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UTILITIES CORPORATION (PTY) LTD

Transitioning to Data-Driven Electricity Regulation

A Scientific Framework for Tariff Determination and Utility Price Applications

Table of Contents

Executive Summary

From Cost Recovery to Economic Stewardship

The recent approval of substantial electricity tariff increases for South Africa's state-owned power utility represents a critical inflection point for the national economy. While the current **Multi-Year Price Determination (MYPD)** framework was designed to safeguard utility financial viability, it has evolved into a **cost-plus recovery mechanism** that unintentionally entrenches inefficiency, weakens accountability, and transfers avoidable operational failures directly onto consumers and productive industry.

This document argues that the prevailing regulatory methodology is no longer fit for purpose in a power system undergoing structural change. Electricity is no longer a natural monopoly product with inelastic demand. Distributed generation, storage, and self-supply alternatives now impose real competitive discipline. In this environment, tariff regulation must shift from administrative cost validation to **scientific performance enforcement**.

Drawing on regulatory frameworks used in the United Kingdom, Australia, Canada, and selected U.S. jurisdictions, this paper proposes a transition toward **Performance-Based Regulation (PBR)** underpinned by empirical benchmarking, price elasticity modeling, and rigorous cost-of-service analysis. The objective is to ensure that tariffs reflect the cost structure of an **efficient utility**, not the historical expenditure of an inefficient one.

I. Introduction: The Crisis of Methodology

The Paradigm Shift in Global Power Regulation

For much of the 20th century, electricity was viewed as a "natural monopoly" characterized by centralized generation and inelastic demand. In this environment, the **Cost-Plus** or **Rate-of-Return** regulation model was sufficient. The regulator's role was simple: ensure the utility didn't abuse its monopoly power while allowing it to recover enough revenue to build more infrastructure.

However, the global energy landscape has undergone a radical transformation. The rise of Distributed Energy Resources (DERs), high-efficiency battery storage, and Variable Renewable Energy (VRE) has broken the monopoly. In this new era, the "Administrative" approach to tariff setting—where a utility submits a list of costs and the regulator merely debates the "prudence" of those costs—is no longer viable. It is a 19th-century tool attempting to manage a 21st-century technological disruption.

The NERSA/Eskom Impasse: A Symptom of "Regulatory Lag"

The current impasse in South Africa, characterized by massive tariff increase approvals followed by public outcry and industrial litigation, is a symptom of **Regulatory Lag**. The Multi-Year Price Determination (MYPD) methodology currently in use is fundamentally **retrospective**. It looks at what was spent (or misspent) in the past and attempts to correct it through future price hikes.

This methodology creates a **vicious cycle of inefficiency:**

- **The Inefficiency Pass-Through:** Because the utility knows it can apply for a Regulatory Clearing Account (RCA) clawback to recover revenue shortfalls, there is no scientific pressure to optimize operational expenditure (Opex) in real-time.
- **The Lack of Frontier Benchmarking:** Current determinations lack a rigorous "Efficiency Frontier." Without a data-driven comparison against global peers (e.g., in terms of headcount per megawatt or maintenance cost per gigawatt-hour), the regulator is essentially "negotiating in the dark" against a utility that holds all the technical data.

From Administrative Checking to Economic Engineering

The "Crisis of Methodology" lies in the fact that NERSA currently operates as an **auditor** rather than an **economist**. A scientific approach to regulation treats the utility as a black box of efficiency. The regulator should not ask, *"How much did you spend on labor?"* but rather, *"Given the global benchmark for an efficient utility, what SHOULD it cost to provide this service?"*

This document argues for a transition to **Performance-Based Regulation (PBR)**. This is not merely an alternative accounting method; it is a scientific framework that aligns the utility's profit motive with the public's need for low-cost, reliable power.

Objectives of this Proposal

To address this crisis, this document provides a 12-page roadmap for reform, focusing on:

1. **Eliminating the Moral Hazard:** Removing the ability of the utility to pass the cost of its own internal inefficiencies to the consumer.
2. **Implementing Incentive Engineering:** Using mathematical models to reward the utility for meeting specific Energy Availability Factor (EAF) and cost-reduction targets.
3. **Data-Driven Consumer Protection:** Utilizing Price Elasticity of Demand (PED) modeling to ensure that tariff increases do not trigger a "Death Spiral" that collapses the national grid.

Historical Price Trends: Decoupling Electricity Costs from the National Inflation Baseline

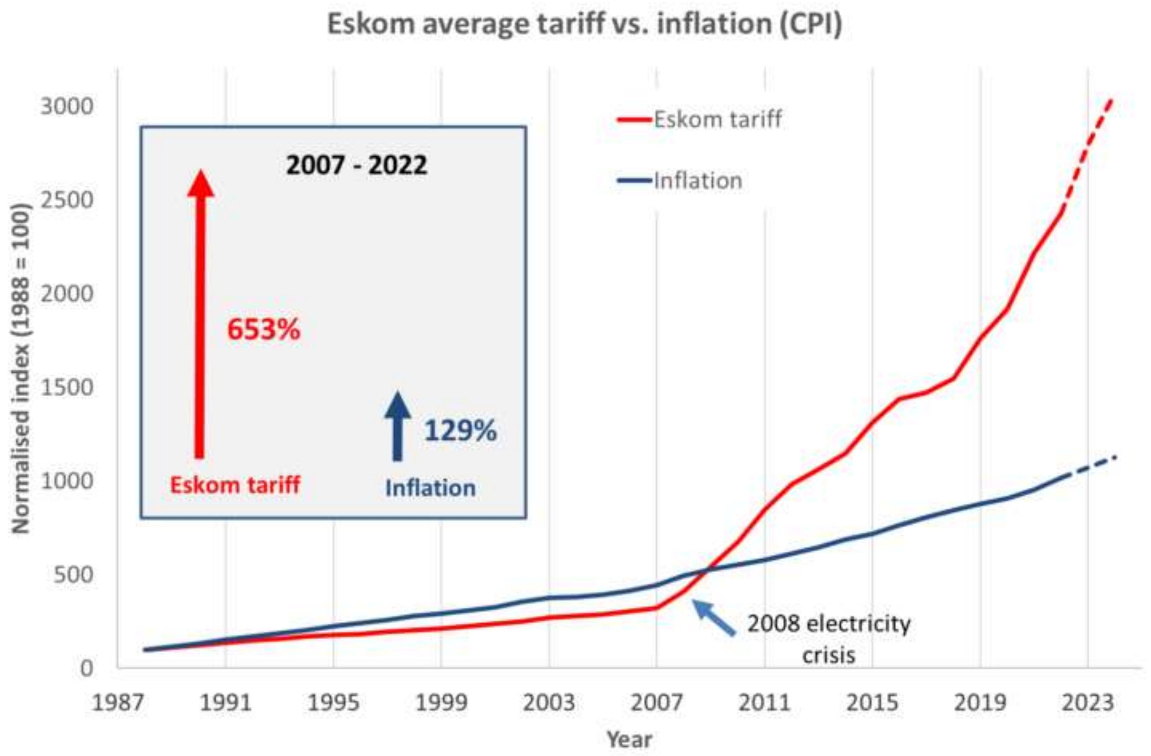

Figure 1: Longitudinal analysis of Eskom nominal tariff increases vs. Headline CPI (1988–2025). Data synthesized from NERSA Multi-Year Price Determinations (MYPD), Eskom Annual Reports, and Statistics South Africa (Stats SA) CPI historical tables. Projections for 2025/26 are based on NERSA's approved 12.74% increase and current inflation forecasts.

Year	Eskom Tariff Increase (%)	CPI (Inflation) (%)	The "Methodology Gap"
2010	24.8%	4.3%	+20.5%
2011	25.8%	5.0%	+20.8%
2012	16.0%	5.6%	+10.4%
2013	8.0%	5.8%	+2.2%
2014	8.0%	6.1%	+1.9%
2015	12.7%	4.6%	+8.1%
2016	9.4%	6.3%	+3.1%
2017	2.2%	5.3%	-3.1%
2018	5.2%	4.6%	+0.6%
2019	13.9%	4.1%	+9.8%
2020	8.8%	3.3%	+5.5%
2021	15.1%	4.5%	+10.6%
2022	9.6%	6.9%	+2.7%
2023	18.7%	6.0%	+12.7%
2024	12.7%	~5.2%	+7.5%
2025 (App.)	33.0% (Requested)	~5.0% (Est.)	+28.0%

The Fallacy of Cost-Plus Regulation

At the core of the current regulatory failure lies the continued reliance on **historical cost recovery**. Under the MYPD framework, the utility's own reported operating and capital costs form the primary baseline for future tariffs. This creates a structural **moral hazard**:

- Overspending is implicitly rewarded
- Forecasting errors are corrected retrospectively through the **Regulatory Clearing Account (RCA)**
- Consumers bear the financial consequences of operational failure

This approach conflates **prudency** with **efficiency**. A cost may be "prudently incurred" in an accounting sense yet remain economically unjustifiable when compared to global best practice. Modern regulators have explicitly rejected this distinction.

II. The Efficiency Gap

Why the Current Model Fails Consumers and the Economy

The reliance on internal cost data allows inefficiency to be passed through tariffs with minimal resistance. As a result:

- Preventable operational waste is socialized
- Capital misallocation ("gold-plating") remains unchecked
- Tariff increases become the default solution to structural problems

By contrast, leading regulators now anchor tariff decisions to **external benchmarks**, asking not *what the utility spent*, but *what an efficient utility would need to spend* to deliver the same service.

III. The Scientific Alternative

Performance, Benchmarking, and Incentive-Based Regulation

This document proposes a tariff-setting methodology built on three scientific pillars:

1. **Empirical Benchmarking and Productivity Enforcement**

Tariffs should be constrained by a **CPI – X** framework, where:

- **CPI** reflects unavoidable inflationary pressure
- **X** represents mandatory productivity improvements derived from benchmarking

Rather than allowing costs to dictate prices, prices should force efficiency gains.

2. **Price Elasticity and Demand Response Modeling**

Electricity demand is no longer perfectly inelastic. Excessive price increases accelerate:

- Industrial grid defection
- Embedded generation uptake
- Economic contraction and job losses

Tariff applications must therefore include **formal price elasticity modeling** to quantify demand destruction risks before approval.

3. Cost of Service (CoS) Rigor

Cross subsidies driven by political considerations must be replaced with **data-driven load profiling**, ensuring each customer class pays for the actual costs it imposes on the system.

IV. Scientific Benchmarking and Efficiency Frontier Analysis

Objective: To move from "Cost-Plus" accounting to a data-driven "Efficiency Frontier" model that protects consumers from paying for utility mismanagement.

1. **The Theory: Moving Beyond "Prudent" to "Efficient"**
   - **The Problem with "Prudency":** Define how current NERSA regulations focus on whether a cost was "prudently incurred" (i.e., did they have a receipt for it?) rather than whether the cost was efficiently incurred.
   - **The Frontier Concept:** Introduce the concept of the Efficiency Frontier. Explain that scientific regulation identifies the "best-in-class" performers globally and sets the tariff based on the cost-profile of those leaders, not the laggards.

2. **Methodologies for Empirical Benchmarking**

Detail the three main "scientific" tools used by regulators like the **AER (Australia)** and **Ofgem (UK)**:

- **Data Envelopment Analysis (DEA):** A linear programming method that creates a "best practice" frontier from a sample of global utilities. Eskom's position is then measured by its distance from this frontier.
- **Stochastic Frontier Analysis (SFA):** An econometric method that separates "random noise" (factors Eskom can't control, like global coal prices) from "technical inefficiency" (factors they can, like overstaffing or plant maintenance failures).
- **Total Factor Productivity (TFP):** Measuring the ratio of total outputs (energy delivered) to total inputs (labor, capital, fuel).

The Formula for Success: Explain the $CPI - X$ framework, where X is the "Efficiency Factor" derived from these benchmarks. If Eskom is 20% less efficient than its peers, X should be higher, forcing them to find savings rather than raising tariffs.

3. **Case Study: The Australian Energy Regulator (AER)**
   - **The "Top-Down" Approach:** How the AER uses benchmarking to set "Operating Expenditure" (Opex) allowances.
   - **The Result:** If a utility's costs are higher than the benchmark, the AER simply refuses to include the excess in the tariff. This forces the utility's shareholders (or the State) to absorb the loss, not the consumer.

4. **Application to the South African Context**
   - **Peer Group Selection:** Identify who Eskom's peers should be for a scientific study (e.g., large vertically integrated utilities in similar economies like Brazil's Eletrobras or India's NTPC).

- **Correcting for "Operating Environment Factors" (OEFs):** Acknowledge that South Africa has unique challenges (e.g., coal quality, aging fleet). Explain how scientific models "normalize" data so that Eskom isn't unfairly compared to a utility running 100% brand-new hydro plants.
- **Quantifying the "Inefficiency Gap":** Reference the World Bank's previous findings that suggest Eskom's staffing and maintenance costs are significantly higher than "benchmark performance" levels.

5. **Transitioning to Performance-Based Regulation (PBR)**
   - **The "Menu" of Incentives:** Propose that NERSA adopts a "sliding scale" where Eskom is rewarded for beating benchmarks and penalized for falling behind.
   - **Scientific KPIs:** Beyond just "keeping the lights on," include:
     - Energy Availability Factor (EAF) vs. Global Benchmarks.
     - Opex per MWh compared to the global median.
     - Headcount per MW installed.

V. Price Elasticity and the Utility Death Spiral

When Higher Prices Reduce Revenue

1. **The Economics of Demand Destruction**
   - **Defining PED in Electricity:** Explain that electricity is no longer a "perfectly inelastic" good. While people need power, their consumption is highly sensitive to price when alternatives (Solar PV, gas, battery storage) become cheaper.
   - **The Threshold of Defection:** Define the "Grid Parity" point—the scientific moment where the Levelized Cost of Energy (LCOE) for self-generation becomes lower than the utility tariff.
   - **Scientific Formula:** Introduce the basic elasticity calculation:

$$PED = \frac{\%\ \text{Change in Quantity Demand}}{\%\ \text{Change in Price}}$$

Argument: If $PED>1$, a 30% tariff increase will result in a >30% drop in demand, leading to lower total revenue for Eskom.

2. **The Death Spiral Mechanism**

2.1. **The Trigger:** A massive tariff increase is approved to cover fixed costs.

2.2. **Response:** High-value customers (industries and wealthy households) reduce consumption or "defect" from the grid via Solar/IPP.

2.3. The Revenue Gap: The utility sells fewer units (kWh) but its fixed costs (debt, power plant maintenance, salaries) remain the same.

2.4. **The Feedback Loop:** To cover the new shortfall, the utility asks for another increase, driving the next wave of customers away.

3. **Quantitative Evidence: Stranded Asset Risk**

- **Fixed vs. Variable Cost Mismatch:** Explain that Eskom's costs are largely fixed (massive coal plants and debt). As volume (Q) drops, the "Average Fixed Cost" per unit sold skyrockets. As demand falls, average fixed costs per kWh rise sharply, rendering legacy assets economically obsolete while debt remains.
- **Cross-Subsidization Collapse:** Use data to show how the "industrial-to-residential" subsidy model breaks. When mines and factories go off-grid or close due to costs, the burden shifts to a shrinking pool of consumers who cannot afford to pay, leading to **increased non-payment** and **municipal debt**.

4. **International Lessons**
   - **Case Study – Hawaii (HECO):** Explore how Hawaii reached "grid parity" first due to high oil-fired electricity costs. Show how the regulator had to pivot to "Decoupling" to prevent the utility from going bankrupt while consumption plummeted.
   - **Case Study – California (CPUC):** Discuss the "Duck Curve" and how price elasticity led to the redesign of "Time of Use" (ToU) tariffs to keep the grid viable.
   - **The Lesson:** Regulators in these regions moved away from simple volume-based increases because they realized they were "pricing themselves out of the market."
5. **The Laffer Curve of Electricity Pricing**
   - **The Peak:** Argue that NERSA's latest approval may have pushed Eskom past the "Revenue Maximizing Point."
   - **Social Impact Science:** Discuss "Energy Poverty." Use the scientific measure of the Energy Burden (the % of household income spent on power). When this exceeds 10%, the "elasticity" isn't just choice – it's a total loss of revenue through illegal connections and non-payment.

There exists a revenue-maximizing tariff level. Beyond it, higher prices yield lower revenue and greater non-payment, theft, and energy poverty.

VI. Policy Recommendations and Legislative Reform

Core Principle

Tariffs must be **economically sustainable**, **technically justified**, and **socially survivable**.

Policy Area	Current Regulatory Failure	Proposed "Scientific" Reform	Key Legislative Change
Cost Recovery	**"Cost-Plus" Model:** Utility recovers almost all costs, including those caused by inefficiency or mismanagement.	**Efficient Frontier Benchmarking:** Only costs that meet a global "Efficient Frontier" (via DEA analysis) are allowable.	**ERA Section 15:** Redefine "allowable costs" to "efficiently incurred costs" based on global benchmarking.
Efficiency Incentives	**Low Accountability:** No penalty for failing to	*CPI−X* **Price Cap:** Mandate a productivity factor	**NERSA Methodology:** Mandate *X*-Factors

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	meet performance targets like EAF or maintenance schedules.	(X) that forces the utility to reduce Opex by a set percentage each year	derived from Total Factor Productivity (TFP) studies.
Revenue Stability	**Volumetric Risk:** Utility profit is tied to selling more power, leading to the "Death Spiral" when prices rise.	**Revenue Decoupling:** Separate utility revenue from sales volume. Fixed costs are recovered via fixed charges, not *c/kWh*.	**ERA Section 16:** Update principles to allow for decoupled revenue and "fixed-cost" rebalancing.
Capital Projects	**"Gold-Plating":** Lack of oversight on massive CapEx projects that often overrun in cost and time.	**Prudency/Efficiency Audits:** Mandatory independent "Gate Reviews" for any CapEx project before it enters the asset base.	**New Regulation:** Introduce "Capital Expenditure Sharing Schemes" (CESS) to penalize overruns.
Transparency	**Information Asymmetry:** NERSA relies largely on data provided by the utility itself.	**Independent Technical Audits:** Mandatory annual Cost of Supply (CoS) studies conducted by independent third parties.	**ERA Section 14:** Strengthen powers to compel data and fund independent audits of utility assets.
Consumer Protection	**Elasticity Ignored:** Tariffs are set without modeling how many businesses will close or go off-grid.	**Mandatory Elasticity Impact Assessment:** Every tariff application must include a peer-reviewed "Demand Response" model.	**Administrative Justice:** Require NERSA to reject increases that result in a net loss of grid users.

VII. Proposed Mitigation: "Decoupling" and New Tariff Structures

- **Revenue Decoupling:** Propose a scientific shift where utility profits are decoupled from the *amount of electricity sold*. This removes the incentive for the utility to fight against energy efficiency.
- **Fixed-Charge Rebalancing:** Discuss the scientific move toward higher fixed charges (*access fees*) and lower volumetric charges (*c/kWh*) to ensure grid stability without penalizing efficiency.

VIII. Implementation Roadmap

Phase 1: Immediate Foundational Readiness (Year 1)

- **ERA Amendment:** Explicitly include "Efficiency" and "Productivity" as core requirements for any tariff approval.
- **Benchmarking Unit:** Establish an independent technical unit within NERSA staffed by econometricians to run yearly comparative studies between the utility and global peers (e.g., using the **AER**'s annual benchmarking methods).

Phase 2: Methodological Transition (Years 2–4)

- **From MYPD to RIIO:** Transition the Multi-Year Price Determination to a Performance-Based Regulation (PBR) framework like the UK's RIIO-3. These shifts focus from "what was spent" to "what was delivered" (Outputs).
- **Tariff Unbundling:** Separate the charges for transmission, distribution, and generation to allow for a competitive market where customers pay the true cost of each service.

Phase 3: Market Maturity (Year 5+)

- **Full Revenue Decoupling:** Implement a system where the utility is indifferent to whether a customer saves energy or generates their own, as their fixed "wires" costs are guaranteed through an access fee.
- **Dynamic Pricing:** Deploy Time-of-Use (ToU) tariffs for all segments, using price signals to shift load away from expensive peak periods.

Conclusion: From Administrative Compliance to Economic Engineering

The End of "Cost-Plus" Accountability

The analysis presented in this document confirms that South Africa's current regulatory trajectory is unsustainable. The reliance on the Multi-Year Price Determination (MYPD) framework – a system fundamentally rooted in a "Cost-Plus" philosophy – has failed to protect the consumer or ensure the utility's long-term health. By allowing the pass-through of operational inefficiencies and ignoring the scientific reality of price elasticity, the current methodology has inadvertently accelerated the "Utility Death Spiral," driving the productive economy toward grid defection.

The Imperative of Performance-Based Regulation (PBR)

To secure the future of the South African power sector, the National Energy Regulator (NERSA) must transition from an administrative entity that "checks receipts" to a technical body that "enforces efficiency." As demonstrated by the global successes of **Ofgem's RIIO** framework and the **Australian Energy Regulator's** benchmarking models, the most effective way to stabilize tariffs is to make utility profit a function of performance, not expenditure.

The scientific application of **Incentive-Based Regulation (IBR)** provides three immediate advantages:

1. **Productivity Gains:** The mandatory formula forces the utility to internalize costs rather than externalize them to the public.
2. **Market Realism:** Cost of Service (CoS) studies ensure that tariffs are reflective of technical reality, preventing the de-industrialization caused by arbitrary cross-subsidies.
3. **Investment Certainty:** A transparent, data-driven methodology replaces "regulatory surprise" with predictability, attracting the capital investment required for a modern, decentralized grid.

Final Call to Action

The massive tariff increases approved in the 2024–2026 cycle is not a solution to the utility's financial woes; they are a symptom of a methodological crisis. If we continue to apply 20th-century monopoly logic to a 21st-century competitive landscape, the national grid risks becoming a stranded asset.

We propose that the **Electricity Regulation Act (ERA)** be urgently aligned with the recommendations in this document. South Africa does not need a more "generous" regulator; it needs a more scientific one. By adopting benchmarking tools, elasticity models, and efficiency frontiers utilized by world-class regulators, we can transform electricity from a mounting economic burden into a catalyst for national growth.

The science of regulation is clear. The only remaining variable is the political will to implement it.

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