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Procurement Cost Volatility and Supplier Dynamics in Southern Leyte Electric Cooperative (SOLECO), Philippines: A Multi-Year Statistical Analysis of Electricity Sourcing in a Liberalized Market

Khorina O. Aguilar*, Jonelle H. Tablada

Southern Leyte State University, Sogod, Southern Leyte 6606, Philippines

***Corresponding author's email**: kaguilar@southernleytestateu.edu.ph

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ABSTRACT

Electric distribution utilities in liberalized power markets are increasingly exposed to procurement risks arising from supplier heterogeneity, contract discontinuities, and spot-market volatility. This study evaluates the electricity procurement profile of the Southern Leyte Electric Cooperative (SOLECO), Philippines, from 2020 to 2025 using supplier-disaggregated monthly disclosures for Mainland and SPUG service areas. Descriptive portfolio analytics, including annual purchased energy, weighted average generation cost, source shares, and volatility indicators, were integrated with inferential testing through one-way ANOVA and Tukey's HSD to determine whether inter-source cost differences were statistically significant. Results show that annual purchased energy increased from 63.60 million kWh in 2020 to 165.92 million kWh in 2025. The weighted average generation cost sharply increased to ₱10.70/kWh in 2022 before partially declining to ₱7.91/kWh in 2023, ₱6.52/kWh in 2024, and ₱6.24/kWh in 2025, indicating a persistently higher post-transition cost baseline. The energy mix shifted from NPC-TSC/PSALM dominance in 2020, with a 70.45% share, toward IPP-led sourcing, with GNPD peaking at 67.56% in 2022, and later toward greater market exposure as WESM, net of SSLA, reached 35.86% in 2024. Portfolio fragmentation also increased, as reflected by the "Others" category reaching 56.94% in 2025. ANOVA confirmed significant mean cost differences across sources, while Tukey's HSD identified WESM as significantly higher than multiple contracted sources and the portfolio benchmark. The findings position procurement as a smart-grid governance issue requiring volatility-aware benchmarking and digital decision support.

1. Introduction

In liberalized electricity markets, effective procurement has become a cornerstone of operational sustainability for electric distribution utilities. Balancing cost efficiency, supply stability, and regulatory compliance remains especially challenging for electric cooperatives in developing regions. The Southern Leyte Electric Cooperative (SOLECO), operating in the Visayas region of the Philippines, provides a representative case of how such utilities navigate increasingly complex sourcing environments. With the decline of legacy power contracts and the rise of Independent Power Producers (IPPs) and spot market mechanisms such as the Wholesale Electricity Spot Market (WESM), cooperatives have become increasingly exposed to pricing volatility and supplier-specific risks [1–3].

Following the implementation of the Electric Power Industry Reform Act (EPIRA) of 2001, Philippine distribution utilities (DUs) were required to operate within a more competitive supply environment. While this framework aims to promote consumer choice and reduce electricity costs, it has also introduced cost unpredictability and increased procurement complexity at the cooperative level [4], [5]. Regulatory measures such as ERC Resolution No. 14 (s.2022), which mandates the unbundling and publication of generation rates, have improved transparency but further intensified the need for data-informed decision-making in contract management and sourcing strategies [6].

Prior studies have examined procurement and optimization approaches in energy systems, including market forecasting [7], portfolio optimization [8], and smart-grid technology integration [9], [10]. Conejo et al. [11] proposed decision-making models for uncertain electricity markets, while Hatami et al. [12] presented methods for minimizing procurement costs through bilateral contracting and spot market participation. Other works investigate how distributed generation [13], real-time pricing [14], and demand-side participation [15] influence utility strategies. However, much of the empirical evidence focuses on investor-owned utilities or system operators in developed economies. Empirical validation of cooperative-level procurement risks in developing market settings such as the Philippines remains limited.

Procurement volatility is increasingly consequential under renewable energy (RE) expansion because higher shares of variable renewable energy reshape both the cost structure and the risk profile of supply portfolios. As variable generation increases, power systems require greater flexibility (e.g., balancing, reserves, and responsive demand) to maintain reliability, which can amplify exposure to short-term market price movements when sourcing relies more heavily on spot-market procurement or short-duration contracting. In this

context, procurement volatility can affect the affordability and bankability of renewable procurement pathways by influencing contract design, risk allocation, and the ability of distribution utilities to sustain stable tariffs while meeting integration requirements [21], [23], [48], [53]. Accordingly, supplier-level volatility metrics and statistically validated cost differences provide practical inputs for renewable procurement design (e.g., contract tenors, indexation, and flexibility provisions) and for digital procurement analytics under increasing variable renewable penetration.

Existing research on electricity pricing and procurement risk commonly relies on wholesale market prices, national-level indicators, or aggregated utility costs. Although useful for macro-level trend analysis, these approaches often obscure supplier-level mechanisms that shape procurement outcomes—such as supplier switching, supplier concentration, and supplier-specific price volatility. For electric cooperatives operating under constrained procurement options and exposure to market fluctuations, these hidden dynamics can materially translate into budget instability, tariff pressure, and planning uncertainty. The present study addresses this evidence gap by examining multi-year, supplier-disaggregated procurement records to quantify how supplier composition and cost behavior jointly shape procurement risk within a cooperative operating in a liberalized electricity market. Unlike prior work relying on aggregated market indicators, this study quantifies supplier-level cost asymmetries and volatility using monthly disclosures and validates differences through ANOVA–Tukey benchmarking, producing procurement risk indicators suitable for cooperative and regulator decision support.

Electric cooperatives—numbering over 100 in the Philippines—serve a substantial share of electricity consumers, particularly in rural or underserved areas [16]. These entities typically operate under tight budget constraints and remain vulnerable to cost shocks driven by volatile supplier pricing. In this context, supplier selection is not merely a technical or financial decision but a strategic one that can influence tariff stability, subsidy requirements, and consumer satisfaction. Nonetheless, procurement decisions are often guided by historical cost averages or short-term delivery volumes without systematic evaluation of whether inter-supplier cost differences are statistically meaningful or economically material [17].

Since 2020, supplier diversification—including PCPC, GNPD, TLI, KEPCO, SPI, and increased reliance on WESM—has added complexity to SOLECO's procurement structure. With each supplier operating under distinct pricing schemes and contractual conditions, the average cost per kilowatt-hour (₱/kWh) varies not only over time but also across sources. Prior work indicates that volume-weighted average cost calculations alone may conceal material procurement risks when not contextualized through variance analysis or statistical modeling [18-19].

From a smart-grid and grid modernization perspective, procurement is not only a financial function but also a data-governance problem. Digitalization trends in modern power systems emphasize improved decision-making through monitoring, analytics, and cyber–physical sensing and control; in parallel, higher renewable integration increases the operational importance of flexibility planning and risk-aware sourcing. Supplier-level indicators—such as volatility, concentration, and outlier behavior—therefore have practical relevance as inputs to digital procurement analytics (e.g., dashboards and early-warning risk flags) that support more adaptive contracting, compliance monitoring, and reliability planning under increasingly variable supply conditions [10], [46], [43], [26].

Renewable procurement strategies frequently rely on structured contracting and portfolio-based sourcing to manage price uncertainty and reduce procurement risk exposure. Evidence from procurement risk literature indicates that explicit risk management and supplier portfolio design can improve cost stability for distribution utilities operating under market uncertainty. Linking supplier-level volatility assessment to renewable procurement strategies strengthens the relevance of cooperative procurement analysis to renewable transition planning, particularly where market volatility and supplier dependence can influence both procurement outcomes and the pacing of RE integration [50-51], [47], [24].

To the best of the authors' knowledge, this work is among the few empirical studies in the Philippine power sector that evaluate cooperative procurement risk using multi-year, supplier-level cost and volume data supported by formal statistical testing. The study contributes in three ways: (1) it provides a six-year, supplier-disaggregated empirical assessment of electricity procurement in a Philippine electric cooperative—an underrepresented setting in procurement research that often relies on aggregated market indicators or short-run price snapshots; (2) it operationalizes procurement risk using supplier-specific volatility and concentration measures to detect instability signals and dependence patterns not visible in system-wide averages; and (3) it links supplier-level procurement evidence to smart-grid–aligned governance by framing procurement as a measurable, data-driven monitoring problem that can support supplier benchmarking, transparency, and decision support for cooperative managers and regulators.

The study evaluates the electricity procurement profile of the Southern Leyte Electric Cooperative (SOLECO) from 2020 to 2025. Specifically, it:

1. Consolidates and validates annual energy procurement data from SOLECO across all suppliers for the years 2020–2025.
2. Determines trends in average generation cost and total energy volume over the six-year period, including identification of cost inflection points.
3. Assesses the degree of cost volatility introduced by different suppliers using standard deviation and supplier-specific cost profiles.
4. Statistically evaluates cost disparities among energy suppliers using one-way ANOVA and Tukey's HSD post hoc analysis.
5. Examines the impact of high-cost, low-volume suppliers (e.g., PCPC) on overall cost structure and procurement risk exposure.
6. Recommends risk-informed procurement strategies, including volume-weighted contracting, supplier benchmarking, and hybrid sourcing models to improve cost efficiency and operational stability.

Beyond cost reporting, procurement is framed as a data-governance problem: if supplier-level volatility and concentration are measurable, they can be monitored and managed. The proposed indicators can be integrated into procurement dashboards and regulatory review protocols to strengthen transparency, anticipate cost shocks, and improve sourcing decisions—particularly for cooperatives facing market and supplier uncertainty.

2. Methodology

This study employed a quantitative analytical approach integrating descriptive statistics and inferential modeling to evaluate cost dynamics and supplier dependency within SOLECO's electricity procurement from 2020 to 2025. The goal was to derive data-driven insights on the evolution of procurement strategies in response to regulatory changes and market liberalization. The analysis concentrated on measuring supplier-level energy contributions, identifying patterns in pricing variability, and statistically validating differences in average generation costs across multiple power providers. To ensure robustness and transparency, the study utilized structured monthly financial and operational datasets officially published by SOLECO and aligned with Energy Regulatory Commission (ERC) reporting standards.

Through this methodology, the study aims to uncover the structural characteristics of procurement behavior that may not be apparent through traditional volume-based assessments alone. Emphasis was placed on identifying statistical outliers in pricing, evaluating volatility across time, and quantifying the significance of observed cost disparities among suppliers. This approach supports a more informed interpretation of procurement risk and financial performance in the context of decentralized electricity distribution.

2.1 Conceptual Framework of Procurement Cost Analysis

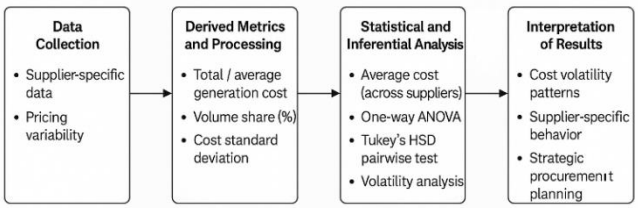


Fig. 1 Framework for Supplier Cost Volatility Analysis and Strategic Procurement Evaluation in Energy Distribution Cooperatives.

This framework illustrates the comprehensive methodological structure employed to assess the evolution, volatility, and strategic implications of electricity procurement costs at Southern Leyte Electric Cooperative (SOLECO) over a six-year period. Rooted in established energy systems analysis and regulatory economics, the framework synthesizes key principles from energy procurement analytics outlined by Kirschen and Strbac [21] and is further enriched by applied techniques in utility performance benchmarking and financial risk modeling as discussed in the works of Eberhard and Gratwick [22], Stoft [23], and Batlle et al. [24]. The framework is arranged into four interconnected stages that together enable a systematic evaluation of supplier behavior, cost asymmetries, and procurement vulnerabilities.

(1) Data Collection serves as the foundational phase, drawing monthly supplier-level reports from SOLECO's public disclosures. These datasets include key procurement parameters such as kilowatt-hour (kWh) volumes, basic and adjusted generation costs, and unit rates. By relying on disaggregated supplier data, this stage ensures the empirical accuracy and replicability of the analysis, aligned with best practices in energy governance and transparency initiatives[22], [25].

(2) Derived Metrics and Processing involves transforming raw data into meaningful indicators through structured computations. Core variables include the total and average generation cost per supplier, volume share (percentage of energy procured per source), and cost standard deviation, which captures volatility across the procurement portfolio. These derived metrics form the basis for comparing supplier contributions, cost exposure, and procurement risk profiles across multiple years [23].

(3) Statistical and Inferential Analysis applies rigorous econometric and statistical techniques to validate observed cost differences. A one-way Analysis of Variance (ANOVA) is used to test for statistically significant disparities in average generation cost among suppliers, while Tukey's Honest Significant Difference (HSD) test identifies specific supplier pairs with meaningful differences. Standard deviation is also employed as a volatility metric, measuring the extent of pricing uncertainty introduced by supplier heterogeneity and shifts in market conditions [21]. These tools facilitate a deeper understanding of supplier performance and market-driven risks.

(4) Interpretation of Results bridges quantitative findings with practical energy planning. By combining boxplots, pairwise comparison charts, and descriptive statistics, this stage identifies persistent cost outliers (e.g., PCPC), maps pricing volatility trends, and outlines strategic procurement implications. The framework supports the formulation of policy recommendations—such as volume-weighted contracting, hybrid sourcing strategies, and dynamic supplier evaluation mechanisms—to improve fiscal predictability and long-term planning outcomes [24].

Overall, this analytical framework unites empirical rigor and policy relevance, positioning it as a robust model for evaluating electricity procurement risks in the context of emerging market liberalization and decentralized power generation. It provides a replicable pathway for distribution utilities seeking to enhance resilience, transparency, and sustainability in their energy sourcing strategies.

2.2 Data Source and Compilation

The dataset used in this study was obtained from the official website of the Southern Leyte Electric Cooperative (SOLECO) [https://www.soleco.com.ph], which publishes monthly electricity procurement reports as mandated by the Energy Regulatory Commission (ERC) under transparency guidelines. These reports provide disaggregated data for both the Mainland grid and the Small Power Utilities Group (SPUG), each detailing supplier-level electricity purchases. Each monthly report is provided in Excel format and includes the following key procurement variables for every participating supplier:

(1) Percentage to Total kWh Purchased – the relative contribution of each supplier to total monthly energy procurement;
(2) kWh Purchased – the absolute energy volume acquired;
(3) Basic Generation Cost (₱) – the baseline generation charge before any financial adjustments;
(4) Other Cost Adjustments – including Deferred Accounting Adjustments (DAA), Non-Specific Subsidies (NSS), and other temporary regulatory or billing modifications;
(5) Total Generation Cost (₱) – the net payable amount after incorporating all cost adjustments;
(6) Average Generation Cost (₱/kWh) – the supplier's effective unit cost calculated as the ratio of total generation cost to kWh purchased.

Monthly reports from 2020 to 2025 were systematically downloaded and extracted to construct a longitudinal dataset suitable for trend analysis and statistical testing. Raw data were preprocessed using Microsoft Excel 365, where manual and formula-based methods

were employed to standardize supplier names, normalize numerical formatting (e.g., removal of embedded commas, conversion of text entries to numeric fields), and address data irregularities such as blank fields or non-reporting months.

The cleaned and consolidated dataset was then aggregated at the annual level, allowing for comparison of supplier performance across years and service areas. Separate datasets were maintained for Mainland and SPUG to preserve contextual differences in sourcing structure, supplier availability, and generation cost levels. This processed dataset served as the foundation for all subsequent descriptive, comparative, and inferential analyses conducted in the study.

2.2.1 Observation structure and handling of missing or irregular months

For inferential testing, the unit of analysis is the supplier–month observation, where each record represents a supplier's reported Average Generation Cost (₱/kWh) for a given month. A supplier–month observation is included if both kWh Purchased and Total Generation Cost are reported and yield a valid unit cost (i.e., kWh Purchased > 0). Months are treated as missing when (i) a supplier is not reported in SOLECO's disclosure for that month, (ii) cost or energy volume entries are blank, or (iii) the unit cost is undefined due to zero volume. Missing months are not imputed to avoid biasing variability estimates and inferential tests; instead, analyses use available supplier–month observations and explicitly document supplier intermittency as part of procurement structure.

Irregular observations (e.g., extreme unit costs linked to temporary regulatory adjustments such as DAA/NSS or one-off billing corrections) are retained if they are consistent with SOLECO's published reports and reflect real procurement charges. However, records are flagged during preprocessing and excluded only when definitional validity is violated (e.g., non-numeric or undefined unit costs). This rule-based approach preserves transparency and prevents artificial smoothing of volatility.

2.3 Derived Metrics and Statistical Framework

To assess procurement behavior and supplier-level cost dynamics, a series of derived metrics were computed from the raw dataset. These metrics were intended to capture not only basic procurement quantities but also the relative contribution, cost efficiency, and volatility of each supplier within SOLECO's annual energy portfolio [26-27]. All computations were performed using a combination of Microsoft Excel 365 for initial calculations and Python 3.11 (with the pandas, numpy, and scipy libraries) for statistical processing and visualization.

(a) Total Generation Cost per Supplier

To account for the full financial exposure per source, the total generation cost was derived using:

$$Total\ Gen\ Cost = Basic\ Gen\ Cost\ +\ Other\ Adjustments \quad (1)$$

Where basic cost reflects the contract rate and other adjustments include subsidies or surcharges such as DAA and NSS. This allowed for a more accurate reflection of real procurement cost, beyond nominal rates.

(b) Average Generation Cost (₱/kWh)

The unit cost for each supplier, used as the primary variable in cost comparison and significance testing, was computed as:

$$Average\ Gen\ Cost = \frac{Total\ Generation\ Cost}{kWh\ Purchased} \quad (2)$$

This ratio normalizes procurement cost by volume and is critical for benchmarking suppliers across differing contract sizes and energy contributions.

(c) Volume Share (%)

The proportional contribution of each supplier to the cooperative's annual energy acquisition was calculated as:

$$Share_i = \frac{kWh_i}{\sum_{j=1}^{n} kWh_j}\ x\ 100 \quad (3)$$

Where $Share_i$ is the percentage contribution of supplier *i* to the total energy procured in a given year; kWh_i is the energy purchased from supplier *i*; $\sum_{j=1}^{n} kWh_j$ is the total energy purchased from all n suppliers; and n is the total number of suppliers for the year. This formula calculates each supplier's relative importance in SOLECO's procurement portfolio.

These values were aggregated by year to compute the annual total energy purchased, weighted average generation cost, and cost variance across suppliers [28].

2.4 Statistical and Inferential Analysis

To rigorously assess supplier-level cost dynamics and validate whether inter-supplier price differences were statistically significant, the study employed a set of inferential statistical methods commonly used in energy procurement analytics and policy evaluation. The main objective of these tests was to determine if observed differences in generation cost per kilowatt-hour (₱/kWh) across multiple suppliers could be attributed to structural disparities rather than random variation [29-30].

(a) Annual Average Cost (Across Suppliers)

To establish a baseline cost comparison, the mean generation cost across all suppliers in a given year was computed using:

$$\bar{U} = \frac{1}{n}\sum_{i=1}^{n} x_i \quad (4)$$

Where $\bar{U}$ is the annual average generation cost across all suppliers; x_i is the average generation cost per supplier *i*.; and n is the number of suppliers reporting in that year. This metric provides a macro-level snapshot of procurement pricing trends and served as a reference point for subsequent volatility analysis and hypothesis testing.

(b) Standard Deviation (Yearly Volatility of Supplier Cost)

This highlights cost variability introduced by supplier heterogeneity and is a common metric for financial risk in energy procurement [20].

$$\sigma = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{U})^2} \quad (5)$$

Where σ represents the standard deviation of supplier costs; x_i and $\bar{U}$ are as previously defined; and n is the number of supplier entries in that year. This measure reflects the extent of procurement cost volatility, a key indicator of financial risk and market fragmentation in cooperative electricity sourcing [2].

(c) One-Way ANOVA (Test of Supplier Cost Differences)

To test whether the average generation costs across different suppliers were statistically different over the study period, a one-way ANOVA was applied to the pooled dataset:

$$F = \frac{SS_B/(k-1)}{SS_W/(N-k)} \quad (6)$$

Where SS_B is the sum of squares between suppliers (based on average cost); SS_W is the sum of squares within each supplier group over time; k is the number suppliers; and N is the total observations across years. A resulting p-value less than 0.05 was used as the threshold for rejecting the null hypothesis that all supplier means were equal. This test enables the identification of whether any supplier's average cost deviates significantly from the rest.

(d) Tukey's HSD (Post Hoc Test for Pairwise Differences)

Following a statistically significant ANOVA result, Tukey's HSD post hoc analysis was conducted to determine which specific supplier pairs exhibited significant differences in mean generation costs:

$$HSD = q \cdot \sqrt{\frac{MS_W}{n}} \quad (7)$$

Where HSD is the minimum required difference between group means for significance; q is the studentized range statistic (based on α, k, and N); MS_W is the mean square within groups; and n is the number of observations per group. This test was applied specifically to the Average Generation Cost (₱/kWh) field across all supplier–month observation, allowing for the precise identification of cost outliers.

2.4.1 Number of observations per supplier used in ANOVA and Tukey tests

The one-way ANOVA and Tukey's HSD post hoc analysis use monthly supplier-level unit costs (₱/kWh) as the dependent variable and supplier identity as the grouping factor. The number of observations per supplier, n_s , is defined as the count of valid supplier–month unit cost observations available for supplier s across the study period (2020–2025). Because suppliers enter and exit the procurement portfolio at different times, the dataset is unbalanced across suppliers. To ensure transparency, supplier–month counts per supplier are reported in Table 1, and the interpretation of pairwise results accounts for unequal group sizes. In the final dataset, all supplier groups meet the minimum sample-size threshold ($n_s \geq 5$), yielding a final ANOVA/Tukey sample size of N = 243 Mainland supplier–month observations.

2.4.2 ANOVA assumptions and diagnostic checks

Prior to interpretation of ANOVA and Tukey results, standard assumptions are evaluated using established diagnostic procedures:

1. Independence: Observations are defined at the supplier–month level as operational procurement outcomes. Because observations are monthly, some temporal dependence may occur; therefore, inferential results are interpreted alongside time-series trends and volatility metrics to contextualize potential serial structure.
2. Normality of residuals: Residual normality is assessed using Shapiro–Wilk tests and Q–Q plot inspection of ANOVA residuals.
3. Homoscedasticity (equal variances): Variance homogeneity across suppliers is assessed using Levene's test (or Brown–Forsythe as a robustness alternative).

If diagnostics indicate substantial heteroscedasticity or non-normal residual behavior, robustness checks are performed using Welch's ANOVA (unequal variances) and/or nonparametric Kruskal–Wallis testing to confirm whether conclusions regarding between-supplier cost differences remain directionally consistent. Tukey's HSD is reported for pairwise comparisons when ANOVA indicates significant mean differences, consistent with common practice in comparative procurement and energy cost studies [29-30].

One-way ANOVA is appropriate because the inferential objective is to test whether mean unit procurement costs differ systematically across multiple suppliers, rather than assessing only temporal movement or volume contributions. Tukey's HSD is used as the post hoc procedure because it controls the family-wise error rate while identifying which supplier pairs exhibit statistically significant differences in mean unit cost. These inferential results are interpreted alongside descriptive analytics (volume share, cost trend, and volatility metrics) to provide both statistical validation and operational relevance.

Table 1 Number of monthly observations per supplier used in ANOVA and Tukey's HSD (Mainland procurement, 2020–2025).

Supplier (Mainland)	n_s (supplier–month observations)	Coverage (years present)
PCPC	62	2020–2025
WESM (net of SSLA)	56	2020–2025
Net Metering-Export	52	2021–2025
GNPD	43	2021–2024
NPC-TSC/PSALM	7	2020–2021
TLI	11	2025
SLPGC	5	2025
SPI	7	2025

Unit of analysis: supplier–month. A month is counted for a supplier if Average Generation Cost (₱/kWh) is numeric and kWh Purchased > 0. The inferential dataset is unbalanced due to supplier entry/exit and intermittent reporting.

Notes:

- Total Mainland supplier–month observations: N = 243.
- Final ANOVA/Tukey sample size: N = 243 supplier–months (Mainland).
- All suppliers in Table 1 satisfy $n_s \geq 5$; therefore, no supplier groups were excluded for small sample size in the final inferential dataset.

2.5 Software and Tools Used

The data processing and statistical modeling in this study were performed using a combination of spreadsheet and programming environments to ensure both transparency and reproducibility. Two primary platforms were employed: Microsoft Excel 365 and Python 3.11.

Microsoft Excel 365 was used for initial data extraction, preprocessing, and normalization. This included manual and automated cleaning of monthly SOLECO procurement reports, standardization of supplier naming conventions, unit consistency verification, handling of null or missing entries, and preliminary calculations (e.g., total generation cost, average cost per kWh).

Python 3.11 was utilized for statistical modeling, visualization, and inferential analysis. Specific open-source libraries were used as follows:

(1) pandas: For dataset merging, grouping, aggregation, and annualization of supplier data.
(2) matplotlib and seaborn: For the generation of high-resolution boxplots, line graphs, and comparative trend visualizations.
(3) scipy.stats: To conduct one-way Analysis of Variance (ANOVA) and assess statistical significance in cost disparities.
(4) statsmodels.stats.multicomp: For implementing Tukey's Honest Significant Difference (HSD) test and performing pairwise post hoc comparisons between supplier means.

Visual outputs were configured at 300 DPI resolution and exported in lossless formats to meet academic publishing standards and facilitate reproducibility of graphical evidence [31].

3. Results and Discussion

This section presents the consolidated findings of SOLECO's electricity procurement analysis from 2020 to 2025, offering a detailed account of evolving supplier composition, generation cost dynamics, and statistically validated cost disparities. The results integrate descriptive statistics—such as volume shares, average rates, and cost volatility measures—with inferential techniques including One-Way ANOVA and Tukey's HSD tests to assess the significance of inter-supplier pricing differences. The discussion begins with a macro-level overview of procurement trends, emphasizing the shift from stable, low-cost contracts with NPC-TSC/PSALM to a more fragmented and cost-volatile supply mix dominated by Independent Power Producers (IPPs) and spot-market purchases via WESM. This transition reflects both regulatory changes and operational responses to supply disruptions, contributing to marked increases in average costs and volatility. Deeper analyses explore how high-cost, low-volume suppliers like PCPC have disproportionately influenced SOLECO's fiscal risk exposure. The findings underscore the strategic implications of supplier selection, portfolio diversification, and the need for data-driven procurement planning within the context of an increasingly liberalized and price-sensitive energy market.

3.1 Energy Procurement Trends (2020–2025)

SOLECO's electricity procurement profile from 2020 to 2025 demonstrates a progression through phases of expansion, disruption, and strategic realignment, consistent with patterns observed among Philippine distribution utilities operating under constrained and transitional generation markets [32-33]. As depicted in Figure 2, SOLECO's total energy procurement (Mainland + SPUG) increased

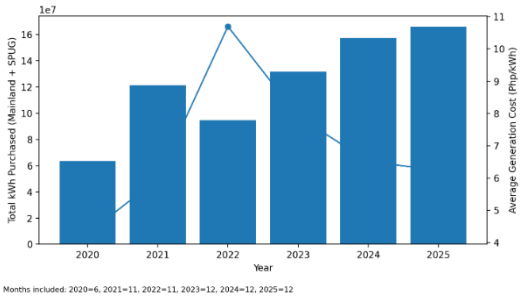


Fig. 2 Energy Procurement Trends of SOLECO (2020–2025).

markedly from 63.60 million kWh in 2020 to 121.19 million kWh in 2021, followed by a reduction to 94.62 million kWh in 2022. Over these years, procurement outcomes remained influenced by legacy contracting conditions and regulated supply arrangements, which helped anchor portfolio behavior, although the observed year-to-year fluctuations indicate emerging structural adjustments in supply sourcing and portfolio composition [33-34].

A major cost disruption is evident in 2022, when the weighted average generation cost sharply increased to ₱10.70/kWh, the highest level across the study period, despite total procurement volume remaining below the 2021 level. This pattern suggests that SOLECO experienced a procurement cost shock driven primarily by supplier-mix changes and heightened exposure to higher-priced procurement channels, rather than by demand growth alone. The resulting cost escalation intensified the cooperative's vulnerability to price spikes and reduced tariff predictability, underscoring the financial sensitivity of cooperatives when stable, regulated supply anchoring is weakened or interrupted [35], [43].

In 2023, SOLECO expanded total procurement to 131.73 million kWh, reflecting a structural response to portfolio reconfiguration through increased sourcing from Independent Power Producers (IPPs) and market-based purchases. Although the weighted average generation cost declined relative to the 2022 peak, it remained elevated at ₱7.91/kWh, indicating that procurement costs had shifted to a higher baseline under a more market-exposed sourcing environment. Such conditions align with post-transition utility behavior where reduced legacy supply and increased reliance on IPPs and market mechanisms can raise cost variability and weaken price predictability [37-38], [41].

By 2024 and 2025, SOLECO exhibited clearer signs of stabilization alongside continued operational scaling. Total procurement increased to 157.53 million kWh in 2024 and 165.92 million kWh in 2025, while weighted average generation costs decreased to ₱6.52/kWh and ₱6.24/kWh, respectively. Despite this downward trend, average costs remained materially above early-period values, indicating a persistent upward adjustment in SOLECO's procurement cost baseline. Similar trajectories have been documented in ERC-regulated areas undergoing contractual transitions, where increased market exposure and portfolio diversification can reduce peak prices over time but do not fully restore pre-transition cost conditions [37-38].

3.2 Source Dependency

The composition of SOLECO's energy mix from 2020 to 2025 illustrates a pronounced transition from legacy, contract-anchored procurement toward a more diversified yet market-exposed sourcing structure. Using Mainland + SPUG monthly procurement totals, Figure 3 summarizes the evolution of SOLECO's portfolio across the four dominant sources—NPC-TSC/PSALM, PCPC, GNPD, and WESM (net of SSLA)—with all remaining suppliers aggregated as "Others" to represent the full portfolio and maintain a 100% annual share basis.

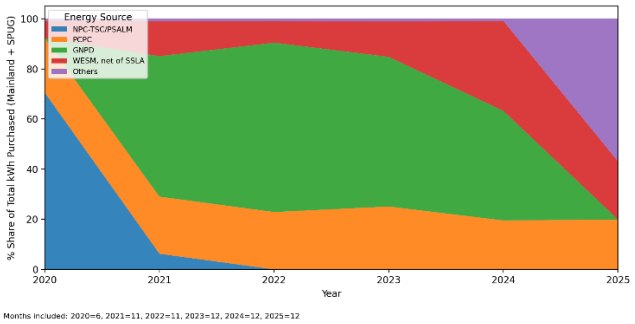


Fig. 3 Evolution of SOLECO's Energy Mix by Source Share (2020–2025).

Legacy-anchored regime (2020). Procurement in 2020 is dominated by NPC-TSC/PSALM (70.45%), indicating strong dependence on legacy supply arrangements associated with greater price predictability [37], [38]. In the same year, PCPC contributes 21.80% and WESM (net of SSLA) accounts for 6.86%, while Others remain marginal (0.89%), suggesting limited diversification beyond the main suppliers.

IPP-dominant transition (2021–2023). A structural reallocation occurs in 2021 as NPC-TSC/PSALM declines to 6.23%, and GNPD becomes the dominant volume source (56.04%), supported by PCPC (22.80%) and increased WESM participation (13.94%). The transition becomes fully evident in 2022, when NPC-TSC/PSALM effectively exits the portfolio (0.00%), while GNPD peaks at 67.56% and PCPC remains substantial at 22.88%, with WESM at 8.59% and Others at 0.97%. In 2023, the portfolio remains IPP-led with GNPD at 59.70%, PCPC at 25.09%, and WESM at 14.13%, reflecting continued reliance on IPPs and market participation to maintain supply adequacy under liberalized conditions [32], [33], [39], [40].

Market-exposed rebalancing (2024–2025). The portfolio shifts toward higher spot-market participation in 2024, where WESM expands sharply to 35.86%, while GNPD declines to 43.72% and PCPC to 19.54%, with Others remaining small (0.88%). In 2025, the dataset indicates a further reconfiguration: GNPD falls to 0.00%, while PCPC remains material (19.90%) and WESM contributes 23.16%. Notably, Others increase substantially to 56.94%, implying that a large portion of procurement volume in 2025 is carried by suppliers outside the four dominant categories (e.g., additional contracted suppliers, alternative procurement sources, or SPUG-related components captured in monthly disclosures). In 2025, the "Others" category is driven primarily by SLPGC (~14.3% of total kWh) and TLI (~12.2%), with smaller contributions from SPI (~1.3%) and NPC-TSC/NPC-SPUG (~0.4%), based on the monthly disclosures. This shift underscores increasing portfolio fragmentation and highlights the importance of tracking not only dominant supplier shares but also the cumulative contribution of secondary sources as part of procurement risk governance.

Overall, Figure 3 indicates that SOLECO's sourcing evolution reflects not only diversification but also a shift in procurement risk architecture—from contract-based anchoring toward a portfolio increasingly shaped by supplier heterogeneity and market-linked procurement dynamics. This reinforces the relevance of supplier-level monitoring (including volatility and concentration indicators) as part of smart-grid–aligned procurement governance, particularly as market-based procurement and secondary supplier participation become more prominent [50-52].

3.3 Statistical Validation and Modeling

To determine whether disparities in average generation cost among SOLECO's energy sources were statistically meaningful rather than due to random variation, a one-way Analysis of Variance (ANOVA) was conducted using supplier–month observations from 2020 to 2025 (Mainland + SPUG combined). The dependent variable was Average Generation Cost (₱/kWh) and the grouping factor was energy source. Consistent with the preprocessing rules in Section 2, only observations with kWh Purchased > 0 and valid numeric unit costs were included. The ANOVA results were statistically significant ($F = 4.7877$, $p = 0.000105$), rejecting the null hypothesis that all sources have equal mean generation costs. This confirms that supplier/source cost differences are systematic and embedded in SOLECO's procurement environment.

Figure 4 reinforces the ANOVA findings by showing distinct unit-cost distributions across sources. NPC-TSC/PSALM exhibits the lowest and most tightly clustered cost profile, consistent with the stabilizing behavior of legacy/regulated supply. In contrast, WESM (net of SSLA) displays the widest dispersion and the most extreme outliers, reflecting the volatility and spike exposure associated with spot-market procurement. PCPC shows a higher central tendency than legacy sources and a wider spread than GNPD and NPC-SPUG, indicating persistent cost premium behavior across observed months. GNPD and NET METERING-EXPORT occupy a mid-range profile with comparatively moderate dispersion relative to WESM.

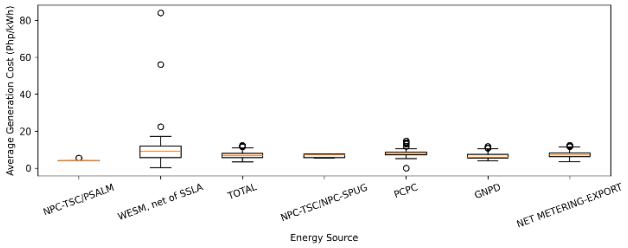


Fig. 4 Boxplot of Average Generation Cost by Energy Source (2020–2025).

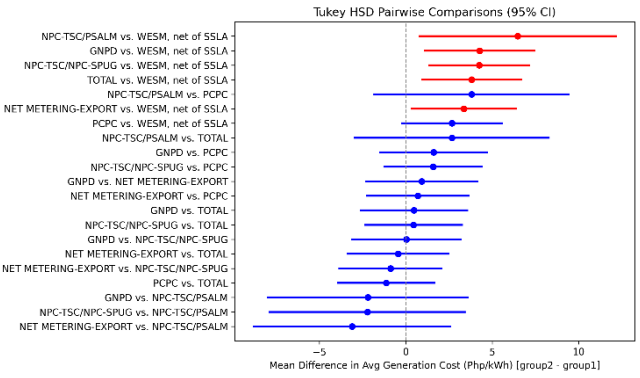


Fig. 5 Tukey HSD Pairwise Comparisons of Average Generation Cost.

Following the significant ANOVA result, Tukey's HSD post hoc testing was used to identify which source pairs differ significantly in mean unit cost. The updated Tukey plot (Figure 5) shows that WESM (net of SSLA) is statistically higher than multiple sources (significant comparisons highlighted in red). Specifically, WESM is significantly higher than:

- NPC-TSC/NPC-SPUG (mean difference ≈ 4.2510 ₱/kWh, p-adj < 0.001)
- GNPD (mean difference ≈ 4.2800 ₱/kWh, p-adj < 0.001)
- TOTAL (portfolio benchmark) (mean difference ≈ 3.8112 ₱/kWh, p-adj < 0.001)

- NPC-TSC/PSALM (mean difference ≈ 6.4795 ₱/kWh, p-adj < 0.001)
- NET METERING-EXPORT (mean difference ≈ 3.3658 ₱/kWh, p-adj < 0.001)

These results indicate that the most statistically distinct—and operationally risk-relevant—cost behavior is associated with spot-market procurement, which exhibits both higher mean costs and substantially higher dispersion relative to contracted sources.

Taken together, the ANOVA–Tukey evidence and the distributional patterns in Figure 4 demonstrate that SOLECO's cost structure is shaped by persistent, source-driven asymmetries. This supports interpreting procurement performance using risk-adjusted benchmarking that captures both systematic mean differences and volatility/outlier exposure, particularly for market-based procurement channels.

3.4 Deep Procurement Cost Analysis

Table 2 provides a six-year temporal dissection of SOLECO's energy procurement profile (Mainland + SPUG), showing how portfolio restructuring and the erosion of legacy supply anchoring translated into measurable shifts in financial exposure and cost volatility. Using monthly totals from SOLECO's disclosures, the early period (2020–2021) reflects a lower-cost baseline relative to the subsequent shock period, with the weighted average generation cost at ₱4.27/kWh in 2020 and ₱5.98/kWh in 2021. Procurement volume also expanded sharply during this phase, rising from 63.60M kWh (2020) to 121.19M kWh (2021), indicating increasing demand and/or procurement scaling under evolving sourcing conditions. While SPUG remains a smaller component of the overall portfolio by volume, supplier-level heterogeneity implies that even limited exposure to high-priced channels can materially influence procurement outcomes, reinforcing why volume-only interpretations may understate procurement risk [46].

A pivotal inflection is observed in 2022, when SOLECO's weighted average generation cost reaches ₱10.70/kWh, the highest across the study period, even though total procurement volume (94.62M kWh) remains below the 2021 level (121.19M kWh). This cost shock indicates a period where procurement outcomes were driven more by supplier-mix and price behavior than by volume expansion. In Table 2, the highest-cost source in 2022 is WESM (net of SSLA) with an annualized unit rate of ₱13.08/kWh, despite contributing only 8.64% of total kWh. This illustrates a clear cost–volume asymmetry, where relatively limited exposure to a high-priced channel can disproportionately influence the overall cost baseline—an effect documented in liberalized markets when utilities compensate for supply gaps through market-based procurement without adequate risk filters, forward-market tools, derivative-market mechanisms, or hedging instruments [44–47].Table 2 Deep Cost and Risk Metrics (2020–2025).

Year	Total kWh	Avg Php/kWh	Cost SD	Highest Cost Source	fRate	Share (%)
2020	63.60M	₱4.27	₱5.10	SELF GENERATION	₱15.62	0.25%
2021	121.19M	₱5.98	₱2.57	WESM (net of SSLA)	₱9.80	13.95%
2022	94.62M	₱10.70	₱3.65	WESM (net of SSLA)	₱13.08	8.64%
2023	131.73M	₱7.91	₱2.42	WESM (net of SSLA)	₱10.76	14.40%
2024	157.53M	₱6.52	₱1.55	PCPC	₱7.74	19.54%
2025	165.92M	₱6.24	₱1.34	NPC-TSC/NPC-SPUG	₱7.53	1.09%

Following this peak, the portfolio exhibits partial normalization but retains a structurally higher baseline. Average costs decline to ₱7.91/kWh in 2023, ₱6.52/kWh in 2024, and ₱6.24/kWh in 2025, yet remain materially elevated relative to the early-period levels. Volatility also persists: while the dispersion of supplier average costs decreases from its 2022 level (Cost SD = ₱3.65) to ₱2.42 (2023), it remains non-trivial and reflects continuing heterogeneity in supplier price behavior under a more market-exposed procurement regime. By 2024, PCPC emerges as the highest-cost source (₱7.74/kWh) while carrying a material portfolio share (19.54%), indicating that cost pressure is no longer confined to a small "tail" exposure but becomes embedded in a major contracted supply component [36]. In 2025, the highest-cost source shifts to NPC-TSC/NPC-SPUG (₱7.53/kWh), albeit with a small share (1.09%), reinforcing that high unit costs can remain present even when volume exposure is limited.

These results affirm the limitations of procurement approaches that rely primarily on volume shares or annual averages without explicitly accounting for supplier-specific volatility and asymmetric risk contributions. They also suggest that diversification alone does not guarantee cost stabilization unless paired with procurement governance mechanisms such as risk filters, supplier benchmarking, and exposure constraints, as emphasized in post-reform and risk-management literature [48-50]. To address these risks, procurement planning should institutionalize volume-weighted supplier evaluation, routine post-hoc benchmarking (e.g., ANOVA–Tukey audits complemented by volatility metrics), and cost ceiling or stabilization provisions in contracting. In addition, embedded renewable generation and demand-side flexibility can reduce sensitivity to spot-market spikes by lowering the required share of market-based procurement during tight system conditions [51-52]. Without these interventions, electric cooperatives remain vulnerable to recurring cost shocks and persistent procurement inefficiencies in liberalized, contract-fragmented power markets.

From a renewable integration perspective, the 2022 volatility episode implies higher uncertainty in short-run marginal procurement costs, which can weaken tariff predictability and complicate the design of long-term renewable procurement contracts (e.g., price-indexing, risk allocation, and flexibility requirements). In systems with growing variable renewable penetration, such volatility increases the value of flexibility resources (e.g., reserves, balancing, and responsive demand) and strengthens the need for digital monitoring to manage market exposure and supplier-risk signals in near real time [48], [50-53].

3.5 Strategic Implications and future directions

The procurement cost dynamics in SOLECO's 2020–2025 dataset indicate that outcomes are shaped not only by total energy volume but also by portfolio composition, supplier heterogeneity, and exposure to high-volatility procurement channels. Using Mainland + SPUG monthly totals, the results show continued procurement expansion through 2025 alongside a pronounced cost shock in 2022 (Table 2 and Figure 2), demonstrating that cost risk can intensify even without proportional volume growth. This trajectory is consistent with patterns reported in other developing-market reforms, where the erosion of legacy contracting and greater market participation shift procurement risk toward price volatility.

Spot-market exposure emerges as a key risk driver. The inferential results confirm significant mean-cost differences across sources (ANOVA: $F = 4.7877$, $p = 0.000105$), and Tukey's HSD identifies WESM (net of SSLA) as significantly higher than multiple contracted sources and the TOTAL benchmark. Together with

the wide dispersion and extreme outliers observed for WESM, the results highlight spot-market procurement as a primary contributor to volatility and tariff-pressure risk [42]. The non-significant difference between PCPC and WESM further suggests that cost pressure may converge across certain contracted and market-based channels, reinforcing the need for empirical, distribution-based risk evaluation rather than supplier-type assumptions.

From a renewable energy and smart-grid perspective, procurement volatility can weaken tariff predictability and complicate renewable procurement design (e.g., indexation and risk allocation), while increasing the value of flexibility resources (balancing, reserves, and responsive demand) and digital analytics for near real-time monitoring [48], [50-53]. Portfolio evolution also indicates rapid shifts in dominance and fragmentation; the rise of "Others" in 2025 implies that secondary sources can become materially significant when aggregated, strengthening the case for improved supplier classification and monitoring. For regulators (ERC and DOE), the findings support integrating volatility- and concentration-based indicators into procurement monitoring and disclosure review to enable earlier detection of tariff-risk exposure and strengthen procurement governance oversight.

Overall, SOLECO's case shows that liberalized-market procurement requires frameworks that separate cost drivers rooted in supplier structure from those arising from market volatility, supporting more resilient planning as the sector becomes increasingly decentralized and price-sensitive.

4. Conclusion

This study evaluated SOLECO's electricity procurement outcomes from 2020 to 2025 using supplier-disaggregated monthly disclosures for Mainland + SPUG, integrating descriptive portfolio analytics with inferential testing (one-way ANOVA and Tukey's HSD). The results provide empirical evidence that SOLECO's procurement environment has shifted toward greater supplier heterogeneity and market exposure, with measurable consequences for cost stability and procurement risk—issues that are increasingly relevant under smart-grid modernization and renewable transition.

Using monthly totals, total purchased energy increased from 63.60 million kWh (2020) to 165.92 million kWh (2025). Over the same period, weighted average generation cost displayed pronounced instability, peaking at ₱10.70/kWh in 2022 despite lower procurement volume than 2021, indicating a price-driven shock linked to portfolio composition and exposure to high-priced procurement channels. Although costs partially normalized in later years (₱7.91/kWh in 2023, ₱6.52/kWh in 2024, and ₱6.24/kWh in 2025), they remained above the early-period baseline, suggesting a persistent upward adjustment in procurement cost conditions following portfolio restructuring.

Portfolio composition results further confirm a structural change in sourcing regimes. The energy mix transitioned from NPC-TSC/PSALM dominance in 2020 (70.45%) toward an IPP-led structure in 2021–2023 (with GNPD peaking at 67.56% in 2022), followed by heightened market exposure in 2024 as WESM (net of SSLA) rose to 35.86%, and a more fragmented portfolio in 2025 where "Others" increased to 56.94%. These shifts indicate that procurement risk is shaped not only by dominant suppliers but also by the growing contribution of secondary sources that may be intermittent yet collectively material.

Inferential results substantiate that procurement costs differ systematically across sources. The ANOVA indicates significant mean-cost differences ($F = 4.7877$, $p = 0.000105$). Tukey's HSD identifies WESM (net of SSLA) as significantly higher than multiple contracted sources and the overall portfolio benchmark, while the boxplot distribution shows WESM exhibiting the widest dispersion and extreme outliers, reinforcing spot-market exposure as a primary cost-risk driver. Together, these findings demonstrate that procurement evaluation cannot rely on volume shares or annual averages alone; it must incorporate supplier-level benchmarking and volatility-aware analysis to capture asymmetric risk contributions within the portfolio.

From a renewable energy and smart-grid perspective, the study positions procurement as a data-governance and decision-support challenge. As higher renewable penetration increases variability and flexibility requirements, distribution utilities benefit from analytical tools that monitor supplier-level volatility, concentration, and outlier behavior to improve transparency, tariff predictability, and procurement resilience. Finally, the study is limited by the completeness of disclosed monthly files in early years (e.g., partial coverage in 2020 and missing months in 2021–2022), and by the focus on disclosed procurement costs rather than contract clauses and operational constraints not captured in the reports. Future work may extend this approach through robustness models for temporal dependence, scenario-based forecasting under renewable expansion, and integration of flexibility and reliability indicators to strengthen smart-grid relevance.

5. Recommendation

1. Implement risk-adjusted portfolio governance. Procurement evaluation should incorporate supplier-level cost distributions (mean, dispersion, and outlier incidence) in addition to volume shares to capture asymmetric risk contributions observed across sources.
2. Treat spot-market procurement as a managed risk exposure. Given the statistically distinct mean-cost behavior and extreme dispersion associated with WESM (net of SSLA), internal exposure management protocols (e.g., thresholds and trigger-based controls) should be adopted to reduce vulnerability to price spikes and improve tariff predictability.
3. Institutionalize routine benchmarking and statistical auditing. Procurement reviews should include inferential benchmarking (e.g., ANOVA–Tukey comparisons) complemented by volatility indicators to detect persistent cost asymmetries and support evidence-based supplier evaluation.
4. Strengthen classification and monitoring of secondary procurement channels. The large "Others" share in 2025 indicates that secondary sources can become materially significant; standardized supplier tagging and improved reporting granularity are necessary to prevent hidden concentration risk and untracked cost escalation within aggregated categories.
5. Develop digital procurement analytics consistent with smart-grid decision support. A procurement dashboard tracking monthly weighted costs, supplier shares, volatility measures, and risk flags can strengthen transparency, governance, and responsiveness under market uncertainty.

6. Definition of Terms

(1) Average Generation Cost (₱/kWh) – The cost per kilowatt-hour (kWh) calculated by dividing the total generation cost of electricity by the total energy (in kWh) procured from a specific supplier. It reflects the unit cost of energy provision.

(2) Bilateral Contract – A power supply agreement between a distribution utility (DU) and an Independent Power Producer (IPP), typically involving a fixed rate and committed volume over a set period.

(3) Cost Adjustment (DAA, NSS, Other Billing Adjustments) – Financial corrections applied to basic generation charges. These may include Deferred Accounting Adjustments (DAA), Non-Specific Subsidies (NSS), and other temporary rebates or surcharges.

(4) Cost Volatility – The extent of variation or dispersion in generation costs across different suppliers, measured using standard deviation. It reflects procurement risk and price unpredictability.

(5) Distribution Utility (DU) – An entity authorized to operate a distribution system for the delivery of electricity to end-users. SOLECO is the DU analyzed in this study.

(6) Generation Cost – The total cost incurred by a DU to procure electricity, inclusive of base generation charges and adjustments, before transmission and distribution charges.

(7) Independent Power Producer (IPP) – A non-government-owned entity that generates electricity for sale under bilateral contracts or to the spot market. Examples include PCPC, TLI, KEPCO, and SPI in the SOLECO procurement mix.

(8) NPC-TSC/PSALM – The National Power Corporation–Transition Supply Contract and the Power Sector Assets and Liabilities Management Corporation. These are legacy providers offering stable, regulated generation prices.

(9) One-Way ANOVA (Analysis of Variance) – A statistical test used to determine whether there are significant differences in the average generation costs among multiple suppliers.

(10) Standard Deviation (σ) – A statistical measure that quantifies the amount of variation or dispersion in a set of values, used in this study to capture cost variability across suppliers.

(11) Supplier Share (%) – The proportion of total kWh procured from a specific supplier relative to the DU's total energy purchase for the given period.

(12) Tukey's Honest Significant Difference (HSD) – A post hoc statistical test used following ANOVA to identify which specific pairs of supplier costs differ significantly.

(13) WESM (Wholesale Electricity Spot Market) – A competitive market platform where electricity is traded on a short-term basis. Prices vary based on real-time demand and supply.

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Ethics and Data Transparency Statement

The study uses publicly available, non-identifiable administrative electricity procurement disclosures released by the Southern Leyte Electric Cooperative (SOLECO) through its official website in compliance with Energy Regulatory Commission transparency requirements. The dataset contains no personal data and involves no human participants; therefore, institutional ethics review/IRB approval is not applicable (exempt). All analyses were conducted on the published reports, and results are reported in aggregated form to support transparency and reproducibility.

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Appendix

Table 3 Tukey HSD Pairwise Comparisons of Average Generation Cost (₱/kWh), 2020–2025

Group 1	Group 2	Mean Diff (G2–G1)	95% CI Lower	95% CI Upper	Adj. p-value	Significant (α=0.05)
NPC-TSC/NPC-SPUG	WESM, net of SSLA	4.251	1.2931	7.2088	0.0005	TRUE
GNPD	WESM, net of SSLA	4.28	1.0522	7.5079	0.0019	TRUE
TOTAL	WESM, net of SSLA	3.8112	0.8983	6.7241	0.0024	TRUE
NPC-TSC/PSALM	WESM, net of SSLA	6.4795	0.7626	12.1963	0.015	TRUE
NET METERING-EXPORT	WESM, net of SSLA	3.3658	0.3	6.4315	0.021	TRUE
PCPC	WESM, net of SSLA	2.6723	-0.2624	5.6071	0.1011	FALSE
NPC-TSC/PSALM	PCPC	3.8071	-1.8713	9.4856	0.4238	FALSE
NPC-TSC/NPC-SPUG	PCPC	1.5786	-1.3042	4.4615	0.6667	FALSE
NET METERING-EXPORT	NPC-TSC/PSALM	-3.1137	-8.8609	2.6336	0.678	FALSE
GNPD	PCPC	1.6077	-1.5515	4.767	0.7391	FALSE
NPC-TSC/PSALM	TOTAL	2.6682	-2.999	8.3354	0.8035	FALSE
PCPC	TOTAL	-1.1389	-3.9756	1.6978	0.8973	FALSE
NPC-TSC/NPC-SPUG	NPC-TSC/PSALM	-2.2285	-7.9189	3.462	0.9079	FALSE
GNPD	NPC-TSC/PSALM	-2.1994	-8.0347	3.6359	0.9224	FALSE
NET METERING-EXPORT	NPC-TSC/NPC-SPUG	-0.8852	-3.9013	2.131	0.9767	FALSE
GNPD	NET METERING-EXPORT	0.9143	-2.367	4.1956	0.9821	FALSE
NET METERING-EXPORT	PCPC	0.6935	-2.3	3.6869	0.9933	FALSE
NPC-TSC/NPC-SPUG	TOTAL	0.4397	-2.4209	3.3004	0.9993	FALSE
GNPD	TOTAL	0.4688	-2.6701	3.6078	0.9994	FALSE
NET METERING-EXPORT	TOTAL	-0.4454	-3.4175	2.5266	0.9994	FALSE
GNPD	NPC-TSC/NPC-SPUG	0.0291	-3.1516	3.2098	1	FALSE