
| RESEARCH ARTICLE**Beyond Revenue Adequacy: Why Ghana Should Adopt Cost-Reflective Electricity Tariff Design To Promote Competitiveness, Efficiency And Financial Sustainability****Elikplim Kwabla Apetorgbor***Independent Researcher, Accra, Ghana***Corresponding Author:** Elikplim Kwabla Apetorgbor, **E-mail:** elikplimapetorgbor@gmail.com**| ABSTRACT**

Ghana's electricity tariff debate has been dominated by the question of whether regulated utilities recover their approved revenue requirements. That question is necessary, but it is not sufficient. A tariff can recover aggregate cost while remaining economically inefficient, commercially distortive and socially regressive if charges do not reflect the costs caused by different customer classes, voltage levels, usage periods, load profiles, service qualities and network locations. This paper argues that the Public Utilities Regulatory Commission (PURC) should move beyond a predominantly cost-recovery-centred framework toward a cost-reflective tariff architecture. The proposed reform does not abandon revenue adequacy; it embeds revenue adequacy within a more disciplined system of cost causation, marginal-cost signalling, performance incentives and targeted social protection. Using Ghanaian regulatory documents, sector data, international regulatory practice and the electricity-pricing literature, the paper shows that an average-tariff approach can transfer losses and inefficiencies to productive customers, weaken demand response, encourage inefficient network expansion, penalise high-load-factor industrial users and obscure the fiscal cost of universal or social obligations. A cost-reflective structure would unbundle customer, energy, capacity, network, loss, reliability and policy costs; introduce time- and voltage-differentiated rates; replace blunt cross-subsidies with transparent, targeted support; and condition allowed revenues on efficiency and service-quality performance. The paper proposes a phased five-year implementation programme built on a modern cost-of-service study, advanced metering, coincident-peak analysis, loss-disallowance trajectories, industrial demand-response products, tariff impact testing and independent ex-post evaluation. Properly designed, the reform can improve utility solvency while reducing the system cost of serving Ghana's economy. The central policy conclusion is that cost recovery answers how much revenue the sector requires, whereas cost reflectivity determines who should pay, when they should pay and what behaviour the tariff should incentivise. Ghana now requires both.

| KEYWORDS

cost-reflective tariffs; cost recovery; electricity regulation; industrial competitiveness; demand response; Ghana; PURC; utility efficiency.

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1. Introduction

Electricity tariffs perform at least four functions simultaneously. They finance the prudent cost of service; allocate that cost among users; signal the economic value of electricity and network capacity; and implement social or public-policy objectives. Ghana's tariff discourse has frequently compressed these functions into a single question: whether approved end-user tariffs produce enough revenue to pay generators, fuel suppliers, the transmission utility and distribution companies. This revenue-adequacy focus is understandable. Ghana's electricity sector has accumulated recurrent financial shortfalls, arrears and fiscal transfers, while high distribution losses and imperfect revenue collection have weakened the commercial chain (World Bank,

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2024a; IMF, 2024, 2025a, 2025b). The 2025 Budget and the Energy Sector Recovery Programme accordingly emphasise metering, collection, loss reduction, fuel optimisation, tariff adjustment and the renegotiation of fixed capacity obligations (Ministry of Finance, 2025a; World Bank, 2024b).

Yet a tariff system can be fully cost-recovering in the aggregate and still be poorly designed. When prices are averaged across hours, voltage levels, customer load profiles and locations, low-cost consumption can subsidise high-cost consumption; customers who contribute little to the system peak can subsidise those who drive investment; efficient industrial users can bear costs created by technical and commercial losses elsewhere; and vulnerable households can receive less protection than affluent consumers who happen to consume within subsidised blocks. Revenue can be collected without transmitting economically useful information. In such a system, the tariff becomes a mechanism for distributing accounting costs rather than a regulatory instrument for reducing future costs.

This distinction is especially important for Ghana. The power system is increasingly thermal, exposed to fuel and foreign-exchange volatility, and characterised by significant differences in customer scale, voltage of supply, load factor and capacity contribution. The Energy Commission projected electricity consumption of 25,836 GWh for 2025, with ECG accounting for about 68 per cent of consumption and thermal generation providing the majority of supply (Energy Commission, 2024). PURC's 2026-2030 Multi-Year Tariff Order recognises investment requirements, industrial competitiveness, consumer conditions and quarterly adjustments for macroeconomic variables, but the dominant public discussion remains the percentage increase in the average tariff rather than the economic architecture of rates (PURC, 2026a).

The policy opportunity is therefore not to choose between financial sustainability and competitiveness. It is to design tariffs that achieve both. Proper cost reflectivity improves financial sustainability because customers face prices associated with the costs they cause, while utilities face stronger incentives not to pass avoidable inefficiencies into allowed revenue. It improves competitiveness because firms that use electricity at off-peak times, maintain high load factors, take supply at higher voltages, manage reactive power or offer interruptible demand should pay less than otherwise similar firms that impose greater system costs. It improves social legitimacy because explicit, targeted assistance is more transparent than hidden cross-subsidies embedded in broad customer categories.

This paper advances three propositions. First, cost recovery and cost reflectivity are not substitutes: cost recovery is a constraint on aggregate revenue, while cost reflectivity is a principle for designing the structure of charges. Second, Ghana's current emphasis on periodic revenue adjustment should be complemented by granular cost allocation, performance-based regulation and demand-side price signals. Third, the transition should be phased, data-driven and distributionally managed so that reform does not become a pretext for indiscriminate tariff increases. The proposed architecture is intended for PURC, the Ministry responsible for energy, the Energy Commission, utilities, industrial consumers, investors and social-policy institutions.

2. Method and analytical orientation

The paper uses a policy-analytical and comparative-regulatory method. It reviews Ghana's statutory framework, PURC rate-setting documents, the 2026-2030 tariff decision, Energy Commission planning data, the Energy Sector Recovery Programme, fiscal-policy documents and IMF programme reports. It then compares the Ghanaian approach with established principles and selected practices from Europe, Australia, New Zealand, Singapore, South Africa, Kenya, Uganda, Nigeria and the United States. The analysis is also informed by the literature on public-utility regulation, marginal-cost pricing, dynamic tariffs, incentive regulation, energy justice and firm productivity.

The approach is normative rather than econometric. It asks what tariff structure is most likely to minimise the long-run cost of reliable electricity service while preserving utility viability, productive-sector competitiveness, social protection and regulatory credibility. The international examples are not presented as templates for mechanical transplantation. They are used to identify design principles that can be adapted to Ghana's institutional capacity, metering coverage, market structure and political economy.

3. Cost recovery and cost reflectivity: a necessary conceptual correction

3.1 Revenue requirement, cost allocation and rate design

Public-utility ratemaking normally proceeds through three analytically distinct stages. The regulator first determines the utility's prudent annual revenue requirement. It then allocates that requirement among functions and customer classes. Finally, it designs rates that recover the allocated amount through fixed, energy, demand, capacity, reactive-power, connection or other charges (Bonbright, Danielsen, and Kamerschen, 1988; Kahn, 1988; NARUC, 2025). Conflating these stages creates the misconception that any rate producing the approved revenue is economically sound.

In simplified form, the allowed annual revenue requirement may be represented as:

$$ARR = OPEX_{prudent} + Depreciation + (WACC \times RAB) + Taxes + Approved \text{ pass-through costs} - Non\text{-tariff revenue}.$$

Cost recovery is achieved when expected tariff revenue, together with any transparent subsidy or government transfer, equals ARR. Cost reflectivity requires a further condition: the structure of expected charges should reasonably correspond to the incremental and embedded costs caused by each user's demand, energy consumption, voltage, losses, reliability requirements, timing and location. In a multi-part tariff:

$$Expected \text{ revenue} = Sum(Fixed \text{ customer charges}) + Sum(Energy \text{ charges by time}) + Sum(Capacity \text{ or demand charges}) + Sum(Network \text{ and ancillary-service charges}) + Explicit \text{ policy levies}.$$

The first equation determines how much the regulated business may recover. The second determines how customers face that requirement. The regulatory task is incomplete until both are addressed.

3.2 Why average cost recovery is not cost reflectivity

An average volumetric tariff can recover total cost, but it does not necessarily reflect marginal generation cost, the user's contribution to coincident system peak, network reinforcement needs, voltage-related loss differences or customer-specific service costs. It may therefore generate excessive consumption in high-cost hours and insufficient consumption in low-cost hours. It can also encourage customers to self-supply or defect from the grid even when their exit raises costs for remaining users. Conversely, an excessive fixed charge may protect utility revenue but suppress conservation and disproportionately burden low-use households (Borenstein, 2005; Borenstein and Holland, 2005; Lazar and Gonzalez, 2015).

The classic Bonbright criteria remain useful: rates should promote revenue adequacy, stability, fairness, simplicity, customer understanding and efficient use. Modern electricity systems add flexibility, decarbonisation, digital metering, distributed energy resources and resilience. Regulators therefore need tariffs that preserve the revenue requirement while improving the timing, composition and location of demand (CEER, 2020; ACER, 2023, 2025; Regulatory Assistance Project, 2021).

Cost reflectivity must also be distinguished from a policy of charging every customer the full standalone cost of serving that customer. Electricity networks contain common costs, economies of scale and public-service obligations. Some averaging is unavoidable and often desirable. The relevant standard is reasonable cost causation, not impossible engineering precision. Where public policy deliberately departs from cost causation - for example, to support vulnerable households or remote communities - the departure should be explicit, quantified, funded and periodically reviewed.

Table 1. Cost-recovery-centred and cost-reflective tariff approaches

Dimension	Cost-recovery-centred approach	Cost-reflective approach	Regulatory implication
Primary question	How much revenue must the utility collect?	Which user causes which cost, at what time and service level?	Revenue adequacy remains necessary but is not the end of tariff design.
Cost basis	Average approved cost divided across broad classes.	Prudent embedded cost plus forward-looking marginal cost, differentiated by demand, time, voltage, losses and service.	Requires cost-of-service, load research and interval-meter data.
Efficiency treatment	Avoidable losses and weak performance may be passed through if approved as sector cost.	Efficiency benchmarks, loss-disallowance and performance incentives separate prudent from avoidable cost.	Consumers should not finance chronic inefficiency without a corrective trajectory.
Customer signal	Mostly kWh price and periodic percentage adjustment.	Multi-part rates signal energy, capacity, network use, peak contribution, power factor and reliability.	Customers can lower bills by lowering system cost.

Dimension	Cost-recovery-centred approach	Cost-reflective approach	Regulatory implication
Equity	Broad cross-subsidies embedded in customer categories.	Targeted assistance funded transparently; non-vulnerable users face cost-causative rates.	Social protection becomes more accurate and fiscally visible.
Competitiveness	Industrial tariffs may be used as a residual source of revenue.	High-load-factor, high-voltage, off-peak and flexible customers receive lower cost-based charges.	Efficient firms are rewarded rather than penalised.

Source: Author synthesis from the cited literature and regulatory materials.

4. Ghana's present tariff challenge

4.1 The statutory mandate is broader than revenue collection

PURC's legal mandate under the Public Utilities Regulatory Commission Act, 1997 (Act 538) includes providing rate guidelines, examining and approving rates, protecting the interests of consumers and utility providers, promoting fair competition and monitoring service standards. The Energy Commission Act, 1997 (Act 541) and the Electricity Regulations, 2008 (L.I. 1937) reinforce planning, licensing and technical-governance functions. The statutory architecture therefore does not confine tariff regulation to cash collection. It supports a balanced mandate covering viability, efficiency, quality, transparency and public interest.

PURC's Rate Setting Guidelines already distinguish the revenue requirement from allocation and tariff structure and recognise prudent costs, regulatory assets, return, depreciation and adjustment mechanisms (PURC, 2020). Its generation-capacity procurement guidelines further emphasise competitive procurement and least-cost supply (PURC, 2023b). PURC's own regulatory briefs acknowledge that tariff structures can incentivise efficient energy use and that fairness, transparency and sustainability are core concerns (PURC, 2024). The proposed reform is therefore an evolution of PURC's existing philosophy, not a departure from its law.

4.2 Financial distress has encouraged an incomplete policy response

Ghana's financial stress is real. The World Bank reported that ECG distribution losses were about 28.4 per cent in 2022, collection was approximately 85.6 per cent, tariffs did not fully cover cost of service, and the energy sector had become a major fiscal burden (World Bank, 2024a). Subsequent official and IMF assessments continued to identify losses, slow tariff adjustment, costly liquid fuels, arrears, governance weaknesses and weak collection as drivers of the sector shortfall (IMF, 2024, 2025a; Ministry of Finance, 2025b). PURC's move to a Multi-Year Tariff Order and quarterly adjustment mechanism improves predictability and reduces the erosion of tariff value by inflation, exchange rates, fuel prices and generation-mix changes.

The danger is that automatic adjustment becomes the dominant reform instrument. A quarterly adjustment formula can preserve the real value of approved revenue, but it cannot by itself determine whether the underlying cost is efficient, whether losses are prudently allocated, whether industrial customers cause the costs charged to them, or whether the rate encourages load shifting. A well-calibrated indexation mechanism protects utilities from exogenous shocks; a cost-reflective design protects the economy from endogenous inefficiency.

The Minister for Finance has publicly argued that tariff increases alone cannot solve the sector problem and that distribution inefficiencies materially enlarge the shortfall (Ministry of Finance, 2025b). This observation supports a shift from a tariff-centred recovery strategy to a total-cost strategy. The objective should not be to collect an ever-larger amount from a static customer base; it should be to reduce the efficient revenue requirement per unit of reliable service.

4.3 Averaging and cross-subsidisation can weaken productive competitiveness

Industrial competitiveness depends not only on the average electricity price but also on the predictability, structure and controllability of the bill. Firms invest in efficient motors, power-factor correction, energy management, storage, load shifting and high-voltage connections when the tariff rewards those actions. Where most system costs are recovered through averaged energy charges or non-coincident maximum-demand charges, the private savings from operational flexibility may be smaller than the system savings. The tariff then fails to convert technical efficiency into commercial value.

International evidence shows that electricity shortages and high or poorly structured electricity costs reduce firm productivity, output and investment, while self-generation can impose additional capital and operating costs (Allcott, Collard-Wexler, and

O'Connell, 2016; Abeberese, 2017; Fisher-Vanden, Mansur, and Wang, 2015; Cole et al., 2018; Oseni and Pollitt, 2015). Ghana should therefore treat tariff design as industrial policy. An efficient manufacturer that operates continuously at a high load factor and takes supply at medium or high voltage should not be used as a residual source of cross-subsidy if its cost to serve is comparatively low.

Broad cross-subsidies can also accelerate grid bypass. Large customers may invest in captive generation, solar and storage primarily to avoid tariffs rather than because self-supply is cheaper for the system. The remaining utility customer base then bears a higher share of sunk network and contractual costs, creating a utility death-spiral dynamic. Cost-reflective network and standby charges, combined with fair compensation for exports and flexibility, are more sustainable than either punitive exit fees or undifferentiated volumetric rates (MIT, 2016; Regulatory Assistance Project, 2021).

4.4 Hidden subsidies are weak social policy

A social tariff is justified where electricity expenditure imposes an unacceptable burden on vulnerable households. However, consumption blocks and broad residential subsidies are imperfect proxies for income or vulnerability. Larger or wealthier households can capture significant benefits, while poor households with shared meters, informal connections or high essential-use requirements may be excluded. The literature on utility subsidies consistently finds that connection constraints and weak targeting can make consumption subsidies regressive or fiscally inefficient (Komives et al., 2005; Kojima and Trimble, 2016; Trimble et al., 2016).

Cost reflectivity does not require the removal of social protection. It requires separation of the economic tariff from the social transfer. PURC should calculate the cost-reflective bill, while government funds an explicit, targeted credit through the national social-protection architecture. Such a credit can be financed from the budget, a transparently disclosed levy, or a defined universal-service fund. The beneficiary, unit subsidy, total fiscal cost, funding source and expiry or review date should be published. This improves accountability and avoids forcing industrial or non-residential users to finance social policy through opaque mark-ups that damage employment and investment.

Table 2. Ghanaian tariff-design problems and cost-reflective remedies

Observed problem	Economic consequence	Recommended tariff or regulatory response	Indicative KPI
High technical and commercial losses	Efficient customers may finance avoidable inefficiency; revenue requirement grows.	Set utility-specific efficient-loss baselines, a declining glide path, and partial disallowance above benchmark; share verified gains.	Distribution loss; collection rate; cash recovery; loss-reduction capex delivery.
Quarterly pass-through of macro variables	Preserves utility revenue but can obscure whether base costs are efficient.	Retain pass-through for uncontrollable variables, but apply ex-post true-up, prudence review and efficiency factors.	Variance between forecast and actual fuel, FX and generation mix; disallowed cost.
Broad customer-class averaging	Cross-subsidies unrelated to cost causation; bypass incentives.	Undertake class cost-of-service and marginal-cost studies; publish allocation factors and subsidy matrix.	Cost-to-serve ratio by class; cross-subsidy value; bypass/self-generation trend.
Weak time differentiation	Peak demand and network reinforcement are underpriced; off-peak capacity is underused.	Introduce TOU, critical-peak and peak-time rebate options, starting with smart-metered C&I customers.	Peak reduction; load factor; off-peak sales; avoided capacity cost.
Demand charges based on individual maximum	May penalise loads that do not coincide with system peak.	Move progressively toward coincident-peak or time-banded demand charges, with transparent ratchets.	Customer coincident peak; system peak contribution; bill responsiveness.

Observed problem	Economic consequence	Recommended tariff or regulatory response	Indicative KPI
Opaque social and geographic obligations	Policy costs are hidden and accountability is weak.	Show universal-service and social-policy costs as explicit funded components; target benefits using social registers.	Subsidy incidence; energy burden; beneficiary accuracy; fiscal cost.
Revenue not sufficiently linked to service quality	Tariff increases may not translate into reliability and customer service.	Introduce performance-based rewards and penalties for SAIDI, SAIFI, voltage quality, connections and complaints.	Reliability indices; complaint resolution; connection time; customer satisfaction.

Source: Author synthesis from the cited literature and regulatory materials.

5. The economic case for a cost-reflective design

5.1 It reduces the long-run revenue requirement, not merely reallocates it

The strongest argument for cost reflectivity is dynamic, not distributive. A tariff that reflects peak and network costs changes behaviour, which can defer generation, transmission and distribution investment, reduce fuel use, lower losses and improve asset utilisation. The resulting efficient revenue requirement is smaller than under a tariff that passively recovers the cost of an unmanaged load profile. In this sense, cost reflectivity is a cost-reduction policy.

Real-time pricing is not immediately feasible for all Ghanaian customers, but decades of experimentation show that customers respond to time-varying prices, especially when enabling technologies and clear communication are available (Faruqui and Sergici, 2010; Wolak, 2011; Faruqui, Sergici, and Akaba, 2014; Jessoe and Rapson, 2014). Time-of-use pricing can deliver a substantial share of the benefit with lower complexity. Critical-peak pricing or peak-time rebates can target the small number of hours that drive capacity and network expenditure. The appropriate Ghanaian sequence is to start with large and smart-metered customers, learn from pilots, then widen coverage.

The generation dimension is particularly relevant where fuel cost and plant efficiency vary across units and hours. If off-peak demand can be served by efficient baseload or otherwise underutilised capacity, a lower off-peak rate can increase sales while reducing the average cost per unit. Conversely, a higher peak rate can reduce dependence on costly peaking generation, liquid fuel and emergency procurement. A tariff that raises all hours equally misses this opportunity.

5.2 It protects efficient industrial consumers and rewards flexibility

For industrial users, the relevant cost drivers include voltage level, connection assets, load factor, power factor, coincidence with system peak, reliability requirements and interruptibility. Cost reflectivity should therefore produce differentiated products rather than a single industrial tariff. A high-voltage, high-load-factor customer that can curtail on notice should receive a lower network and capacity charge than a low-load-factor customer requiring firm supply at the distribution edge. This is not a concession; it is cost-based pricing.

PURC should introduce or strengthen the following products: firm and non-firm network service; interruptible or curtailable tariffs; day-ahead and critical-peak demand response; off-peak industrial expansion tariffs; seasonal tariffs for irrigation and agro-processing; high-load-factor contracts; and optional indexed energy products for customers able to manage fuel or wholesale-price risk. Each product should be transparent, non-discriminatory and available to similarly situated customers.

These products can improve national competitiveness in mining, aluminium, cement, steel, cold storage, ports, data centres, manufacturing and emerging electric-mobility value chains. They can also support regional power trade by making domestic load more flexible when export opportunities or system constraints change.

5.3 It disciplines utilities through performance-based regulation

Cost-reflective customer charges are credible only if the regulated cost base is itself efficient. Otherwise, the reform becomes cost pass-through with finer billing categories. PURC should combine tariff redesign with an incentive-regulation framework that distinguishes controllable and uncontrollable cost, sets multi-year efficiency targets, benchmarks losses and operating expenditure, and links a portion of revenue to service performance (Littlechild, 1983; Joskow, 2008, 2014; Ofgem, 2022).

Under a price-cap or revenue-cap framework, the allowed trajectory can include an inflation index, an efficiency factor, approved output adjustments and clearly defined pass-through items. Utilities retain part of verified efficiency gains for a limited period, while customers receive the benefit in the next control period. Penalties should apply for failure to meet reliability, connection, metering, billing and complaint-resolution standards. Capital expenditure should be subject to output-based approval, procurement discipline and ex-post prudence review.

The principle is straightforward: customers should pay the efficient cost of the service they require, not the accounting cost of every expenditure incurred by the utility. PURC's tariff decision should publish a bridge from the utility's application to the approved revenue requirement, identifying reductions for inefficiency, unsupported capital expenditure, excess losses, procurement failures and non-performance.

5.4 It improves investment signals and bankability

Investors require predictable revenue, but predictability is stronger when tariffs are economically coherent. A rate structure that aligns network, capacity and energy charges with cost causation makes demand forecasts more credible, reduces politically contentious cross-subsidies and improves the allocation of investment risk. It also enables customers and energy-service companies to value efficiency, storage, distributed generation and demand response.

Cost reflectivity should be coordinated with competitive procurement. New generation and network investment should be admitted to the revenue requirement only after least-cost planning, transparent procurement, realistic demand forecasts and assessment of non-wire alternatives. PURC's 2023 capacity-procurement guidelines provide an institutional foundation. Tariff reform cannot compensate for avoidable over-procurement or poorly allocated contractual risk; it should expose and reduce those costs rather than socialise them indefinitely.

5.5 It supports electrification, electric mobility and distributed resources

Ghana's future tariff must accommodate electric vehicles, battery storage, rooftop solar, embedded generation, mini-grids and active customers. Flat volumetric tariffs can encourage charging at the evening peak, overcompensate or undercompensate distributed generation, and shift network cost to customers without distributed assets. International regulators increasingly use time-differentiated network tariffs, export compensation, capacity components and flexibility markets to address these issues (MIT, 2016; CEER, 2020; ACER, 2025).

PURC should establish an off-peak electric-vehicle tariff, require managed charging for large fleets and public stations, and allow aggregators to offer demand response. For distributed generation, compensation should reflect avoided energy, losses and capacity where demonstrable, less the cost of balancing, metering and network use. Standby and backup charges should be based on the probability and cost of coincident use, not designed as punitive barriers to self-generation.

6. International best practice and its relevance to Ghana

International practice converges on several principles even though institutional models differ. First, allowed revenue and tariff structure are treated separately. Second, cost allocation is based on customer, energy and demand causation. Third, time-varying signals are increasingly used where metering permits. Fourth, social protection is targeted or transparently funded. Fifth, utility revenue is tied to efficiency and outputs rather than unrestricted cost pass-through.

European regulators emphasise transparency, predictability, cost reflectivity and efficient use of networks. CEER recommends tariffs that support flexibility, storage and electric vehicles, while ACER's 2023 and 2025 reports compare national practices in cost models, cost cascading, injection charges, connection charges, reactive energy and time-of-use structures (CEER, 2020; ACER, 2023, 2025). The lesson for Ghana is not to replicate complex European locational pricing immediately, but to establish a transparent hierarchy: customer-specific cost, voltage-related network cost, coincident capacity cost and time-related energy cost.

Australia requires distribution businesses to submit Tariff Structure Statements explaining how tariffs comply with pricing principles, customer impacts and transition strategies (AER, 2023). New Zealand's distribution-pricing principles similarly emphasise efficient price signals, subsidy transparency and transition management (Electricity Authority of New Zealand, 2019). These practices show the value of requiring utilities to justify the structure of rates, not only their total revenue.

The United Kingdom's RII framework links revenue to incentives, innovation and outputs and uses multi-year controls to balance investment, efficiency and service quality (Ofgem, 2022). Ghana can adopt a simpler version with a limited set of measurable outputs, independent data verification and symmetric rewards and penalties.

African comparators demonstrate the importance of gradualism. Kenya's tariff reviews differentiate customer categories and include fuel, foreign-exchange and inflation adjustments; Uganda publishes quarterly end-user tariffs and has used declining

connection and lifeline measures; Nigeria's Multi-Year Tariff Order combines cost assumptions, loss targets and service bands, although implementation illustrates the political and data challenges of moving toward cost reflectivity (EPRA, 2023; ERA, 2024; NERC, 2024). The central lesson is that cost-reflective tariffs require credible service commitments. Customers will resist higher or more differentiated charges where service quality, metering and billing remain unreliable.

Singapore combines market-based energy procurement with regulated network charges and time-sensitive commercial products, supported by advanced metering and competitive retailing (EMA, 2024). South Africa's tariff methodology and cost-of-supply reforms underscore the need to align municipal and utility tariffs with cost causation while protecting vulnerable users (NERSA, 2021). These cases reinforce a staged Ghanaian pathway anchored in metering, data and institutional credibility.

Table 3. Selected international practices and their application to Ghana

Jurisdiction/practice	Core design feature	Value for Ghana	Caution
EU/ACER-CEER	Transparent network-cost allocation; TOU and flexibility-oriented tariffs; periodic best-practice reporting.	Create published tariff-methodology reports and progressively time-differentiate network and energy charges.	Avoid excessive complexity before data and metering are mature.
Australia	Tariff Structure Statements with customer-impact analysis and transition plans.	Require ECG, NEDCo and other distributors to file tariff-design statements, not only revenue applications.	Regulator must independently test customer impacts.
United Kingdom RIIO	Revenue linked to outputs, incentives and innovation over a multi-year control.	Attach part of allowed revenue to reliability, losses, connections, metering and service quality.	Limit the number of indicators and verify data independently.
New Zealand	Distribution-pricing principles and subsidy transparency.	Publish a subsidy and cost-allocation matrix by customer class.	Transition gradually to avoid bill shocks.
Kenya/Uganda	Periodic tariff reviews, pass-through mechanisms and differentiated classes.	Retain necessary macro pass-through while strengthening cost-of-service and efficiency targets.	Pass-through should not dilute prudence review.
Nigeria	MYTO, loss targets and service-differentiated tariffs.	Use measurable service commitments and feeder-level data for tariff options.	Service-band pricing is vulnerable to data disputes and enforcement failures.
Singapore	Advanced metering, competitive energy products and regulated network charges.	Develop optional indexed and TOU products for large and smart-metered customers.	Retail competition requires strong settlement and consumer-protection systems.

Source: Author synthesis from the cited literature and regulatory materials.

7. A proposed cost-reflective tariff architecture for Ghana

7.1 Layer 1: a rigorously efficient allowed revenue requirement

PURC should retain a multi-year revenue requirement, but strengthen the prudence and efficiency tests. The base-year review should include a regulatory asset register, asset verification, useful-life review, procurement benchmarking, working-capital discipline, related-party transaction review, debt and capital-structure assessment, fuel and dispatch audit, and reconciliation of collected revenue with cash distributions. Unsupported or inefficient costs should be excluded or recovered only upon verified delivery.

Controllable operating expenditure should be subject to an efficiency factor. Distribution losses should be split into technical and commercial components and assigned a declining utility-specific benchmark. Costs associated with losses above the approved trajectory should not be fully passed to customers. The treatment can be symmetric: utilities retain a share of savings below the target and bear a share of excess cost above it.

7.2 Layer 2: transparent functionalisation and customer-class cost allocation

The approved revenue requirement should be functionalised into generation energy, generation capacity, transmission, distribution network, customer service, metering, system operation, losses, ancillary services and policy costs. Allocation to

customer classes should use measurable drivers: number of customers, energy by time period, non-coincident demand, coincident peak demand, voltage level, line and transformer losses, service drops, metering cost and reliability requirements. PURC should publish the allocation factors and a cross-subsidy matrix showing, for each major class, the ratio of tariff revenue to allocated cost of service. A policy tolerance band can be defined, with a multi-year glide path for classes materially above or below cost. This improves predictability and prevents sudden rebalancing.

7.3 Layer 3: multi-part retail tariffs

A modern tariff should contain components that correspond to the main cost drivers. The customer charge should recover meter, billing and customer-service costs, but should remain moderate for vulnerable and low-use customers. The energy charge should reflect generation energy, fuel, variable operation and losses and should vary by time where metering allows. The capacity or demand charge should recover generation and network capacity associated with coincident or time-banded peak demand. A voltage-differentiated network charge should recognise lower distribution cost and losses for customers taking supply at higher voltage.

Reactive-power or power-factor charges should be calibrated to the actual cost imposed and accompanied by a correction programme. Connection charges should reflect incremental connection cost, with transparent treatment of shared assets and network reinforcement. Reliability premiums can be offered for enhanced or redundant service, while interruptible customers receive credits for verifiable curtailment capability.

For residential customers without interval meters, PURC can initially retain a simple inclining-block structure but gradually separate a modest customer charge from energy charges and improve the targeting of the lifeline credit. Smart-metered residential customers should be offered an optional TOU tariff with bill-protection for a defined introductory period.

7.4 Layer 4: time-of-use and demand response

PURC should define system peak, shoulder and off-peak windows using actual load and marginal-cost data, not conventional assumptions. Windows should be reviewed periodically as solar, storage, industrial demand and electric vehicles alter the load curve. Seasonal differentiation may be appropriate where hydro availability, temperature, gas supply or irrigation demand materially changes cost.

Large industrial and commercial customers with interval meters should move first. TOU energy charges should be combined with a time-banded or coincident demand charge. Optional critical-peak pricing can apply to a limited number of declared events, while peak-time rebates can offer a politically easier entry point for customers unwilling to accept downside exposure. Baseline methodologies must be robust to prevent gaming.

A regulated demand-response framework should allow ECG, GRIDCo, aggregators and large customers to contract for curtailment, reserve and emergency response. Payments should reflect avoided generation, fuel, reserve or network cost. Performance should be measured against interval-meter data and independently verified.

7.5 Layer 5: transparent social and public-service obligations

PURC should calculate and publish the economic cost-reflective tariff independently of social-policy decisions. Government should then specify the beneficiary categories, subsidy amount and funding source. The national household registry, poverty data and disability or social-assistance programmes can support targeting. A basic-needs credit may be delivered through prepaid meters, mobile money or utility accounts.

Remote-community, mini-grid, street-lighting and strategic-industry obligations should also be explicit. Where government chooses a uniform national tariff despite geographic cost differences, the equalisation payment should be identified as a policy transfer rather than hidden within another utility's revenue requirement. Transparency permits Parliament, consumers and investors to see the true cost of the obligation and assess whether it remains justified.

7.6 Layer 6: service quality and customer protection

Cost-reflective tariffs must be service-reflective. PURC should publish minimum standards and compensation rules for outages, voltage excursions, estimated billing, delayed connections, meter failures and complaint resolution. Service-quality penalties should be automatic where feasible and credited directly to customer accounts. Large customers should have access to power-quality contracts with defined standards and remedies.

Tariff complexity should be managed through standard bill formats, online calculators, customer education and independent comparison tools. Every customer should be able to understand the fixed, energy, demand, network, policy and tax components of the bill and identify actions that can reduce cost.

8. Implementation roadmap

A credible transition should be revenue-neutral at the point of structural reform unless a separately justified revenue increase is approved. This distinction is essential: changing tariff design should not be confused with increasing the total revenue requirement. PURC should model bill impacts using at least twelve months of interval data and publish distributional results before implementation.

The reform should be governed through a Cost-Reflective Tariff Implementation Committee chaired by PURC and including the Energy Commission, Ministry of Energy, Ministry of Finance, GRIDCo, ECG, NEDCo, private distributors, consumer representatives, industry associations, social-protection agencies and independent experts. PURC should retain final decision authority and ensure that utility data are independently audited.

Table 4. Proposed five-year implementation sequence

Phase	Timing	Key actions	Customer protection	Decision gate
Diagnostic and legal preparation	0-6 months	Complete cost-of-service, marginal-cost, load-research, subsidy-incidence and metering-readiness studies; audit asset and customer data; publish methodology consultation.	Freeze structural rebalancing until impact data are available; strengthen complaint and billing audits.	Independent data-quality certification.
Large-customer pilots	6-18 months	Mandatory TOU for selected smart-metered SLT/high-voltage users; optional critical-peak, interruptible and peak-time rebate products; power-factor review.	Shadow bills for 3-6 months; transition caps; contractual clarity.	Verified peak response and no material billing failures.
Cost allocation and performance regulation	12-24 months	Publish class cost-of-service and subsidy matrix; implement loss glide paths, service-quality incentives and capex prudence framework.	No class moves more than a defined annual percentage toward cost without review.	First annual performance report and true-up.
Wider smart-meter rollout	18-36 months	Default TOU for eligible C&I and optional residential TOU; managed EV charging tariff; demand-response aggregation rules.	Bill protection for vulnerable and pilot residential customers; targeted credits.	Meter and settlement accuracy threshold achieved.

Phase	Timing	Key actions	Customer protection	Decision gate
Advanced network pricing	36-60 months	Coincident-peak demand charges, voltage/loss differentiation, DER export and standby rules, limited locational signals for large users.	Periodic equity and competitiveness assessment; appeals mechanism.	Independent five-year evaluation and next MYTO reset.

Source: Author synthesis from the cited literature and regulatory materials

9. Managing political economy and transition risks

9.1 Bill shock and reform legitimacy

Even a technically sound tariff can fail if customers experience abrupt or unexplained bill increases. PURC should apply annual rebalancing caps, shadow billing, grandfathering for limited periods and explicit transition credits. The reform narrative should emphasise controllability: customers who shift use, improve power factor, lower peak demand or choose interruptible service must be able to see measurable savings.

Public consultation should disclose winners and losers by decile, customer class, region and industry. A reform that hides distributional consequences will invite reversal. A reform that publishes them can negotiate a legitimate transition.

9.2 Data limitations and metering integrity

Cost reflectivity is data-intensive. Poor meter data, customer misclassification, estimated billing and weak settlement can turn a sophisticated tariff into arbitrary billing. Ghana should therefore prioritise meter-data management, transformer and feeder metering, customer census reconciliation, interval-data validation and cybersecurity. The tariff should not be more granular than the data can credibly support.

PURC should establish data-quality standards and impose penalties for missing or manipulated data. Independent verification should be funded through the regulatory levy but procured competitively. Data used for rate setting should be published in anonymised form to enable academic and stakeholder scrutiny.

9.3 Regulatory capture and cost inflation

A more detailed cost model can create opportunities for regulated entities to overstate asset, demand or service requirements. PURC requires specialist capability in engineering economics, load research, accounting, finance, data science and procurement. Expert evidence should be contestable, and material assumptions should be disclosed. Related-party contracts and single-source procurement require enhanced scrutiny.

The Commission should publish a reasoned decision showing the utility request, approved amount, efficiency reductions and customer allocation. Regulatory transparency is not merely procedural; it reduces the cost of capital by improving predictability and confidence.

9.4 Affordability and energy justice

Time-varying tariffs can disadvantage customers who cannot shift essential consumption, including some low-income households, renters and customers dependent on medical or cooling equipment. Equity analysis should therefore be built into tariff design. Opt-in pilots, automated controls, targeted credits and exemption or protection rules may be needed during transition (Hobman et al., 2016; Bouzarovski, 2018).

However, equity should not be used to justify permanent inefficiency. Poor households ultimately bear the consequences of fiscal deficits, unreliable service, inflation and weak job creation. The equitable objective is a lower-cost system with targeted protection, not a high-cost system financed through opaque subsidies.

10. Policy recommendations

1. PURC should formally adopt a Cost-Reflective Tariff Design Code that separates revenue requirement, cost allocation, tariff structure, social policy and performance regulation.

2. Every major tariff review should include an independently audited class cost-of-service study, forward-looking marginal-cost study, load research and published cross-subsidy matrix.
3. Quarterly adjustment should be retained for genuinely uncontrollable variables, but combined with prudence review, ex-post true-up and efficiency sharing.
4. Distribution losses and collection inefficiencies should be placed on utility-specific declining trajectories, with partial cost disallowance above target and rewards below target.
5. Large and smart-metered customers should receive TOU, coincident-peak, interruptible, high-load-factor and power-quality tariff options within the first eighteen months.
6. Industrial tariffs should reflect voltage, losses, load factor, peak contribution and flexibility; productive customers should not be used as a residual financing class.
7. Social protection should be converted from broad hidden cross-subsidies into explicit, targeted and funded credits, with annual publication of beneficiaries and fiscal cost.
8. A defined share of utility revenue should depend on reliability, metering, connection, billing, complaint resolution and loss-reduction outputs.
9. PURC should require utility Tariff Structure Statements and customer-impact models, with shadow billing and annual rebalancing caps.
10. The Energy Commission, PURC and GRIDCo should coordinate tariff design with least-cost planning, competitive procurement, demand response, electric mobility and distributed-resource policy.

11. Discussion

The central institutional challenge is that cost recovery is visible and politically immediate, whereas cost reflectivity produces benefits over time. A regulator under pressure to close a cash shortfall can raise the average tariff more quickly than it can complete load research, install interval meters, redesign demand charges or implement performance regulation. Yet repeated average increases without structural reform may be self-defeating. They raise production costs, intensify resistance, encourage bypass and leave the underlying cost base largely unchanged.

A cost-reflective approach changes the unit of regulatory analysis. Instead of asking only whether ECG or another utility collected enough, PURC asks whether each cedi of allowed revenue corresponds to prudent cost, whether each customer class pays an appropriate share, and whether the tariff makes the next cedi of system cost more or less likely. This framework aligns the interests of utilities, investors and consumers around efficient service rather than around nominal tariff levels.

The argument is not that Ghana should immediately adopt real-time retail pricing or fully locational distribution tariffs. Such complexity would exceed present metering and settlement capability and could undermine trust. The argument is that Ghana should establish a disciplined progression from broad averaging toward measurable cost causation. Large users and smart-metered customers provide the natural starting point. Their load data are richer, their ability to respond is greater, and the economic gains from peak management are larger.

The reform also clarifies the role of the state. Government determines social and industrial policy and funds transparent deviations from economic tariffs. PURC determines prudent cost, allocation and service obligations independently. Utilities deliver outputs and bear a meaningful share of controllable-performance risk. Customers receive price signals and protection appropriate to their circumstances. This allocation of responsibility is more credible than requiring the tariff to conceal fiscal, social, industrial and operational failures within a single average price.

12. Conclusion

Ghana should not abandon cost recovery. A financially insolvent electricity sector cannot provide reliable service, attract capital or support industrialisation. But cost recovery alone is not a complete tariff philosophy. It can preserve revenue while entrenching losses, inefficient procurement, broad cross-subsidies, unmanaged peaks and weak service quality. The result may be a solvent tariff on paper but an uncompetitive economy and an inefficient system.

PURC should therefore adopt cost-reflective tariff design as the organising principle for the next stage of reform. The design should recover only prudent and efficient costs; allocate those costs according to customer, energy, demand, voltage, loss, timing and service causation; reward flexibility and high load factor; make social and geographic subsidies explicit; and link utility

revenue to measurable outputs. The transition should be phased, data-driven, revenue-transparent and protected against bill shock.

The policy distinction can be stated succinctly. Cost recovery determines the size of the revenue envelope. Cost reflectivity determines its economic quality. Ghana's competitiveness, energy security and fiscal sustainability require PURC to regulate both.

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