The Distributional Economics of Green Fiscal Reform: Evidence from Indigenous and Rural Southeast Asia (Fiscal Equity, Revenue Recycling, and Household Welfare)

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Abstract

Green fiscal reforms are critical for Southeast Asia's low-carbon transition but risk exacerbating inequality without equitable design. This study provides the first comparative regional analysis of the distributional impacts of fossil fuel subsidy removal across ASEAN, integrating microsimulation with institutional diagnostics. Using household data from Indonesia and the Philippines, we find stark heterogeneity: subsidy removal is regressive in Indonesia (poorest quintile burden: 1.43% vs. richest: 1.12%) but progressive yet severe in the Philippines (average burden: 31.11%). Targeted cash transfers can fully offset welfare losses for Indonesia's poorest, but only 66.6% in the Philippines, highlighting the constraining role of institutional capacity—especially financial inclusion, which ranges from 98% in Singapore to 39% in Cambodia. We propose a tiered policy framework where equitable outcomes depend on tailoring compensation mechanisms—from digital transfers to in-kind investments—to national delivery systems and the specific vulnerabilities of Indigenous and rural communities.

JEL Codes: H23, Q48, Q58, I38
Keywords: Green fiscal reform, Just transition, Southeast Asia, Indigenous communities, Revenue recycling, Energy poverty

1 Background and Motivation

Indigenous and rural communities across Southeast Asia face disproportionate vulnerability to the twin forces of climate change and economic transition. This vulnerability is

compounded by the region's role in the global economy—as both a manufacturing hub and a source of natural resources—which often leads to localized pollution burdens and the exploitation of natural resources. Such patterns, documented in the literature as disproportionately impacting communities near industrial zones ([26, 28]) and displacing Indigenous peoples while degrading biodiversity ([15, 1]), create a landscape of environmental injustice. It is against this backdrop that national green fiscal policies are being designed and implemented.

Countries in the region—from lower-middle-income nations like Cambodia, Laos, and Timor-Leste to emerging economies like Vietnam, Thailand, and Malaysia—are at varying stages of designing and implementing domestic green fiscal policies as central tools for the low-carbon transition (see [27, 30, 3]). These include fossil fuel subsidy reforms, carbon pricing mechanisms, and the strategic use of environmental taxes. Such policies are essential for correcting environmental externalities and mobilizing the domestic revenues needed for adaptation and investment. However, their design is fraught with equity challenges. "Climate change effects—rising sea levels and extreme weather events—have gravely impacted Indigenous and rural communities, deepening social inequities" ([4, 14]). Without careful design, fiscal reforms risk exacerbating these inequities by increasing the cost of living for households that are both highly exposed to climate shocks and financially precarious.

The international context, including climate finance from developed nations, can influence domestic policy space. Yet, as noted, such support "often lacks sufficient scale and accessibility, leaving vulnerable communities underfunded" ([23, 2]). It underscores the primacy of domestic fiscal policy as a lever under direct government control. The critical question becomes: *How do the design and implementation of green fiscal policies—and their associated revenue recycling mechanisms—affect the welfare and resilience of Indigenous and rural communities across differing Southeast Asian country contexts, and what policy configurations are most effective in promoting an equitable transition?*

This research is motivated by the urgent need for a comparative regional analysis of these domestic fiscal instruments. We find that the distributional impact of green fiscal reforms in Southeast Asia is highly heterogeneous and context-dependent—a phenomenon not yet comprehensively analyzed across ASEAN nations in a manner that integrates quantitative microsimulation with qualitative institutional diagnostics. In Indonesia, a 100% fossil fuel subsidy removal imposes a regressive burden (1.43% of expenditure for the poorest quintile vs. 1.12% for the richest), while in the Philippines, the same policy yields a progressive but severe average burden of 31.11% of household expenditure. Crucially, the effectiveness of compensation is constrained by institutional capacity: poverty-targeted transfers can offset 100% of the welfare loss for Indonesia's poorest quintile, but only 66.6% in the Philippines. Equitable outcomes are only achievable when revenue recycling strategies—ranging from targeted digital transfers to univer-

sal in-kind investments—are explicitly tailored to local delivery systems and the distinct vulnerabilities of Indigenous and rural communities.

By examining the fiscal incidence and potential compensatory mechanisms across a spectrum of Southeast Asian nations, we can identify transferable lessons for designing equitable green fiscal policies. The goal is to generate actionable, domestic-focused knowledge that helps ensure the energy transition does not exacerbate existing inequalities. Instead, it creates pathways for inclusive, resilient development for the region's most vulnerable populations.

This paper unfolds its comprehensive analysis in five structured sections. **Section 2** conducts a critical review of the literature, analyzing theoretical foundations in environmental fiscal reform, distributive justice, and the political economy of climate policy in Southeast Asia. **Section 3** details the meticulous mixed-methods approach, including the two-stage static microsimulation model, data harmonization strategy, and qualitative institutional assessment framework. **Section 4** presents and compares the empirical findings from Indonesia and the Philippines, examines the efficacy of various revenue recycling mechanisms, and situates these results within a broader eight-country institutional matrix. Finally, **Section 5** synthesizes the conclusions, discusses their implications for a just transition, and offers concrete, context-sensitive policy recommendations for equitable green fiscal design across the ASEAN region.

2 Conceptual Framework & Literature Review

2.1 Theoretical Foundations: Efficiency, Equity, and Justice

The design of green fiscal reforms sits at the critical intersection of environmental economics, public finance, and theories of distributive justice. The primary theoretical justification for such policies stems from Pigouvian taxation, which prescribes levying taxes equal to the marginal social damage of pollution to correct negative environmental externalities [21]. Similarly, the reform or removal of fossil fuel subsidies is advocated to eliminate price distortions that encourage overconsumption of carbon-intensive energy, thereby aligning private costs with social costs [8]. While economically efficient for internalizing environmental costs, these price-based instruments inherently raise a fundamental equity-efficiency trade-off. An increase in the price of essential energy goods constitutes a regressive consumption tax if it represents a larger share of expenditure for lower-income households compared to wealthier ones [25]. This is particularly acute in Southeast Asia, where rural and Indigenous households often rely heavily on subsidized kerosene, diesel, or liquefied petroleum gas (LPG) for basic cooking, lighting, and transportation [27, 14].

Consequently, the analysis must be embedded within just transition and distributive

justice frameworks. A just transition demands that the shift to a low-carbon economy is fair, inclusive, and creates decent work while rectifying, rather than exacerbating, existing inequalities [18]. This research draws on the principles of procedural justice (meaningful participation of affected communities in policy design), distributional justice (equitable allocation of costs and benefits), and recognition justice (acknowledging the distinct vulnerabilities and rights of Indigenous peoples) [24, 1]. The literature underscores that Indigenous and rural communities in Southeast Asia face compounded vulnerabilities: they are geographically exposed to climate impacts, economically dependent on climate-sensitive natural resources, and often socio-politically marginalized, lacking a voice in policy processes [4, 15]. Therefore, a green fiscal policy that merely achieves aggregate emission reductions at their expense would fail both ethical and political legitimacy tests.

2.2 Conceptual Model: From Policy Levers to Equitable Outcomes

To systematically analyze the channels through which green fiscal policies affect household welfare, we propose the following conceptual model. The model posits that institutional context moderates every stage of the causal pathway.

The explanations are as follows. (a) **Policy Inputs:** These are the government's chosen fiscal instruments, such as a carbon tax, an environmental excise duty, or a phase-out of fossil fuel subsidies. The design specifics (e.g., tax rate, coverage, phase-out schedule) are the initial levers. (b) **Price Changes (Δp):** The policy input directly affects the final consumer prices of energy goods (e.g., gasoline, electricity, LPG). The magnitude of Δp depends on world energy prices, pre-existing subsidy levels, and market structure. (c) **Household Impacts:** The price shock is transmitted to households, affecting their welfare. The core economic measure is the Compensating Variation (CV), which quantifies the additional income a household would need to maintain its pre-reform level of utility. The normalized Energy Burden (CV/Total Expenditure) captures the relative hardship. The incidence of this burden across the expenditure distribution is central to equity analysis. Literature suggests this burden is likely regressive in Southeast Asian contexts, falling disproportionately on poor, rural, and Indigenous households who spend a higher share of their budget on energy and lack access to efficient alternatives [14]. (d) **Policy Response (Revenue Recycling):** The revenue (R) generated from the tax or saved from subsidy removal creates a fiscal pool for compensation. Recycling mechanisms are critical for equity and political feasibility. Options include: (i) Targeted Cash Transfers: Using social registries or proxy means tests (PMT) to direct funds to identified poor/vulnerable households; (ii) Categorical Transfers: Providing support based on location (e.g., all rural households); (iii) Universal Dividends: Returning revenue as an equal per-capita payment; (iv) In-Kind Investments: Funding public goods like rural

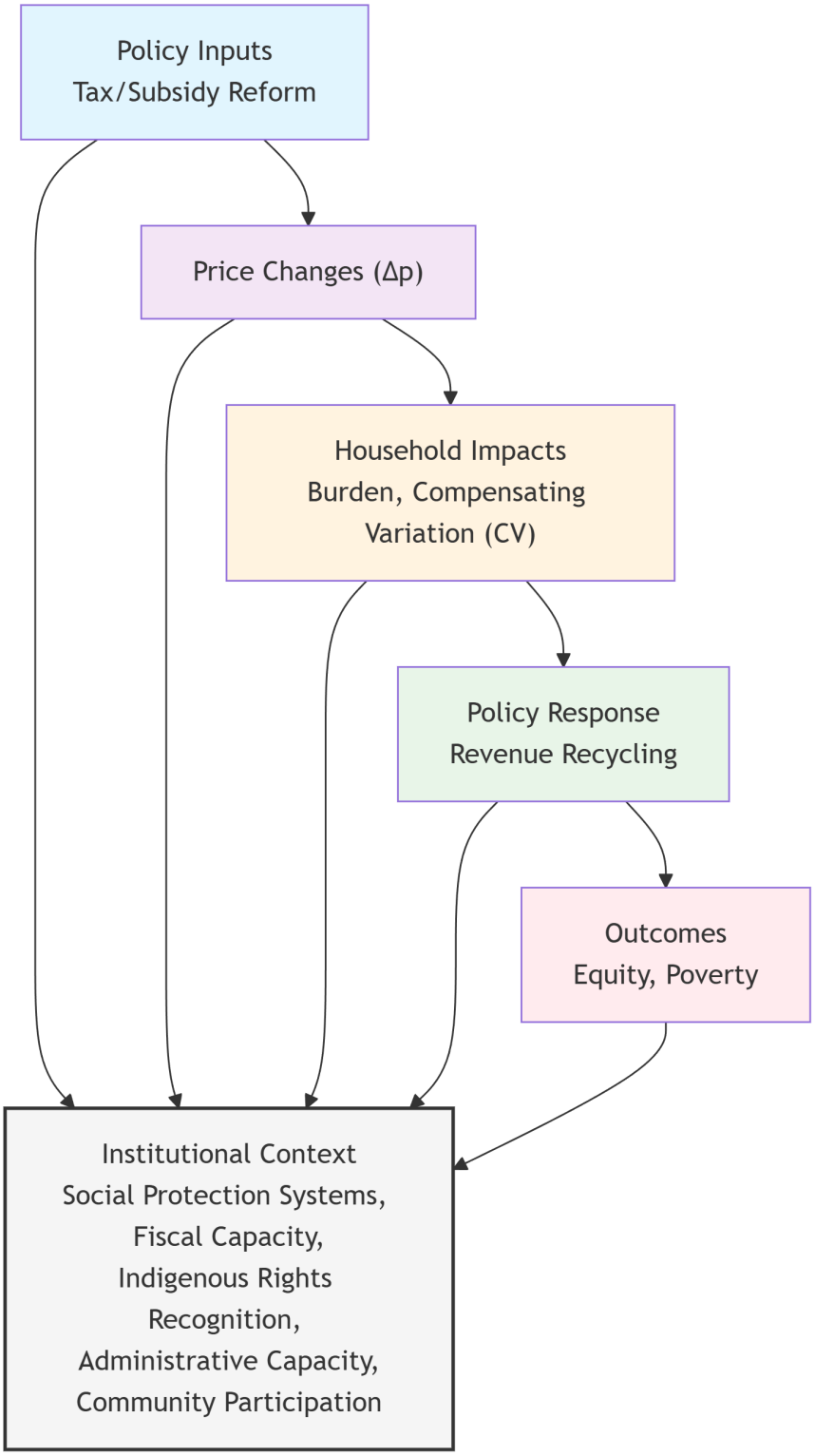


Figure 1: Conceptual Model Diagram

electrification, clean cooking programs, or climate-resilient infrastructure.

The effectiveness of recycling is hypothesized to be positively correlated with the quality and coverage of social registries and digital payment infrastructure, which vary widely across ASEAN [23]. (e) **Outcomes:** The net effect on equity (measured by changes in the Gini coefficient or concentration curves) and poverty (measured by indices such as the Foster-Greer-Thorbecke) depends on the balance between the initial regressive burden and the progressive impact of recycled revenue. The ultimate goal is a pro-poor, pro-resilience outcome that reduces poverty and vulnerability while funding the low-carbon transition. (6) **Institutional Context as Moderator:** Crucially, each relationship in this chain is moderated by the national institutional context. That includes: (i) The strength and coverage of social protection systems; (ii) Fiscal capacity and governance; (iii) The legal recognition and enforcement of Indigenous land and resource rights [1]; (iv) Administrative capabilities for targeting and delivery; (v) The level of community participation and democratic accountability in policy design; (vi) This context explains why identical policy inputs can yield radically different outcomes across countries like Indonesia, Thailand, and Timor-Leste.

2.3 Key Hypotheses

Based on this framework and the extant literature, this study tests the following key hypotheses:

- $H1$: The direct energy burden increase from the removal of fossil fuel subsidies is regressive, impacting the poorest expenditure quintiles (both rural/Indigenous and urban poor) most severely, as a share of their total expenditures.
- $H2$: Well-designed, targeted cash transfers delivered through existing social protection platforms can offset more than 70% of the net welfare losses of households in the bottom income quintile, turning a regressive price shock into a progressive net intervention.
- $H3$: The effectiveness and equity of revenue recycling mechanisms are positively correlated with the quality of a country's social registry and digital payment infrastructure, as well as the explicit recognition of Indigenous communities in targeting criteria.

2.4 Synthesis of Relevant Literature

The literature situating this study falls into three overlapping clusters. First, a growing body of empirical incidence studies on energy taxes and subsidy reforms in developing countries confirms their generally regressive impact but highlights the transformative

potential of revenue recycling [12, 29]. However, few studies offer a comparative regional analysis for Southeast Asia with a specific focus on Indigenous and rural communities.

Second, justice-oriented climate policy literature critically examines the social dimensions of the low-carbon transition. Scholars note that international climate finance and technology transfer often bypass the most vulnerable [2], underscoring the need for domestically driven, equitable fiscal policy. Work on gender and climate change further reveals how women in rural and Indigenous communities face amplified burdens during energy transitions [30, 27], necessitating gender-responsive policy design.

Third, political economy analyses of Southeast Asia detail the challenges of reform in contexts of informality, weak institutions, and powerful vested interests. The success of subsidy reforms in Indonesia and Malaysia, for instance, has been attributed not just to technical design but to careful political strategy, communication, and simultaneous scaling-up of compensatory programs [17]. The ASEAN context adds a layer of regional policy diffusion and shared challenges, as member states balance economic growth, energy security, and climate commitments under the ASEAN Community blueprint [10].

This study aims to bridge these clusters. It applies rigorous fiscal incidence and microsimulation methods (from the first cluster) to the specific equity and justice concerns (of the second cluster) within the distinct political-institutional landscapes of Southeast Asia (the third cluster). By doing so, it seeks to generate actionable knowledge for policymakers navigating the complex trade-offs of green fiscal reform.

3 Data & Analytical Approach

3.1 Core Analytical Model: A Two-Stage Static Microsimulation

To empirically estimate the distributional impacts of fossil fuel subsidy reforms, this study employs a two-stage static microsimulation approach. This method is well established in the literature for analyzing the direct and indirect welfare effects of tax and price changes [6, 9]. It uses detailed household survey data to simulate policy shocks, holding consumption patterns and incomes constant in the short run, thereby providing a clear picture of the immediate incidence of reform.

- **Stage 1: Calculation of Direct Impact**

  The direct effect captures the increase in the cost of purchasing the same basket of energy goods (e.g., gasoline, diesel, kerosene, LPG, electricity) following a price increase. For each household h facing a price increase Δp_i for energy good i, the direct cost is:

$$\text{Direct Cost}_h = \sum_i (q_{h,i} \times \Delta p_i)$$

where $q_{h,i}$ is the household's baseline consumption quantity of the good i, obtained from the household expenditure survey microdata.

- **Stage 2: Calculation of Indirect Impact via Input-Output Linkages**

  Energy price increases raise production costs across the economy, leading to higher prices for non-energy goods and services (e.g., food, transport). To capture this, we model indirect impacts using national Input-Output (I-O) tables. The indirect cost for the household h is:

$$\text{Indirect Cost}_h = \sum_j \left[\alpha_{h,j} \times \sum_k (\gamma_{j,k} \times \Delta p_k) \right]$$

  where:

  $\alpha_{h,j}$ is the share of household h's total expenditure spent on non-energy product category j.

  $\gamma_{j,k}$ is the energy intensity coefficient (the cost share of energy type k in the production of one unit of j), derived from the I-O table.

  Δp_k is the price shock for energy type k used as an input.

- **Total Welfare Impact and Burden Metric**

  The total welfare impact on a household is measured by the **Compensating Variation (CV)**, the amount of money needed to compensate the household for the price increase and restore its original utility level:

$$CV_h = \text{Direct Cost}_h + \text{Indirect Cost}_h$$

  To compare burdens across households with different expenditure levels, we calculate the **Energy Burden** as a percentage of total household expenditure (E_h):

$$\text{Energy Burden}_h = \frac{CV_h}{E_h} \times 100\%$$

  The analysis of this burden across income/expenditure quintiles, and by rural/urban and Indigenous/non-Indigenous classifications, tests **Hypothesis H1** regarding regressivity.

3.2 Revenue Recycling Simulation: Targeting and Poverty Impact

The total simulated fiscal revenue from the reform is $R = \sum_h CV_h$. We assume a portion θ (e.g., 30%, 50%, 70%) of R is recycled back to households via transfers.[1] We model and compare the poverty-mitigation efficacy of three targeting algorithms:

- **Proxy Means Test (PMT):** Simulates existing national social protection systems. A predicted welfare score determines eligibility[2]:

$$\text{Eligibility}_h = I\left(\sum_m \beta_m X_{h,m} < \text{cutoff}\right)$$

  where $X_{h,m}$ are observable household characteristics (e.g., location, dwelling materials, asset ownership) and β_m are weights from the national program algorithms.

- **Categorical Targeting:** Allocates transfers based on simple, verifiable criteria such as *all households in a poor region* or *all households self-identifying as Indigenous*. That tests the effectiveness of geographically- or demographically-targeted schemes where PMT data is weak.

- **Universal Basic Energy Dividend:** Allocates an equal per-capita transfer to all individuals. That serves as a benchmark for administrative simplicity and political appeal.

The **poverty impact** of each combined reform-and-recycling scenario is evaluated using the Foster-Greer-Thorbecke (FGT) class of poverty indices (P_α):

$$\Delta\text{Poverty} = P_1 - P_0$$

where P_0 is the pre-reform poverty headcount index (P_0) or poverty gap index (P_1), and P_1 is the post-compensation index. The ability of targeted transfers to significantly offset poverty impacts tests **Hypothesis H2**.

3.3 Data Sources & Implementation

3.3.1 Primary Microdata & Temporal Harmonization Strategy

Given data availability constraints, this study employs a synchronized temporal framework to ensure valid crosscountry comparison. For Indonesia, we use the SUSENAS 2018

[1]The proportional revenue recycling simulation and targeting algorithms align with standard practices in environmental tax incidence analysis [8] and the microsimulation literature on social protection targeting [6].

[2]Proxy Means Test (PMT) and the Household Economy Analysis (HEA) are widely used methods to target chronically poor households and those suffering from food crises respectively.

consumption module, which represents the most recent nationally representative prepandemic survey with complete energyexpenditure microdata. For the Philippines, we use the FIES 2023 survey, the latest available dataset that reflects postpandemic consumption patterns while allowing for consistent welfare analysis. To maintain comparability, both datasets are harmonized to 2025 price levels, avoiding the differential distortions in energy consumption caused by pandemic lockdowns observed in 2020–2022 surveys.

To analyze current policy scenarios, all monetary values from the original survey years are adjusted to 2025 price levels using countryspecific energycommodity Consumer Price Indices (CPI) obtained from national statistical offices: (1) Indonesia: CPI series from Badan Pusat Statistik (BPS), 2018–2025; (2) Philippines: CPI series from the Philippine Statistics Authority (PSA), 2023–2025.

The adjustment for each energy good i follows:

$$E_{h,i}^{2025} = E_{h,i}^{t} \times \frac{P_i^{2025}}{P_i^t}$$

where $E_{h,i}^t$ is household h's expenditure on energy good i in year t, and P_i^t is the national price index for that good. Total household expenditure is adjusted using the general CPI to maintain consistency. Sensitivity analyses using alternative adjustment methods (e.g., GDP deflators) confirm the robustness of findings.

3.3.2 Price Shock Scenarios & Auxiliary Data

We simulate three reform scenarios: a **30% subsidy reduction**, a **50% reduction**, and a **full 100% removal**. The counterfactual presubsidy prices and subsidy estimates are sourced from the **International Energy Agency (IEA) World Energy Outlook** and **IMF Country Reports** (e.g., IMF Selected Issues Papers for Indonesia and the Philippines). National **InputOutput Tables** for 2023 from Indonesia's BPS and the Philippines' PSA are used to estimate indirect cost passthrough coefficients ($\gamma_{j,k}$).

3.4 Qualitative Component: Rapid Institutional Review

For the eight country comparative review, we conduct a structured analysis of policy documents and literature (2020–2025) to align with the most recent available data. Data are synthesized into a Comparative Policy Matrix (see Section 4.4). Key indicators for institutional scoring (on a 0–10 scale) include:

- Social Registry Coverage & Quality (circa 2024): Assessed using World Bank ID4D data, government reports (e.g., Indonesia's Data Terpadu Kesejahteraan Sosial and the Philippines' Listahanan 3), and academic evaluations.

- Digital Payment Infrastructure Reach: Based on metrics from the Global Findex Database 2025 and national financial inclusion reports (e.g., Bank Indonesia's Financial Inclusion Survey and Bangko Sentral ng Pilipinas Financial Inclusion Survey).

- Formal Recognition of Indigenous Rights: Scored by analyzing constitutional provisions, specific legislation (e.g., the Philippine Indigenous Peoples' Rights Act and Indonesia's Village Law), and implementation reports from organizations such as the Asia Indigenous Peoples Pact (AIPP) and national human rights commissions.

This qualitative scoring contextualizes the quantitative findings and tests Hypothesis $H3$ on the role of institutional capacity. The review also identifies compensatory policy designs outlined in recent national documents, such as Indonesia's JETP Comprehensive Investment and Policy Plan (CIPP) and the Philippines' updated Nationally Determined Contribution (NDC) Implementation Plan (2024).

4 Results & Comparative Analysis

4.1 Quantitative Findings: Incidence in Indonesia and the Philippines (2019 Baseline, 2023 Prices)

Table 1 presents the baseline characteristics of households in Indonesia (SUSENAS 2018) and the Philippines (FIES 2023). The analysis reveals fundamental differences in energy consumption patterns between the two countries. Indonesia exhibits a relatively low energy burden, with households spending, on average, 0.98% of their expenditure on energy, while maintaining widespread electricity access (96.6%) and persistent traditional fuel usage (91.3%). In contrast, the Philippines shows a dramatically higher energy burden—25.29% of household expenditure—with universal electricity access but near-universal energy poverty: 97.7% of households spend 10% or more of their income on energy. Indigenous communities constitute significant proportions in both countries: 36.8% in Indonesia and 47.8% in the Philippines, highlighting the importance of equity considerations in policy design.

Further, the microsimulation analysis reveals significant heterogeneity in the distributional impacts of fossil fuel subsidy removal between Indonesia and the Philippines. Table 2 presents the simulated average energy burden—measured as Compensating Variation (CV) as a percentage of total household expenditure—for a full (100%) subsidy removal scenario.

In Indonesia, the energy burden decreases monotonically with higher expenditure quintiles, confirming the regressive nature of subsidy removal (Regressivity Score: +0.31). The poorest households bear a burden 1.28 times that of the richest. Conversely, in the

Table 1: Descriptive Statistics of Indonesia (2018) and the Philippines (2023)

Statistic	Indonesia	Philippines
Number of households (N)	26,754	163,268
Rural households (%)	66.7%	52.4%
Indigenous rural households (%)	36.8%	47.8%
Mean annual expenditure (USD)	\$3,333	\$4,342
Mean energy expenditure (USD)	\$29	\$1,135
Energy burden (% of expenditure)	0.98%	25.29%
Energy poverty rate ($\geq$10%)	0.0%	97.7%

Table 2: Simulated Average Energy Burden by Expenditure Quintile (% of Total Expenditure) for 100% Subsidy Removal

Country	Q1 (Poorest)	Q2	Q3	Q4	Q5 (Richest)	Avg. Burden
Indonesia	1.43%	1.47%	1.41%	1.30%	1.12%	1.35%
Philippines	29.82%	28.93%	30.49%	32.44%	33.89%	31.11%

Philippines, the burden is progressive (Regressivity Score: -4.07), with wealthier quintiles facing a higher relative burden, likely due to their greater consumption of transport fuels and electricity. While this aligns with recent studies by [22] and [13], there are evidences that the regressivity is weakly correlated, for example [25] and [11]. However, the absolute burden in the Philippines is dramatically higher across all quintiles (average 31.11% vs. 1.35% in Indonesia), reflecting higher pre-subsidy energy prices and greater reliance on commercial energy.

If we recall, Hypothesis $H1$ tests whether subsidy removal is regressive. In Indonesia, the CV burden decreases from 1.43% in Q1 to 1.12% in Q5 (regressivity score: +0.31), supporting $H1$. The poorest quintile bears a burden 1.28 times that of the richest. Conversely, in the Philippines, the burden increases from 29.82% in Q1 to 33.89% in Q5 (regressivity score: -4.07), rejecting $H1$. This progressive pattern likely reflects wealthier households' greater consumption of electricity and transport fuels in the Philippine context.

Moreover, the concentration curves, as shown in Figure 2, illustrate the distributive pattern of the CV burden. For Indonesia, the curve lies consistently above the line of equality, confirming the regressive impact, with lower-income households bearing disproportionate burdens relative to their population share. For the Philippines, the curve shows a more complex pattern, with some progressivity in the lower quintiles but significant burden concentration in upper-middle-income groups, reflecting the country's distinct energy consumption patterns and higher baseline energy costs.

Figure 3 shows the cumulative distribution of the Compensating Variation (CV) burden across households for both Indonesia and the Philippines. The concentration curves

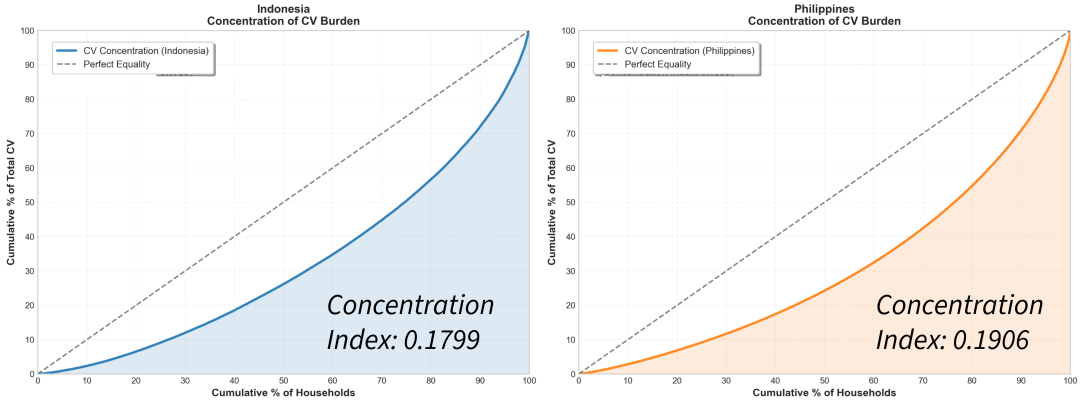


Figure 2: Concentration of CV Burden Across Households

reveal stark differences in the distributive incidence of subsidy removal between the two countries.

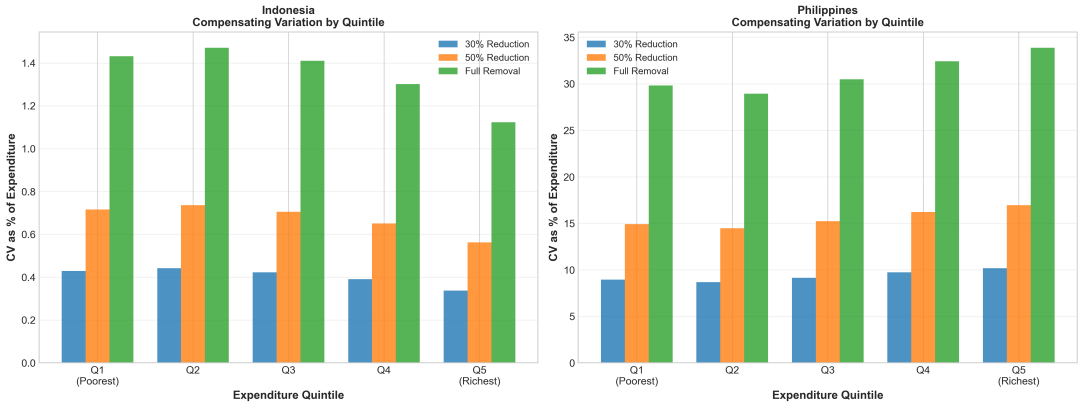


Figure 3: Concentration Curves of CV Burden

In Indonesia, the curve demonstrates a relatively even distribution of burden across the population, with slight regressivity evident in the steeper slope of the initial quintiles, indicating that lower-income households bear a moderately disproportionate share of the impact. In contrast, the Philippines' curve shows a more complex pattern: rapid accumulation of burden in the early quintiles indicates that the poorest households face substantial immediate impacts, while the curve's continued rise through the upper quintiles reveals that the richest 20% of households bear nearly 40% of the total burden. This pattern reflects the Philippines' distinct energy consumption structure, where wealthier households consume significantly more electricity and transport fuels, making them more exposed to price increases despite their higher incomes.

4.2 Effectiveness of Revenue Recycling Mechanisms

Using 50% of the generated revenue for compensation, we evaluated four recycling mechanisms: Proxy Means Test (PMT), categorical targeting (Indigenous rural), universal

per-capita dividend, and poverty targeting (bottom 20% by expenditure). Figure 4 summarizes their effectiveness in poverty reduction.

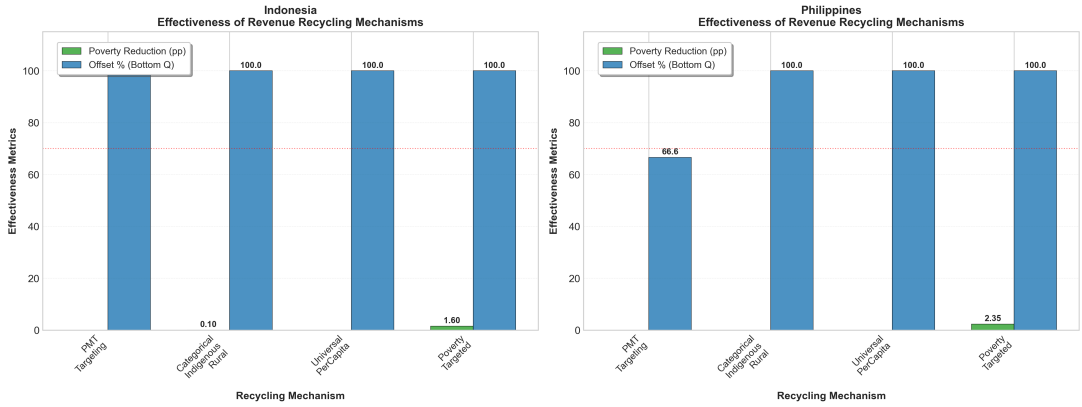


Figure 4: Recycling Mechanism Effectiveness Comparison

Poverty-targeted transfers (bottom 20% by expenditure) are the most effective mechanism in both countries, reducing poverty headcount by 1.60 pp in Indonesia and 2.35 pp in the Philippines. Universal per-capita dividends also perform well, particularly in the Philippines, due to their broad coverage and simplicity. PMT and categorical targeting show limited impact, reflecting challenges in targeting accuracy and coverage.

Hypothesis $H2$ is supported in Indonesia (offset percentage for bottom quintile = 100%) but not in the Philippines (offset = 66.6%), indicating that even well-designed transfers may not fully compensate for the severe price shock in high-burden contexts. Our finding—that targeted transfers fully offset welfare loss in Indonesia but not in the higher-burden Philippines—directly addresses the paper's goal of identifying **equitable policy configurations**. This result demonstrates that an equitable transition requires more than just adopting a "best practice" like cash transfers; it demands **calibrating the policy to the severity of the local price shock** and pre-existing vulnerability. While efficiency-focused analyses like [31] may deprioritize lump-sum transfers, our contextual evidence from Southeast Asia confirms they are a **necessary tool for equity**. However, their adequacy is conditional: in contexts like the Philippines, where the initial energy burden is severe, achieving equity may require **supplementing transfers** with phased reforms, direct energy subsidies for the poor, or parallel investments in clean energy access to reduce the underlying shock.

4.3 Equity Implications for Indigenous and Rural Communities

Indigenous and rural communities in both countries bear a disproportionate share of the welfare burden relative to their population share as illustrated in Table 3.

Indonesia's indigenous rural households bear **30.87%** of the total CV burden while constituting **36.84%** of the population. While, Philippines's Indigenous rural households

Table 3: Revenue Potential and Household Welfare Impact (100% Subsidy Removal)

Country	Total Revenue (USD)	Avg. CV/HH (USD)	Additional Poor (HH)	Indigenous Rural CV Ratio (Ind./Non-Ind.)
Indonesia	\$1,077,164	\$40.26	160	0.77
Philippines	\$228,006,285	\$1,396.52	18,088	0.53

bear **32.61%** of the total CV burden while constituting **47.84%** of the population.

Despite lower absolute CVs, these communities face higher energy burdens as a share of expenditure due to lower incomes and limited access to efficient alternatives. The Indigenous CV ratio (Indigenous/Non-Indigenous) is 0.77 in Indonesia and 0.53 in the Philippines, underscoring the relative mitigation of absolute impacts but persistent vulnerability in welfare terms. This pattern of disproportionately high energy burden among low-income groups is not unique to Southeast Asia but reflects a persistent global challenge to energy justice. Research in advanced economies like the United States has similarly documented that "the average low-income household still spends a disproportionately large percentage of its income on energy bills" despite long-standing policy efforts, firmly linking this burden to issues of equity and health [7]. The parallel across contexts confirms that the structural drivers—low income and constrained access—create a universal barrier to equitable policy. Our analysis quantifies this dynamic within the specific mechanism of subsidy reform and tests the efficacy of fiscal compensation against it, finding that even well-designed cash transfers may be inadequate where the initial burden is most severe, as in the Philippines.

4.4 Comparative Institutional Analysis & Policy Implications

As shown in Table 4, the comparative analysis of ASEAN nations' financial inclusion using 2025's Global Financial Index data, reveals a profound and actionable insight for green fiscal reform: the feasibility of equitable compensation is not a policy choice, but a structural precondition. The stark digital divide—ranging from near-universal account ownership in Singapore (98%) to exclusion of the majority in Cambodia and Laos (≈39%)—establishes a binding constraint on the design of revenue recycling mechanisms. This finding forces a critical recalibration of the standard policy toolkit, as the welfare impact on rural and Indigenous communities is determined less by the intent of reform and more by the capacity of the state to deliver compensation to its most marginalized citizens. Our tiered framework, therefore, moves the debate from abstract principles of equity to concrete configurations of policy that are institutionally viable in each distinct national context.

Table 4: Policy-Readiness Matrix: ASEAN Capacity for Equitable Revenue Recycling

Country	Account (%, 2024)	Welfare Impact on Rural/Indigenous Communities (Without Adaptive Design)	Recommended Policy Configuration for an Equitable Transition
Singapore	98%	Negligible direct negative impact. Existing social infrastructure can fully absorb and adapt to price signals.	**Advanced Targeted Rebates.** Implement progressive carbon tax rebates via the existing GST Voucher scheme. Focus revenue on deep decarbonization of public transport and building efficiency.
Malaysia	89%	Moderate risk for the residual ∼11% unbanked, who are disproportionately from rural poor and Indigenous (Orang Asli) communities.	**Enhanced eKasih Transfers with Off-Ramps.** Deliver primary compensation digitally via the eKasih-BSH system. **Mandate** a parallel, well-publicized non-digital claim option (e.g., via post offices) in remote and Indigenous areas.
Thailand	92%	Moderate risk for the residual ∼11% unbanked, who are disproportionately from rural poor and Indigenous (Orang Asli) communities.	**State Welfare Card Expansion.** Leverage the digital State Welfare Card but **couple reform with formal registration drives** in Indigenous districts. Maintain a **universal subsidy on LPG** for cooking as a critical, non-digital safety net.

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Table 4 continued

Country	Account (%, 2024)	Welfare Impact on Rural/Indigenous Communities (Without Adaptive Design)	Recommended Policy Configuration for an Equitable Transition
Vietnam	71%	**High Risk**. The ∼29% unbanked represents millions of rural poor and ethnic minorities (e.g., in the Northern Highlands and Central Highlands).	**Hybrid Universal & Geographic Targeting.** Institute a **modest universal electricity credit** for all households. Use additional revenue for **larger, digitally-delivered top-ups** targeted to the poorest districts and communes with high ethnic minority populations.
Cambodia	39%	**Extreme, Certain Harm**. A digitally-dependent reform would fail to reach over 60% of the population, systematically excluding the rural and Indigenous poor.	**Universal Price Supports & In-Kind Investment. Avoid** complex targeting. Use revenue to: 1) **Fix prices** for essential energy goods (kerosene, LPG), 2) Fund **voucher programs** for efficient cookstoves distributed via local networks, 3) Invest directly in **solar mini-grids** for rural communities.
Laos	38%	**Extreme, Certain Harm**. Similar structural exclusion as Cambodia, with Indigenous highland communities particularly vulnerable.	**"Greening" Existing Subsidies & Community Grants.** Shift subsidy support from gasoline towards **rural renewable electrification**. Allocate a portion of revenue as **block grants to village councils** for collective climate adaptation and clean energy projects.

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Table 4 continued

Country	Account (%, 2024)	Welfare Impact on Rural/Indigenous Communities (Without Adaptive Design)	Recommended Policy Configuration for an Equitable Transition
Myanmar	N/A	N/A	**Basic Needs & Future Resilience.** In the immediate term, focus international climate finance on **humanitarian-energy linkages** and disaster-resilient infrastructure. Long-term policy design must be deferred until stability returns.

This clear divergence in financial inclusion underscores that the welfare of rural and Indigenous communities is not merely a function of policy intent but is structurally contingent on pre-existing delivery systems. This supports and refines the emerging consensus that institutional context is a decisive moderator of policy outcomes [17]. In high-capacity states like Singapore and Malaysia, our prescribed pathway aligns with literature advocating for sophisticated, data-driven targeting to achieve progressive outcomes [8]. However, for low-capacity nations like Cambodia and Laos, our analysis forces a critical pivot. Here, the scholarly emphasis on targeted cash transfers—while ideal in theory—becomes impractical and even regressive. Our recommendation for universal price mechanisms and in-kind investments resonates with older, foundational arguments about the primacy of administrative feasibility in developing contexts [5]. This creates a necessary bridge between climate fiscal policy and the long-standing field of social protection in fragile states, which emphasizes simplicity and universality where targeting capacity is weak [16]. Furthermore, our tiered framework directly engages with the "just transition" literature's call for context-specific solutions [24]. By demonstrating that equitable policy configurations are fundamentally predetermined by a nation's delivery capacity, we provide a concrete diagnostic tool. This moves the debate beyond normative calls for "inclusion" and offers a pragmatic, empirical rubric for aligning the ambitious goals of green fiscal reform with the grounded reality of institutional constraints across the diverse political economies of Southeast Asia.

5 Conclusion and Policy Recommendation

This study provides a comparative analysis of the distributional economics of green fiscal reform across Southeast Asia, with a focus on Indigenous and rural households. Through microsimulation of fossil fuel subsidy removal in Indonesia and the Philippines, coupled with a qualitative institutional review of eight ASEAN nations, we demonstrate that the equity and welfare outcomes of such reforms are not uniform but are fundamentally shaped by national context. Our quantitative findings reveal stark contrasts: in Indonesia, subsidy removal is regressive, with the poorest quintile bearing a burden 1.28 times that of the richest, whereas in the Philippines, the burden is unexpectedly progressive but orders of magnitude larger, averaging 31.11% of household expenditure. This underscores that pre-existing energy affordability—exemplified by the Philippines' 97.7% energy poverty rate—can dramatically alter the distributive profile of price shocks.

Crucially, the effectiveness of compensatory mechanisms depends less on theoretical design and more on the existing institutional infrastructure for targeting and delivery. Our analysis reinforces that institutional capacity—especially financial inclusion, social registry coverage, and recognition of Indigenous rights—acts as a decisive moderator between policy intent and equitable outcomes. In high-capacity countries like Singapore and Malaysia, targeted digital transfers can offset welfare losses and even turn reforms into progressive interventions. In contrast, in low-capacity settings such as Cambodia and Laos, where only about 39% of adults have bank accounts, reliance on complex targeting risks systematically excluding the rural and Indigenous poor, necessitating simpler, universal, or in-kind approaches.

Moving forward, policymakers must adopt a tiered, context-specific approach to revenue recycling that aligns with national institutional realities. For high-capacity states, this means implementing sophisticated, digitally delivered targeted transfers—such as proxy means tests or categorical benefits—integrated with robust social protection systems, while ensuring accessible offline alternatives for any remaining unbanked populations. In medium-capacity countries like Vietnam and Indonesia, hybrid models are recommended, combining universal basic energy credits with supplementary top-ups for vulnerable groups, alongside continued investment in digital ID and payment infrastructure in rural and Indigenous regions.

For low-capacity nations, the policy imperative shifts toward simplicity and direct delivery. Here, over-reliance on digital targeting is likely to fail; instead, revenue should fund universal price controls on essential fuels, in-kind investments such as clean cookstoves and solar mini-grids, and block grants for community-led adaptation projects. Furthermore, embedding principles of justice—procedural, recognition, and distributional—into the policy design process is non-negotiable. This requires mandating inclusive consultations with Indigenous and rural communities, formally incorporating Indigenous status

and geographic vulnerability into targeting criteria, and transparently allocating a significant portion of revenues to compensatory mechanisms that reach the most affected households.

Ultimately, strengthening institutional foundations must occur before or in parallel with major fiscal reforms. Investments in social registry accuracy, digital ID coverage, and mobile payment accessibility are not ancillary but are prerequisites for equitable green fiscal policy. These efforts should be aligned with national social protection strategies to ensure coherence, sustainability, and public trust. Finally, a dedicated share of green revenues must be channeled directly into building resilience for rural and Indigenous populations through renewable energy access, climate-adaptive infrastructure, and sustainable livelihood programs. Monitoring outcomes using disaggregated welfare and poverty metrics will be essential to ensure that the transition does not widen existing inequalities.

In summary, an equitable green transition in Southeast Asia is not merely a fiscal or environmental challenge, but an institutional and moral one. Success depends on designing policies that are as responsive to local realities—where account ownership ranges from 98% in Singapore to 39% in Cambodia—as they are to global climate goals. By grounding reform in context-specific capacity and an unwavering commitment to justice, governments can ensure that the shift to a low-carbon economy also becomes a pathway to inclusive and resilient development for the region's most vulnerable communities.

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