household equivalised expenditure decile. Emissions are expressed relative to the decile mean expenditure and national mean expenditure. These emissions are expressed relative to income. Understanding the indirect emissions from non-fuel consumption is important for grasping the impact on different demographics, as these emissions are not always visible. Consumption patterns and associated carbon footprints can vary greatly among households, influenced by diet, spending on durable goods, and travel. At the bottom of the distribution, around 60% of emissions related to consumer activities are directly linked to households using fossil fuels. In comparison, this ratio falls to about 50% at the top of the distribution due to the relatively higher importance of other expenditures. The share of imported emissions is relatively small at, on average, 4.4%, ranging from 3% at the bottom of the distribution to 6% at the top.

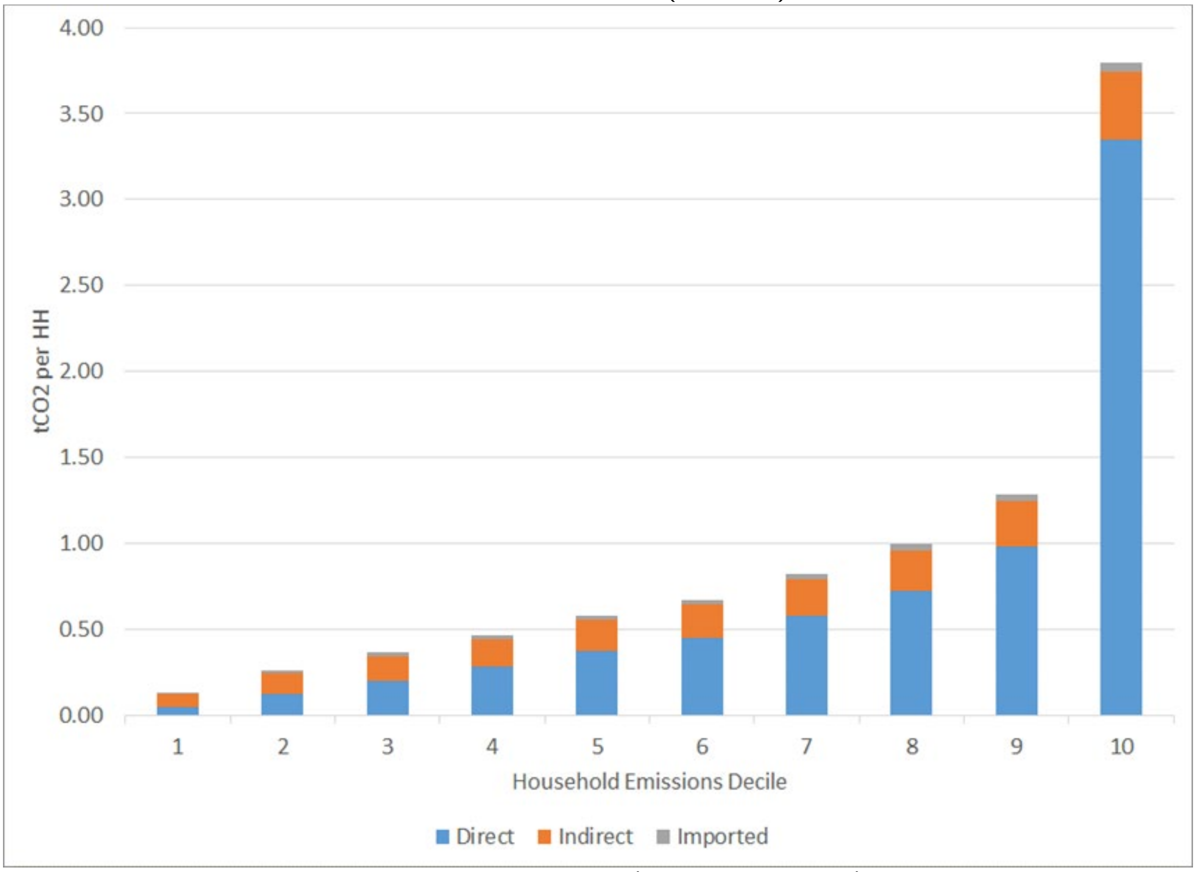
However, the range of emissions between the top and the bottom of the expenditure distribution is smaller than the range between the households with the highest and lowest emissions. To understand the range independent of income, we report in Figure 4.4 the average emissions (unadjusted for expenditure) per household, ranked according to total household emissions. While emissions per household increase steadily over the distribution, there is a threefold jump between the 9th and top decile. Overall, direct emissions are the most important, particularly at the top. This share rises over the distribution, with only about one-third of emissions amongst households, with the lowest emissions intensity being from direct energy consumption. At the top of the distribution, this rises to nearly 90%. Thus, direct emissions are by far the largest driver of differential emissions across the distribution.

The difference in emissions across the emissions distribution in Figure 4.4 reflects both the vertical distribution of emissions reflecting differences in income and horizontal differences associated with other household attributes. Figure 4.5 presents a comparative analysis of household characteristics between high- and low-emission households. The graphic displays the average value of each characteristic variable for different emission levels as a proportion of household income deciles concerning the overall average for the population. A higher value indicates a relatively greater importance of that category in that part of the distribution. On average, emissions increase with income, so factors associated with higher income, such as employment or university education, are represented to a greater extent at the top of the distribution, highlighting the vertical inequality linked to carbon pricing. However, the sex of the head of the household shows only a slight disparity over the distribution.

For rural households, both transport expenditures and solid fuels can represent a substantial portion of energy consumption, resulting in higher emissions. Conversely, urban areas tend to rely more on natural gas and liquid fuels, which has lower emissions per energy unit. While motor fuels are generally pricier, they also produce less CO_2 per unit than solid fuels. Additionally, non-fuel expenditures significantly impact household budgets. Families with more children are also more prevalent among households with higher emissions intensities than among those at the lower end of the distribution.

Counter to these horizontal dimensions is the share of over 65's, which are more prevalent at the bottom of the distribution, reflecting their lower incomes. According to Reaños et al. (2022), pensioners and residents of rural areas experience the highest horizontal inequality concerning carbon prices as a percentage of household income.

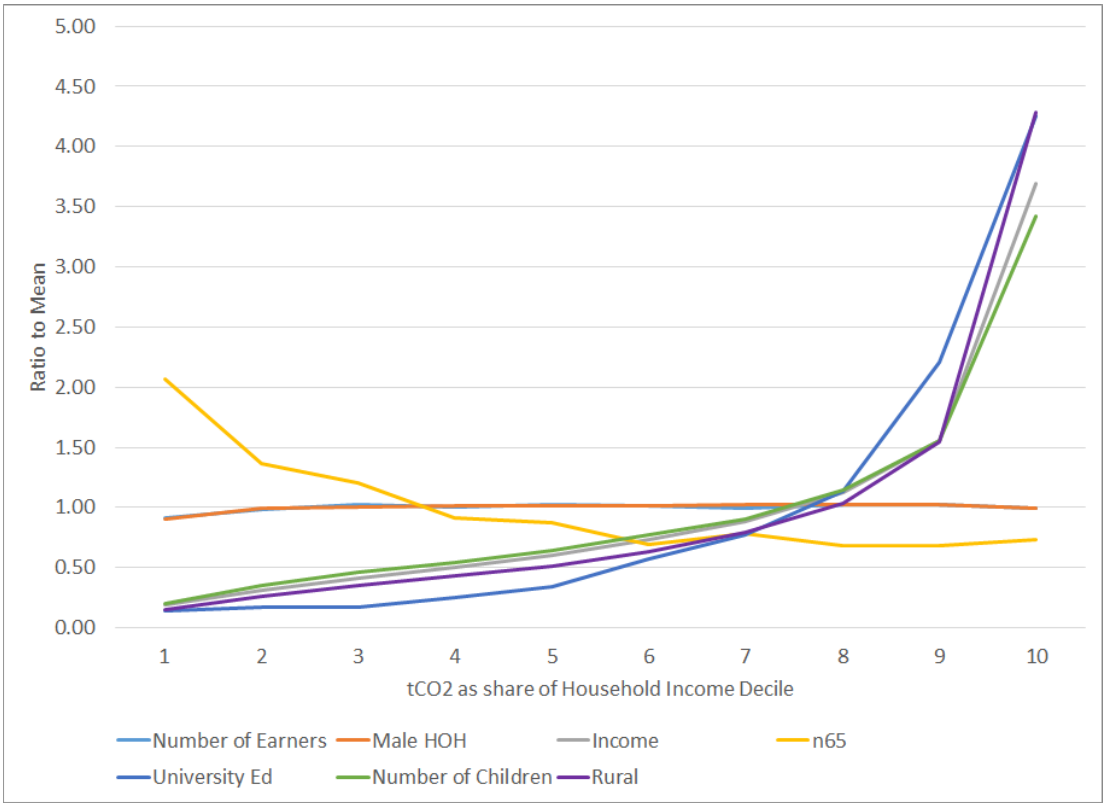
Figure 4.22. Emissions from household consumption, tCO_2 per household at different points in the national emissions distribution (Indonesia)



Note: Average emissions across the national emissions distribution (not income distribution), from lowest-emitting to the highest-emitting households. The ranking variable is emissions linked to household consumption, equivalised to account for household size. Estimates follow the "consumer responsibility" principle, accounting for all household consumption, including both domestically produced and imported goods.

Source: OECD calculations using IEA emissions factors for different fuels, WIOD Input-Output database as well as household budget surveys (2015).

Figure 4.23. Household characteristics at different emission levels (Ratio of the household characteristic relative to the mean) (Indonesia)



Note: The ratios compare socio-economic characteristics between high-emitting and low-emitting households (based on emissions as a percentage of household income) in the following ways: For the number of earners and children in the household, the ratio represents the average number of earners and children per household. For other categories, the ratio indicates the number of households located in rural areas, those headed by males, those led by individuals with tertiary education, or those headed by pensioners.

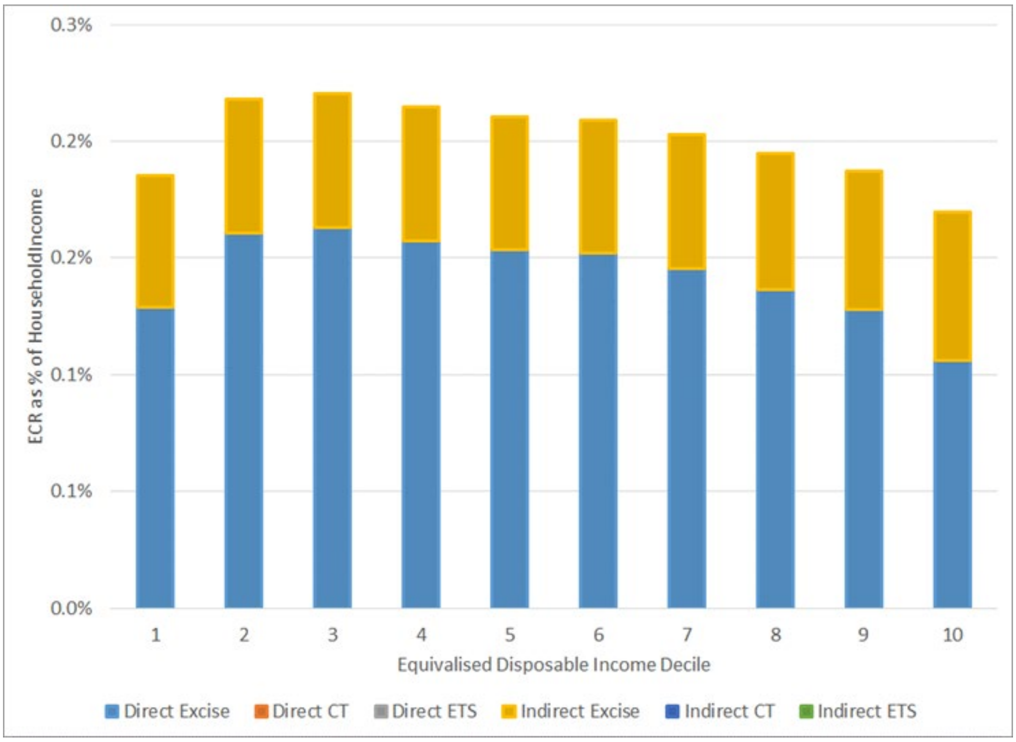
Source: OECD calculations using IEA emissions factors for different fuels, WIOD Input-Output database as well as household budget surveys (2015).

Figure 4.5 highlights the socio-economic disparities between high- and low-emitting households based on emissions as a share of income. Higher-emitting households tend to have more earners and higher incomes and are more likely to be led by individuals with tertiary education. These households also have more children and are predominantly urban, reflecting higher energy consumption associated with wealthier, city-based lifestyles. In contrast, lower-emitting households are more likely to be rural, pensioner-headed, and have fewer earners, suggesting lower income levels and reduced energy usage. The declining presence of elderly household heads and female-headed households in higher deciles further underscores the income-energy divide. These patterns emphasize that policies aimed at reducing household emissions must consider the economic and demographic realities of different household groups to ensure both effectiveness and equity in addressing the carbon footprints. These patterns emphasize that policies aimed at reducing household emissions must account for income levels, urbanization, and household composition to be effective. For instance, targeted subsidies for energy-efficient appliances in low-income households, expansion of affordable clean energy access in rural areas, and progressive carbon pricing that minimizes the burden on lower-income groups can help ensure a fair and effective transition to lower emissions.

4.3. Converting excise duties to carbon taxation

A common reform proposal related to carbon taxation is to move from differential indirect taxation to a common approach proportional to carbon emissions (Adam et al., 2022). It is reflected in actual policy reforms as in the case of Finland (Vehmas, 2005; Paukku, 2022) or in Ireland, where carbon taxes replaced the nominal growth in excise duties (de Bruin and Yakut, 2023). Figure 4.6 describes the distribution of excised duties both concerning direct fossil fuel consumption and in relation to excise duties paid in the production of other goods and services purchased by households. Excise duties are levied only on petrol and diesel in Indonesia (Table 1.1) at an equivalent rate of 2.6% and 4.3% of value respectively of diesel and petrol. Incidentally these are lower the VAT rate on fuels in Indonesia of 10% in 2021. As the budget share of motor fuel consumption does not vary that much over the income distribution (Figure 4.1), the distributional pattern of excised duties is relatively weak, but with direct consumption having the biggest impact on the overall distributional patterns.

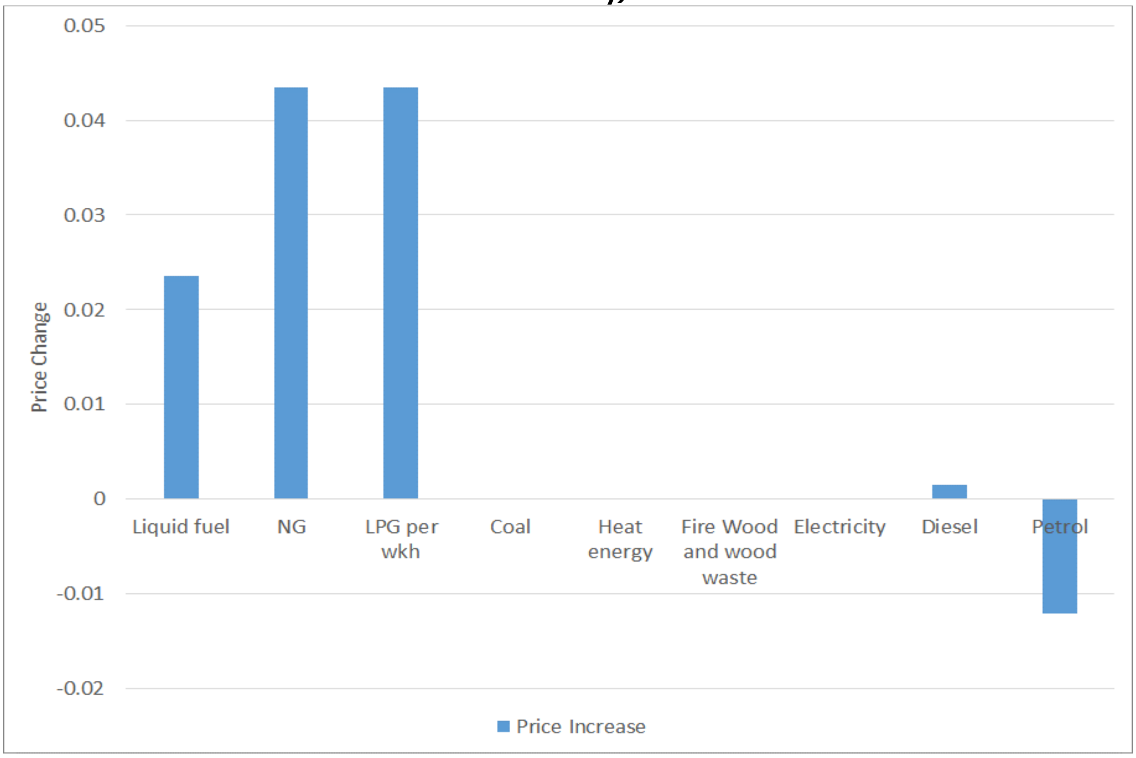
Figure 4.24. Excise Duties as a percentage of disposable income by equivalised disposable income deciles, 2021



Note: Excise – Excise Duties; CT Carbon Tax; ETS – Emissions Trading Scheme. D prefix means Direct; I prefix means Indirect.

Source: OECD calculations using IEA emissions factors for different fuels, WIOD Input-Output database as well as household budget surveys (2015).

Figure 4.25. Distributional Impact of Moving from Excise Duties to Carbon Taxes (Change in Price from Revenue Neutrality)



Source: OECD calculations using IEA emissions factors for different fuels, WIOD Input-Output database, and household budget surveys (2015).

Before a behavioural change and at an economy-wide level utilising data from the OECD Effective Carbon Rate database, converting excise duties to carbon taxes on a revenue-neutral basis would see a reduction in petrol taxes, with a slight increase in diesel taxes, but with the largest increases in Natural Gas.

Table 4.1 reports the redistributive characteristics of converting Excise Duties into a Carbon Tax. Two scenarios are considered a revenue-neutral version post behavioural response and an emissions-neutral version. The Gini of equivalised household expenditure for Indonesia is 46.5. Eliminating excised duties (column (A)) would reduce inequality slightly due to the regressive nature of Excise Duties with a Kakwani measure of progressivity of 0.2% with a relatively small overall tax rate. Moving to a revenue-neutral carbon tax would result in a slightly smaller redistributive impact as the excise duties are slightly less regressive than excise duties. There is no visible difference between the emissions-neutral and the revenue-neutral version.

Table 4.4. Decomposition of Drivers of the Distributional Impact of Climate Change

Indicators	ED	ED-CT (RN)	ED-CT (EN)	CT30
	A	B	C	D
Gini Pre-tax (G*100)	0.465	0.465	0.465	0.465
Gini post-Carbon tax (Gt*100)	0.463	0.464	0.464	0.466
Average Tax rate (ATR)	-0.010	-0.023	-0.023	0.021
Tax Concentration Coefficient (C)	0.264	0.407	0.407	0.409
Carbon Tax Regressivity (K)	-0.201	-0.058	-0.058	-0.056
Carbon Tax Suits Index (S)	-0.252	-0.073	-0.073	-0.070
Carbon Tax Redistribution (RS*100)	0.002	0.001	0.001	-0.001

Notes: G = Gini index of equivalized household Expenditure; Gt = Gini index of equivalized household expenditure minus equivalized household carbon tax; K = Kakwani = C - Gt; S = Suits index; RS = Reynolds-Smolensky = G - Gt; Calculations are based on equivalized household expenditure.

Scenarios – redistributive impact of ED –Excise Duties; ED-CT – Excise Duty to Carbon tax conversion; CT30 - Carbon tax of €30 per tCO_2; RN – Revenue Neutrality; EN – Emissions Neutrality

4.4. Introducing a carbon tax

We also considered in Table 4.1 the introduction of a carbon tax at €30 per ton of CO_2. The table presents the re-distributional effects of the carbon tax across different segments of the expenditure distribution before accounting for any behavioural responses. The findings indicate that the carbon tax has a slightly regressive impact, meaning it modestly reduces inequality. This effect is due to the tax being somewhat more concentrated on households at the upper-lower end of the expenditure distribution, making wealthier households bear a slightly higher relative burden compared to those with lower expenditures.

4.5. Revenue neutral mitigation measures

The carbon tax generates significant revenue, making the use of this revenue a crucial factor in determining its overall distributional impact, especially through the mechanism of revenue recycling. Figure 4.7 illustrates the changes in household welfare due to the carbon tax, without accounting for any revenue recycling. The analysis shows that the burden of the carbon tax tends to increase with expenditure levels across the distribution. However, the total impact, adjusted for behavioural responses, is slightly smaller. This reflects the lower share of purchased fuels among households at the bottom of the expenditure distribution, making them less affected by the carbon tax since non-purchased fuels are generally not subject to it.

We evaluate six potential mitigation measures funded through revenue recycling:

- An In-Work Benefit: This benefit is aimed at individuals with low incomes who are employed, tapering off as their incomes increase.
- Universal Basic Income (UBI): A flat-rate payment given to every adult.
- Targeted Benefit for Low-Income Households: This measure directs benefits to those below the poverty line, with the support tapering off completely as incomes rise.
- Targeted Benefit for Fuel-Poor Households: This approach targets households identified as being in fuel poverty, providing them with additional support.
- Proportional Reduction in Indirect Taxes: This scenario uses carbon tax revenues to proportionally reduce all existing indirect taxes.
- Proportional Reduction in Food-Related Indirect Taxes: Here, the revenue is specifically used to reduce taxes related to food consumption.
- Proportional Reduction in Income Taxes
- Increase in the Solar Panel Refit Tariff

Our analysis assumes that each of these measures is implemented as part of a revenue-neutral reform, meaning that all revenue collected through the carbon tax at the national level is fully redistributed to resident households. The in-work benefit is designed to provide support to working individuals, gradually reducing as their incomes rise. In contrast, the UBI offers a uniform payment to all adults, making it a more straightforward but broad-based approach to compensation.

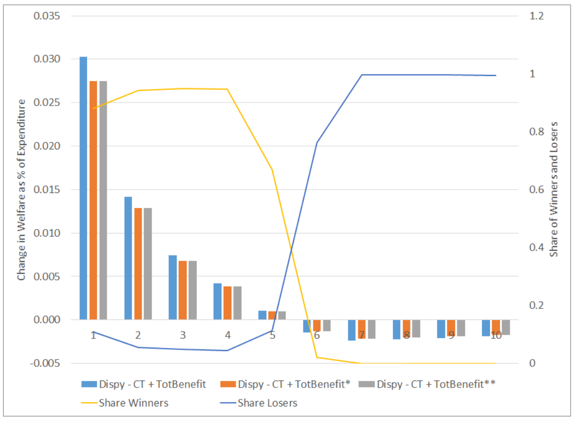
Targeted benefits offer more focused support. In one variant, the revenues are directed towards households below the poverty line, with the benefit fully phased out as income levels increase. Another variant targets household experiencing fuel poverty, aiming to alleviate the burden of higher energy costs specifically.

Lastly, using carbon tax revenues to reduce other taxes is often discussed in the context of environmental tax reform. We model two such scenarios: one in which the revenues proportionally lower all indirect taxes, and another where the focus is on reducing taxes that specifically impact food. These approaches are intended to offset some of the regressive effects of the carbon tax, by reducing the overall tax burden on consumers and potentially lowering the price of essential goods.

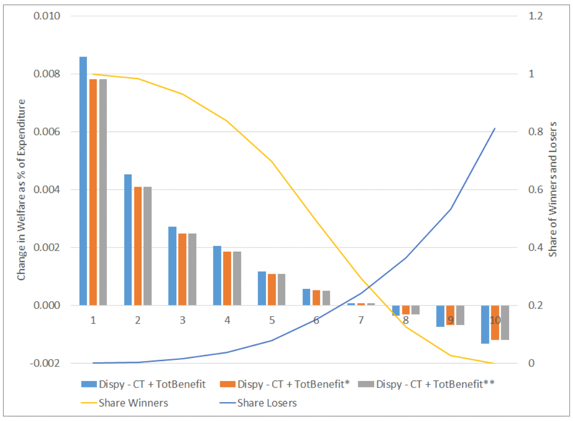
By exploring these different mitigation measures, the analysis aims to identify strategies that can balance the goals of reducing emissions and maintaining or improving equity across income groups.

Figure 4.26. Net Distributional Impact of a Carbon Tax with Revenue Recycling (as % of Expenditure)

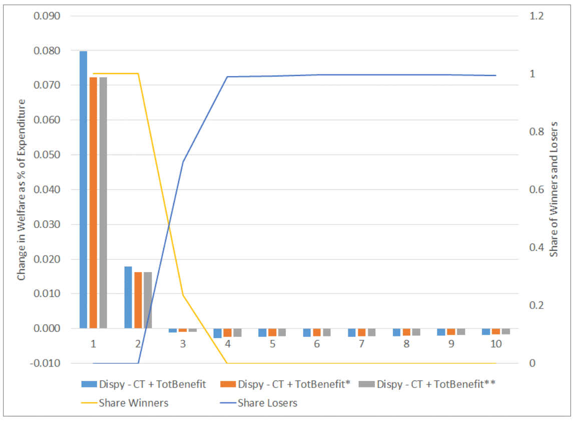
(a) In-Work Benefit



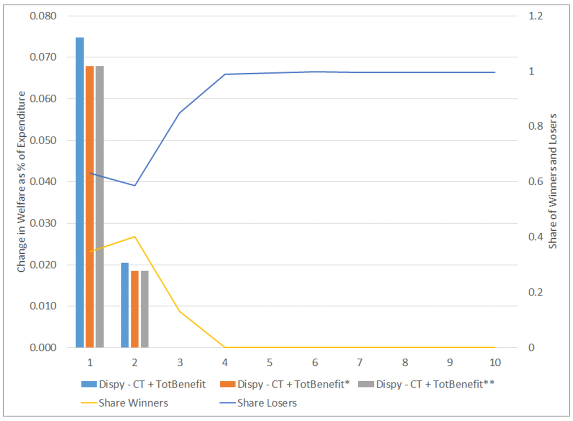
(b) Universal Basic Income



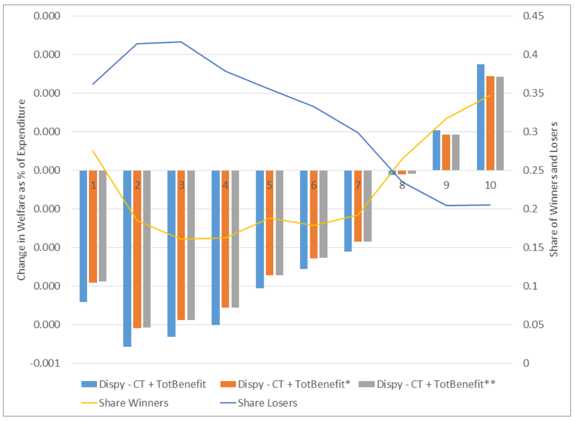
(c) Target Benefit



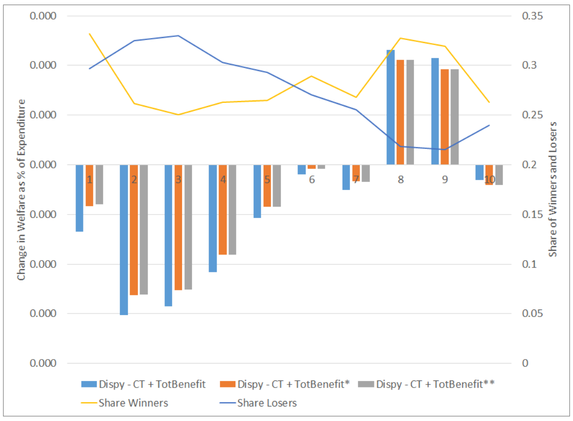
(d) Targeting Energy Poverty



(e) Proportional Indirect Tax Reduction



(f) Proportional Indirect Tax Reduction on Food



Note:

1. Dispy – CT + Measure: Net Impact Pre Behavioural Response; Dispy – CT + Measure *: Net Impact Post Price Behavioural Response; Dispy – CT + Measure **: Net Impact Post Income Behavioural Response
2. Deciles: Equivalised Expenditure

Source: Authors' calculation (2024).

Figure 4.8 presents several analytical measures, categorized by equivalised expenditure, to assess the impacts of a carbon tax and various revenue recycling measures:

- Expenditure minus carbon tax plus Measure: Net Impact Pre-Behavioural Response
- Expenditure minus carbon tax plus Measure: Net Impact Post Price Behavioural Response*
- Expenditure minus carbon tax plus Measure*: Net Impact Post Income Behavioural Response**
- Share of Winners and Losers (with "winners" defined as those whose post-tax expenditure increases by more than 0.5%, accounting for both price and budget elasticity adjustments, and "losers" defined similarly for losses).

4.6. Behavioural responses

Two types of behavioural responses are accounted for:

• Price Response: Reflects changes in household expenditure resulting from price increases due to the carbon tax.

• Income Response: Reflects changes in expenditure driven by shifts in income from the redistribution of carbon tax revenue, influenced by the budget elasticity.

In-Work Benefits (5.a): The analysis shows that the greatest gains as a percentage of expenditure occur in the lower deciles, while losses are concentrated in the top half of the distribution. This measure targets individuals who earn less than twice the poverty line and are employed. As a result, it significantly benefits those at the lower end of the distribution, but those unable to work do not receive benefits. The price response helps to offset some of the initial income loss caused by the carbon tax, while the income response is modest, leading to an overall progressive net impact. Given the high employment rates in Indonesia, this measure results in a larger proportion of winners among the lower-income groups.

Universal Basic Income (5.b): This approach produces less extreme gains and losses compared to the in-work benefit, but a broader base of beneficiaries, especially in the lower half of the distribution. The flat-rate nature of the UBI results in a more evenly distributed benefit, making it a more inclusive but less targeted approach to redistribution.

Means-Tested Benefits Targeted at Those Below the Poverty Line (5.c) and Energy Poverty Targeted Benefit (5.d): These measures achieve the highest gains for the poorest households, with winners concentrated heavily at the bottom of the expenditure distribution. However, the significant degree of targeting introduces concerns about creating "unemployment traps," where the incentives to seek or maintain employment are reduced due to the sharp tapering of benefits.

Reduction in Indirect Taxes (5.e): This method has the least pronounced distributional impact among the measures considered. The net changes in welfare are smaller across each expenditure decile compared to direct benefit payments. Lower-income households tend to benefit slightly more since they spend a larger share of their budget on non-fuel items, leading to a greater reduction in indirect taxes than the increase in their carbon tax burden. Conversely, the upper deciles see fewer winners.

Reduction in Food-Related Indirect Taxes (5.f): When revenue recycling is directed specifically at reducing taxes on food, there is a higher proportion of winners among lower-income households. This measure is especially beneficial for those at the bottom of the distribution, as food makes up a larger share of their overall spending.

4.7. Redistributive impact

The overall redistributive effects of these measures are quantified by examining changes in the Gini coefficient of equivalised expenditure before and after the carbon tax and revenue recycling (Figure 4.9).

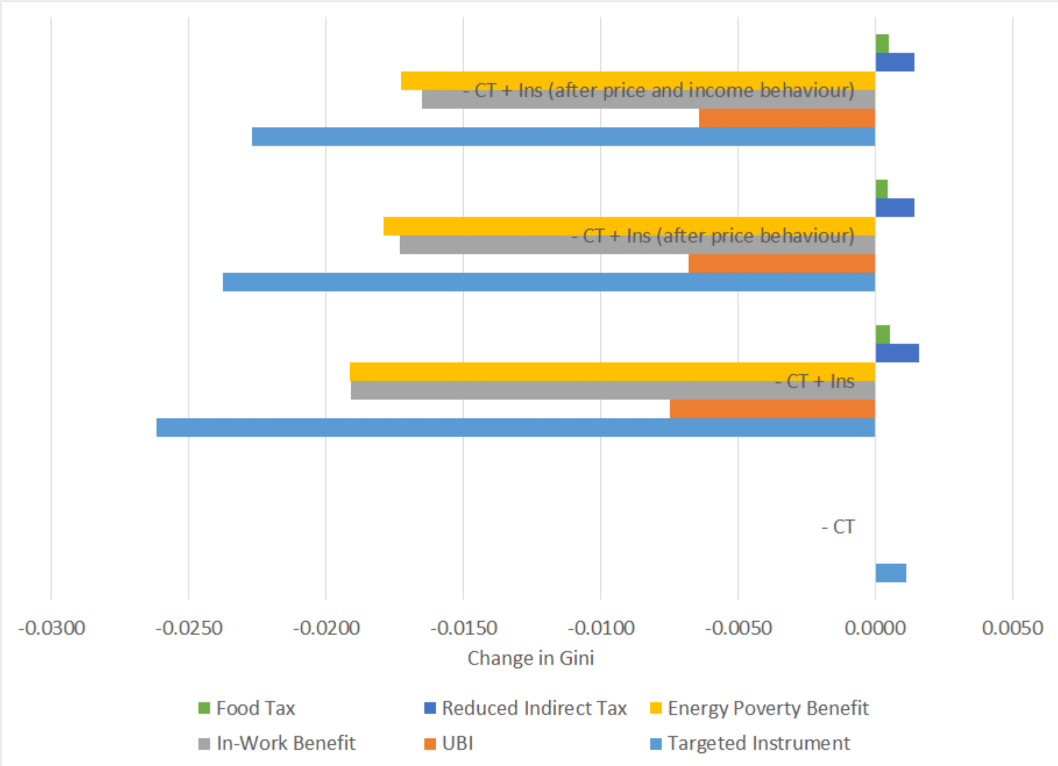
Key observations include:

- Revenue recycling drives distributional outcomes: The way carbon tax revenues are recycled has a larger effect on income distribution than the carbon tax itself, which tends to have a relatively neutral (flat) impact across income groups.
- Targeted transfers are most progressive: Allocating revenues to targeted transfer, such as cash benefits for low-income or energy-vulnerable households, results in the largest reductions in inequality, as reflected by notable declines in the Gini coefficient. However, this approach may weaken work incentives due to its focus on non-working households.
- In-Work Benefits Support Equity and Incentives: Channelling revenues into benefits for low-income workers is also progressive. It supports households with lower earnings while maintaining incentives to work. However, it excludes those not currently in the labor force.
- Lowering Indirect Taxes Has Limited Equity Gains: Using recycled revenues to cut indirect taxes benefits all households somewhat and offers modest relief for lower-income groups. However, it is less effective in addressing inequality compared to more targeted approaches.

In summary, the choice of revenue recycling mechanism significantly shape the equity outcomes of a carbon tax policy. Targeted benefits offer the greatest redistributive impact, whereas reductions in indirect taxes tend to have a more neutral effect. In the case of Indonesia, the strategy for recycling carbon tax revenue plays a more pivotal role in determining the overall distributional impact than the carbon tax itself.

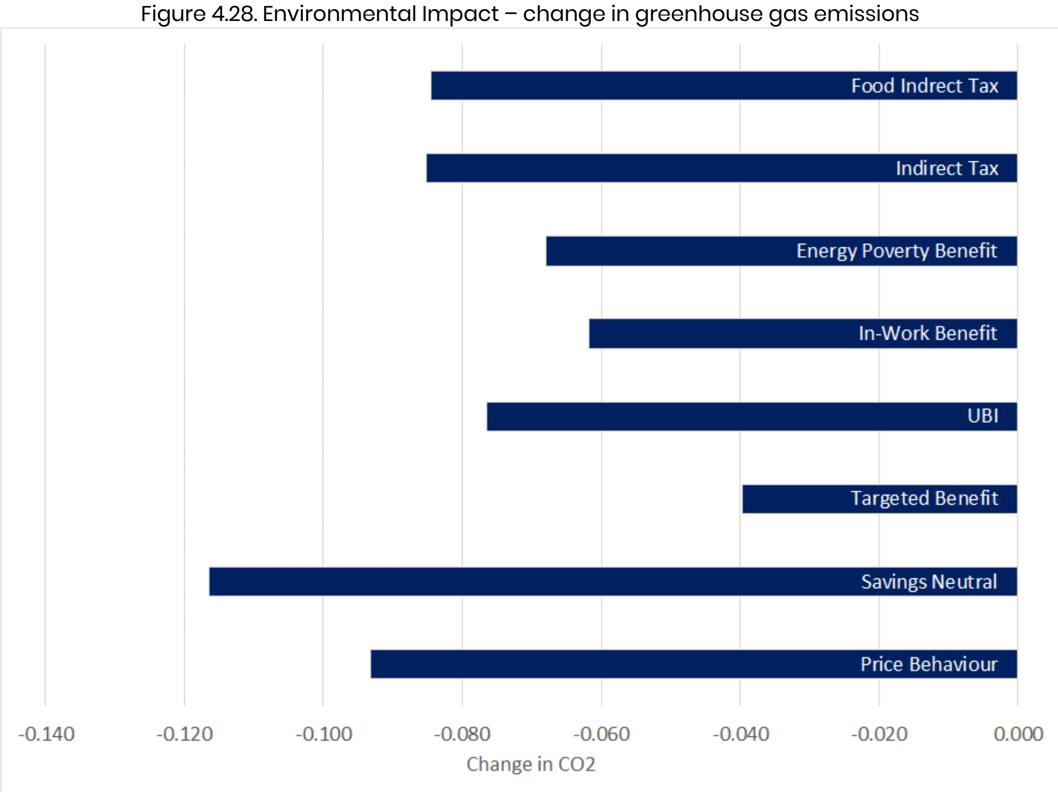
Figure 4.10 illustrates the changes in greenhouse gas (GHG) emissions resulting from the combined effects of the carbon tax and various revenue recycling strategies. It shows two scenarios for price-related impacts without revenue recycling: one based on a basic price elasticity and another assuming a fixed savings rate. The basic price elasticity scenario captures how households adjust their consumption in response to increased prices due to the carbon tax, resulting in a GHG emissions reduction of about 9%. Revenue recycling reduces the carbon reduction with the biggest reduction seen amongst the most targeted instruments.

Figure 4.27. Change in Gini for different Revenue Recycling Options (by behavioural change)



Source: Authors' calculation (2024).

Figure 4.28. Environmental Impact – change in greenhouse gas emissions



Source: Authors' calculation (2024).

4.8. Introducing an emissions trading scheme

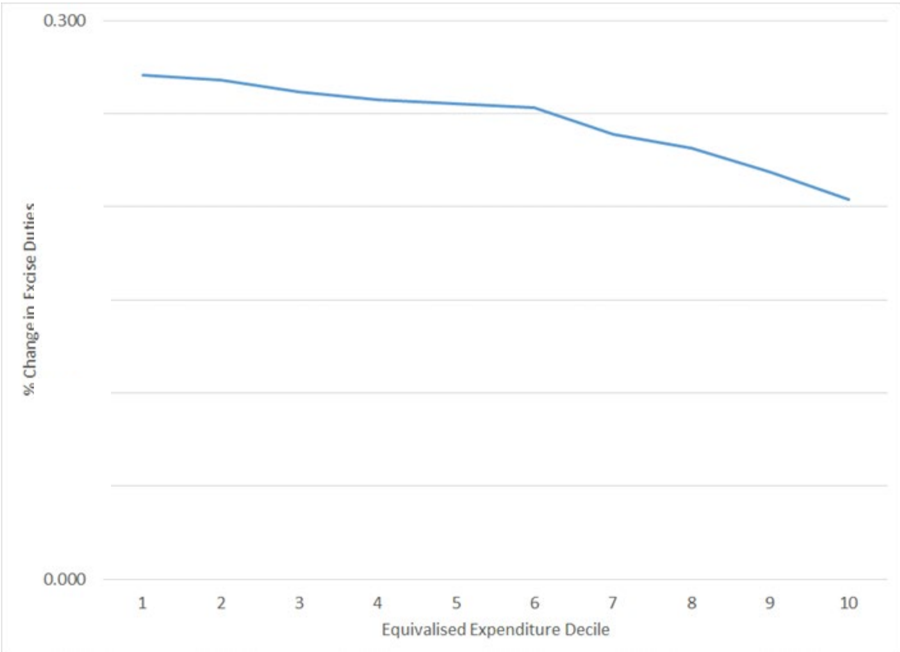
Indonesia is introducing an Emission Trading Scheme. On February 22, 2023, Indonesia's Ministry of Energy and Mineral Resources (MEMR) introduced a mandatory, intensity-based emissions trading system (ETS) targeting the power generation sector.

This new initiative applies to power plants with a production capacity exceeding 100 MW, although smaller coal and fossil fuel plants may be included later. Initially, the system will encompass 99 coal-fired power plants, which collectively contribute 81.4% of the country's total power generation capacity. Most of these facilities are operated by the state-owned electricity company, Perusahaan Listrik Negara (PLN). Intensity targets will be set by the government, dictating the number of allowances allocated per MWh of electricity produced. In total, it is projected that allowances equivalent to 20 million tCO_2eq will be distributed.

The ETS will roll out in three stages. The first phase (2023-2024) will focus exclusively on coal-fired power plants. During the second (2025-2027) and third (2028-2030) phases, the government intends to extend the system's scope to include oil and gas-fired power plants, as well as coal-fired power plants not connected to PLN's grid.

Figure 4.11 describes the distributional impact relative to existing direct and indirect excise duties (Figure 4.6). The reform sees an increase in indirect taxes of about 23% varying from an increase of about 27% at the bottom of the distribution to a 20% increase at the top of the distribution. As the existing Excise Duties are only slightly regressive, the net impact of the proposed ETS would be a minor increase in this regressivity.

Figure 4.29. Distributional Impact of a new Emissions Trading Scheme on Coal Electricity Generation as % of Total Excise Duties



Source: Authors' calculation (2024).

4.9. Energy subsidy removal

This section presents the microsimulation results for energy subsidy removal in Indonesia. Table 4.2 details the projected effects of eliminating energy subsidies across the country. The table shows that energy subsidies in Indonesia have limited redistributive impact, with the overall Gini index barely changing after subsidy implementation. Most subsidies, particularly for gasoline and gasoil, are regressive and benefit richer households, as indicated by their high concentration coefficients and negative Kakwani and Suits indices. In contrast, electricity subsidies—especially for 450 VA and 900 VA users—are better targeted to poorer households and show more progressive characteristics. However, the fiscal value of these subsidies is small, resulting in minimal overall redistribution. This suggests that removing regressive subsidies (like gasoline and gasoil) would not significantly worsen inequality, while preserving or converting well-targeted subsidies (like electricity) into direct transfers could maintain benefits for the poor and improve policy efficiency.

Nevertheless, the inequality impact of subsidy removal appears slightly greater than that of a well-designed carbon tax. As shown in the comparison, implementing a carbon tax without compensation (CT30) marginally increases inequality, but less so than the regressive impact of subsidies. More importantly, when carbon tax revenues are recycled—through revenue-neutral or equal nominal compensation schemes—the inequality effects are nearly neutral. This suggests that carbon pricing, if paired with effective compensation, may offer a more equitable and efficient alternative to broad energy subsidies.

Table 4.5. Distributional Impact of Energy Subsidy Removal in Indonesia

Indicator	Total	Gasoline	Gasoil	Kerosene	LPG	Electricity (450)	Electricity (900)	Electricity (Total)
Gini Pre-subsidy (G*100)	0.465	0.465	0.465	0.465	0.465	0.465	0.465	0.465
Gini Post - subsidy (Gt*100)	0.468	0.465	0.465	0.465	0.466	0.466	0.465	0.466
Average rate (ATR)	0.0078	0.0031	4e-06	0.0001	0.0026	0.0016	0.0003	0.0019
Tax Concentration Coefficient (C)	0.118	0.397	0.467	0.183	0.055	-0.237	-0.29	-0.246
Regressivity (K)	-0.343	-0.064	0.006	-0.278	-0.406	-0.698	-0.751	-0.707
Suits Index (S)	-0.354	-0.097	-0.034	-0.342	-0.434	-0.646	-0.692	-0.654
Redistribution (RS*100)	-0.003	0	0	0	-0.001	-0.001	0	-0.001

Notes: G = Gini index of equivalized household Expenditure; Gt = Gini index of equivalized household expenditure minus equivalized household carbon tax; K = Kakwani = C - Gt; S = Suits index; RS = Reynolds-Smolensky = G - Gt; Calculations are based on equivalized household expenditure.

5. Summary insights and actionable recommendations

5.1. Key takeaways from the study

The section on inequality discusses income and expenditure inequality, showing that regional, educational, and employment disparities are present in Indonesia. These assessments are directly relevant to the microsimulation analysis of a carbon tax, which provides a basis for its distributional effects, behavioural responses, and policy trade-offs. Given that lower-income households spend a larger proportion of their income on energy, the carbon tax's regressive effects (higher relative burden on the poor) must be compensated with any revenue-neutral scenario based on the territorial divide. Non-eastern regions (Java, Sumatra, Bali, and Kalimantan) tend to have higher mean expenditures, better energy access, and stronger economic resilience to price shocks. In contrary, Eastern regions (Maluku, Papua, East Nusa Tenggara, and North Maluku) remain severely disadvantaged in terms of electrification, LPG access, and fuel availability, making a one-size-fits-all carbon tax more highly regressive in these areas.

Moreover, considering Indonesia's current energy landscape, a direct CO_2 emissions-based carbon tax may not be the most feasible starting point. Instead, Indonesia should adopt a fuel-based carbon taxation approach phase. This territorially differentiated strategy ensures a just energy transition, minimizes regional disparities, and enhances policy feasibility while gradually moving toward broader carbon pricing mechanisms after the complete elimination of energy subsidies. Given that Indonesia still heavily subsidizes fuel and electricity, moving directly to a CO_2-based tax would create inconsistencies in the tax system. A fuel-based tax allows for a gradual transition while avoiding excessive burdens on energy-insecure regions. A fuel-based carbon tax, applied after the full removal of subsidies, minimizes the sudden burden on low-income and energy-insecure households especially in the disadvantaged regions. Revenue from a fuel-based carbon tax can be reinvested into regional energy access improvements, especially in eastern Indonesia. Given the wide range of revenue-neutral options, the next section ranks the administrative feasibility of any carbon tax package and scenarios.

5.2. Policy recommendations considering administrative feasibility for a just transition

Given Indonesia's current fiscal structure, political realities, and administrative capacity, the following policy options are ordered from the most feasible to the least administrative feasible:

5.2.1. Reduction in Food-Related Indirect Taxes (5.f) (Most Feasible)

- This measure generates a high proportion of winners among low-income households.
- Food expenditures constitute a substantial share of spending for the poorest deciles, making this a highly equitable measure.
- Politically viable as it mitigates regressive impacts while being relatively straightforward to implement, it uses the existing VAT administration in Indonesia.

5.2.2. Reduction in Indirect Taxes (5.e)

- Provides moderate but widespread welfare benefits, especially for lower-income groups.
- Implementation is relatively easy since it builds upon existing tax structures.
- Net welfare effects are modest, making this a less impactful but politically acceptable step.

5.2.3. Energy Poverty Targeted Benefit (5.d)

- Ensuring substantial benefits for the most vulnerable households.

- Targeting mechanisms need to be improved, but it can be implemented alongside existing social assistance schemes.
- • Requires medium-term administrative reforms to enhance effectiveness.

5.2.4. Means-Tested Benefits Targeted at Those Below the Poverty Line (5.c)

- Achieves the highest gains for the poorest households.
- Implementation is challenging due to risks of "unemployment traps."
- Requires significant improvements in beneficiary identification and administrative capacity.

5.2.5. In-Work Benefits (5.a)

- Progressive impact and effective in benefiting the working poor.
- Requires extensive administrative infrastructure to track employment status.
- Less inclusive as it excludes those unable to work, limiting its social protection role.

5.2.6. Universal Basic Income (5.b) (Least Feasible in the Short Term)

- Provides broad-based redistribution benefits.
- Indonesia lacks a robust social protection database, making UBI implementation challenging.
- High fiscal costs make it politically and economically difficult to sustain without major reforms.

5.3. Final remarks

Based on distributional impacts, feasibility, and political constraints, a phased approach is recommended:

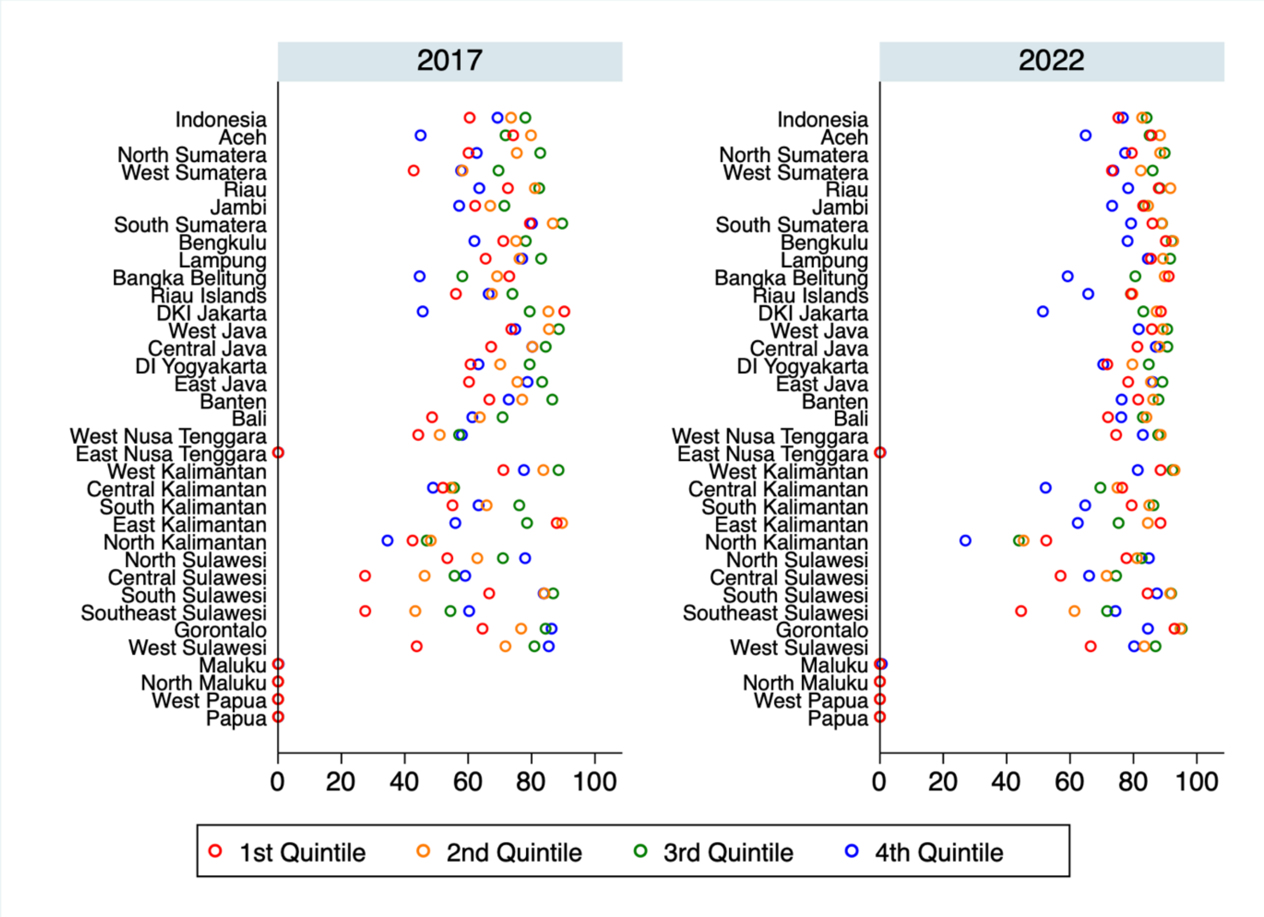
1. Pre-carbon tax implementation: removal of energy subsidy
2. Short-Term (Immediate Implementation): Reduction in food-related indirect taxes and reduction in indirect taxes.
3. Medium-Term (Gradual Expansion): Energy poverty targeted benefits and means-tested benefits.
4. Long-Term (Structural Reforms Needed): In-work benefits and universal basic income.

5.4. Political Feasibility Consideration:

Due to Indonesia's substantial energy subsidies, implementing a full CO_2-based tax is only feasible after a fuel-based milestone is implemented.

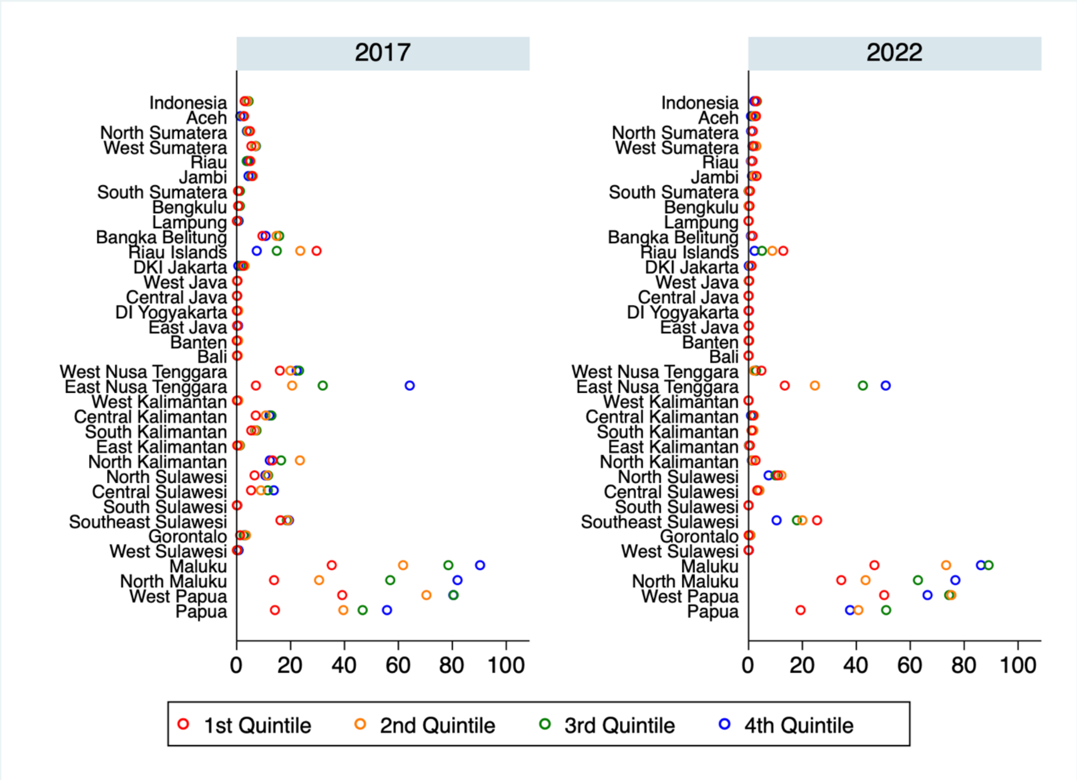
Appendix

Appendix 1. Progress on the 3 Kg LPG Consumption from 2017 to 2022 by Province and Expenditure Quintile



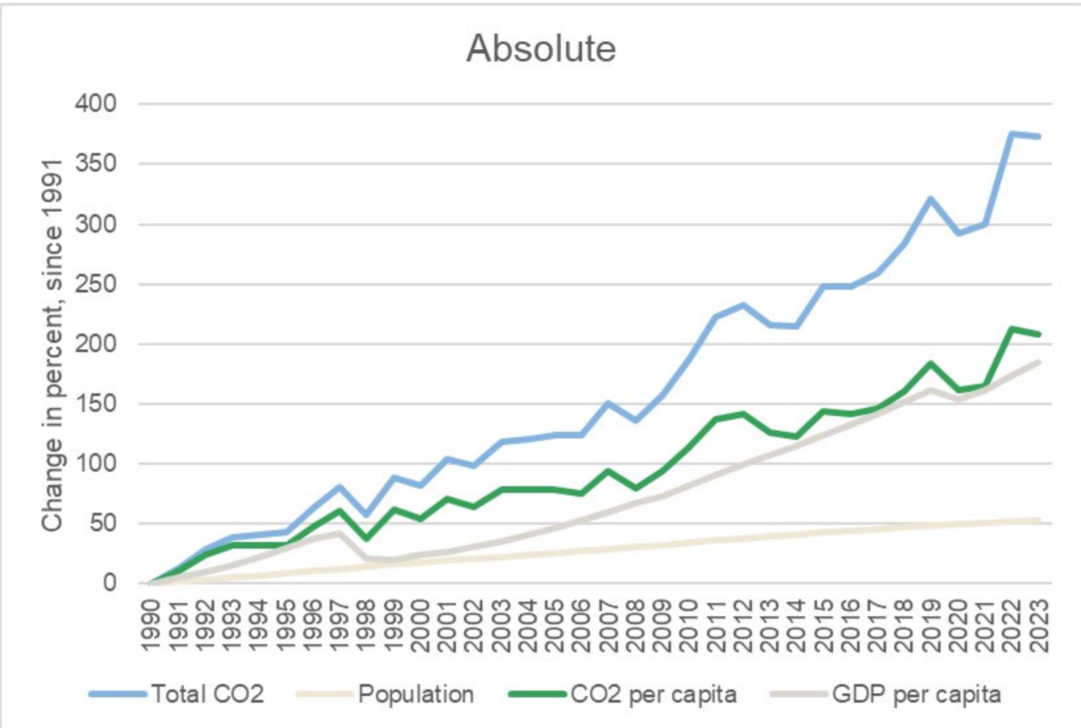
Source: SUSENAS, 2017 and 2022 (processed by author)

Appendix 2. Progress on the Kerosene Consumption from 2017 to 2022 by Province and Expenditure Quintile



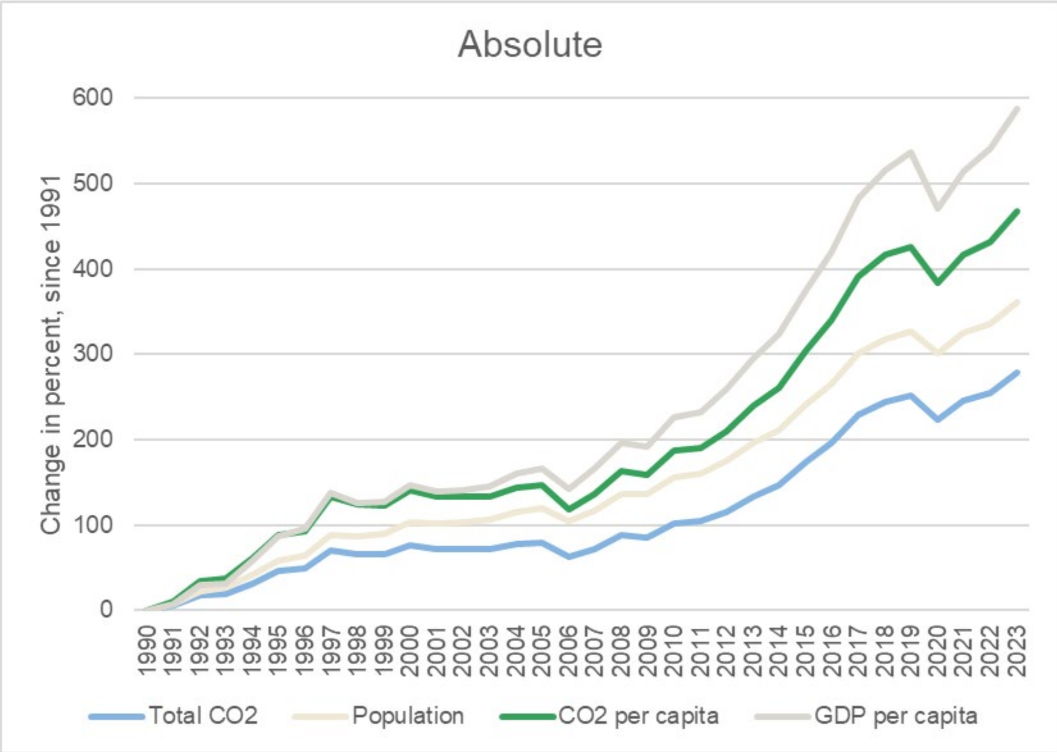
Source: SUSENAS, 2017 and 2022 (processed by author)

Appendix 3. CO_2, Population, and GDP Comparison for Indonesia



Source: Global Change Data Lab (2025), processed

Appendix 4. CO_2, Population, and GDP Comparison for Philippines



Source: Global Change Data Lab (2025), processed

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Liste des sigles et abréviations

ADB	Asian Development Bank
AFD	Agence française de développement
AEDP	Alternative Energy Development Plan (Thailand)
BBM	Bahan Bakar Minyak (fuel/gasoline)
BBTUD	Billion British Thermal Unit per Day
BKF	*Badan Kebijakan Fiskal (Ministry of Finance, ex-Fiscal bureau)*
BLT	Bantuan Langsung Tunai (direct cash transfer)
BPS	Badan Pusat Statistik (*Central Statistical Office*)
Bappenas	Kementerian Perencanaan Pembangunan Nasional/Bappenas (*planning ministry*)
CEQ	Commitment to Equity
CO2/CO_2	Carbon dioxide
CPI	Consumer Price Index
CT	Carbon Tax
CT30	Carbon tax set at €30 per tCO_2
DTKS	Data Terpadu Kesejahteraan Sosial (*Integrated Social Welfare Data*)
ECR / ECRs	Effective Carbon Rate(s)
ED	Excise Duties
ED-CT	Excise Duty to Carbon Tax (konversi)
EEG	Erneuerbare-Energien-Gesetz (*Renewable Energy Sources Act -Germany*)
EN	Emissions Neutrality
ETS / ETSs	Emission(s) Trading System(s)
EUR	Euro
FAO	Food and Agriculture Organization
FIT / FiTs	Feed-in Tariff(s)
G	Gini index of equivalized household expenditure
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GoI	Government of Indonesia
Gt	Gini index after carbon tax (definisi dalam tabel indeks)
HBS	Household Budget Survey
IDR	Indonesian Rupiah
IEA	International Energy Agency
IMF	International Monetary Fund

IPP / IPPs	Independent Power Producer(s)
JET	Just Energy Transition
kWh	kiloWatt-hour
LCU	Local Currency Unit
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MEMR	Ministry of Energy and Mineral Resources
METI	Ministry of Economy, Trade and Industry (Japan)
MMBTU	Million British Thermal Units
MoEF	Ministry of Environment and Forestry
MoF	Ministry of Finance
NDC	Nationally Determined Contributions
NEM	Net Energy Metering
OJK	Otoritas Jasa Keuangan (*Financial Services Authority of Indonesia*)
OECD	Organisation for Economic Co-operation and Development
PKH	Program Keluarga Harapan (*Family Hope Program*)
PLN	Perusahaan Listrik Negara
PRICES	Prices, Revenue Recycling, Indirect Taxation, Carbon, Expenditure Simulation model
PSKS	Program Simpanan Keluarga Sejahtera (*Family Welfare Savings Program*)
PSO	Public Service Obligation(s)
Pertamina	Perusahaan Pertambangan Minyak dan Gas Bumi Negara (*oil&gas public company*)
RN	Revenue Neutrality
RON	Research Octane Number (context: Pertalite RON 90 gasoline)
RS	Reynolds-Smolensky index
S	Suits index
SRN-PPI	Sistem Registri Nasional – Pengendalian Perubahan Iklim (*National Registry System*)
TNP2K	Tim Nasional Percepatan Penanggulangan Kemiskinan (*National Team for the Acceleration of Poverty Reduction*)
UBI	Universal Basic Income
USD	United States Dollar
VA	Volt-Ampere
VAT	Value Added Tax
VoA	Voice of America
WIOD	World Input-Output Database

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