

Electricity tariff cross-subsidization within Regional
Electricity Distributors in Namibia

Set-son Kondjashili Shifidi

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ABSTRACT

This research report investigated the dynamics of electricity tariff cross-subsidization within Namibia's Regional Electricity Distributors (REDs), focusing on CENORED, Erongo RED, and NORED. The study aims to analyze the extent and determinants of cross-subsidization among different customer categories, including residential, social, general, general-demand, institutional, and institutional-demand consumers. By utilizing a mixed-methods approach, the research combined quantitative analysis of tariff application sheets and qualitative insights from stakeholder interviews to provide a comprehensive understanding of cross-subsidization practices.

The findings reveal that residential and social consumers are the primary beneficiaries of cross-subsidization, receiving significant financial support to promote equitable access to electricity. Conversely, general-demand and institutional-demand consumers bear the financial burden, contributing disproportionately to the cross-subsidy. The study highlights substantial variations in cross-subsidization levels across the different REDs, reflecting regional economic conditions and consumer demographics.

Key policies, such as the White Paper on Energy Policy (1998) and the National Electrification Policy (2021), play a crucial role in shaping cross-subsidization practices. These policies emphasize equitable access to electricity, particularly for low-income and rural consumers. However, the implementation of these policies presents challenges, including balancing cost reflectivity with affordability and addressing regional disparities.

This research underscores the need for refined cost allocation models, targeted cross-subsidies for low-income consumers, and enhanced transparency in the tariff-setting process. These measures are intended to ensure that cross-subsidization practices promote social equity without overburdening contributing consumer categories. The study's insights contribute to the academic discourse on equitable electricity distribution and provide valuable recommendations for policymakers, regulators, and electricity distributors in Namibia.

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KEY WORDS

- Cost reflectivity
- Cross-subsidization
- Electricity tariffs
- Equitable access
- Namibia
- Regional Electricity Distributors (REDs)

DECLARATION

I, Set-son Shifidi, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of **Master of Management in Energy Leadership**, at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Name: **Set-son K. Shifidi**

Signature:



Signed at ...**Windhoek**

On the ...**28th** day of ...**February**..... **2025**.....

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LIST OF ACRONYMS and ABBREVIATIONS

CENORED: Central North Regional Electricity Distributor

ECB: Electricity Control Board

Erongo RED: Erongo Regional Electricity Distributor

IPP: Independent Power Producer

MME: Ministry of Mines and Energy

NORED: Northern Regional Electricity Distributor

REDs: Regional Electricity Distributors

TOU: Time of Use

CHAPTER 1. INTRODUCTION

1.1 Background

Electricity is a cornerstone of modern society, powering industries, illuminating homes, and driving technological advancements. In Namibia, a country characterized by vast geographical expanses and significant socio-economic disparities, equitable access to electricity is not only a matter of development but also of social justice.

The Electricity Control Board's National Electricity Tariff Study for the Electricity Distribution Industry (2019) underscores the importance of fair and equitable electricity tariffs in ensuring universal access to this essential service. However, the practice of cross-subsidization, where certain consumer groups pay higher tariffs to cross-subsidize lower tariffs for others, introduces complex economic and social dynamics. While cross-subsidization aims to promote fairness by making electricity affordable for low-income and rural consumers, it also raises questions about economic efficiency and the financial burden on contributing consumer categories.

This study seeks to explore these dynamics within Namibia's Regional Electricity Distributors (REDs), focusing on the extent and implications of cross-subsidization across different consumer groups.

1.2 Purpose of the study

The primary objective of this study is to examine the extent and underlying factors of electricity tariff cross-subsidization across various customer categories within Namibia's Regional Electricity Distributors (REDs). Specifically, the research focuses on understanding how residential, institutional, commercial, and industrial consumers either contribute to or benefit from cross-subsidization practices.

To achieve this, the study employs a mixed-methods approach, combining quantitative and qualitative analyses. The quantitative component involves the analysis of secondary data from tariff application sheets to determine approved tariff rates over a specified period. An existing cost allocation model is applied to derive cost-reflective tariff rates for each consumer category within the REDs. This enables the assessment of the level of cross-subsidization reflectivity per consumer category and the identification of regional variations in cross-subsidization practices across Namibia.

In addition, the study incorporates qualitative insights through thematic analysis of primary data gathered from interviews with key stakeholders, including the Electricity Control Board (ECB) and the Ministry of Mines and Energy (MME). This qualitative dimension explores the influence of government policies and regulations on the implementation of cross-subsidization, providing a deeper understanding of the socio-economic and regulatory factors shaping these practices.

By employing a mixed-methods approach, the study combines quantitative analysis of tariff application sheets with qualitative insights from stakeholder interviews. This dual approach allows for a comprehensive understanding of the financial flows, policy influences, and socio-economic impacts of cross-subsidization. The findings are expected to provide valuable insights for policymakers, regulators, and electricity distributors, contributing to the development of more equitable and efficient tariff structures that balance affordability for low-income consumers with the financial sustainability of the electricity distribution system.

1.3 Context of the study

Namibia, as a developing nation, faces significant challenges in achieving widespread electrification, with less than half of its territory currently electrified (Electricity Control Board, 2019). The government's strategic plan, as outlined in the White Paper on Energy Policy (Ministry of Mines and Energy, 1998), emphasizes the expansion of the electrical grid to ensure universal access to

electricity. This policy underscores the importance of equitable access, particularly for historically underserved rural and urban households, and advocates for cross-subsidization as a mechanism to make electricity affordable for low-income and rural consumers. By prioritizing cross-subsidization, the government aims to promote social upliftment and foster economic development.

The establishment of Regional Electricity Distributors (REDs) in 2005 marked a pivotal step toward creating a more efficient and cohesive electricity distribution system in Namibia (Electricity Control Board, 2005). However, despite this progress, the task of achieving nationwide electrification remains a formidable challenge, particularly in rural areas where nearly half of the population resides (Namibia Statistics Agency, 2023). Low population density and financial constraints in these regions complicate the electrification process, with some REDs facing more intense pressures than others. To address these challenges, Namibia has adopted a cross-subsidization model, which utilizes the financial stability of urban areas to support rural electrification efforts. This approach, as highlighted in the National Electricity Tariff Study Report (Electricity Control Board, 2001), is critical for ensuring the affordability of electricity in sparsely populated regions, where high infrastructure costs would otherwise hinder progress.

The transition to REDs also necessitated a re-evaluation of the traditional reliance of Local Authorities on electricity sales to subsidize non-commercially viable services (Electricity Control Board, 2019). To facilitate this shift, specific legal and contractual frameworks were implemented to safeguard the revenue streams of Local Authorities, ensuring their financial stability during this transformative period (SADELEC, 2004). The phasing out of Local Authority surcharges has been a key aspect of this transition, underscoring the need for sustainable financial practices in the electricity distribution sector.

In Namibia, the electricity distribution industry involves several consumer categories. These categories play a crucial role in ensuring efficient electricity supply. The the main distribution consumer categories used by Electricity Control Board (Electricity Control Board, 2019):

1. **Residential consumers:** Domestic users consuming electricity for household purposes, characterized by standard residential energy usage patterns.
2. **Social consumers:** Low-demand domestic consumers with limited energy usage, often subject to monthly caps or restricted breaker sizes. They benefit from cross-subsidized tariffs to ensure affordability.
3. **General consumers:** Commercial entities using electricity for business activities, typically with higher energy demands than residential users.
4. **General-demand consumers:** larger commercial entities and businesses with high peak energy demands, subject to maximum demand charges to ensure infrastructure can support their usage.
5. **Institutional consumers:** Government and private institutions, such as schools and hospitals, with distinct energy usage patterns and requirements.
6. **Institutional-demand consumers:** larger institutional consumers with high-demand subject to maximum demand charges due to their significant peak energy requirements.

1.4 Research problem

Namibia is confronted by the dilemma of trying, on the one hand to promote economic development by means of cost reflective electricity, whilst on the other hand it seeks to offer affordable electricity to lower income consumers. The electricity cross-subsidy arrangements represent the trade-offs made to try and reconcile the horns of this dilemma.

The electricity tariff structure within Namibia's Regional Electricity Distributors (REDs) is defined by a cross-subsidization model. This approach entails that specific customer segments either disproportionately benefit from or contribute to the overall electricity costs. The extent and factors influencing this cross-subsidization remain poorly understood, hindering the development of equitable and efficient tariff structures and the attainment, or not, of policy objectives.

Despite the significance of this issue, there is a dearth of research specifically focused on the Namibian context. This research gap necessitates further investigation to inform policy decisions and improve the allocation of electricity costs among consumers.

1.5 Research objectives and research questions

The primary objective of this study is to analyse the extent of cross-subsidization in Namibia's electricity tariffs within the three established REDs. Specifically, the study aims to:

- Determine the extent of cross-subsidization across different customer categories within the established Regional Electricity Distributors (REDs) in Namibia.
- Identify and understand the factors that significantly contribute to the decisions of cross-subsidization within the Regional Electricity Distributors (REDs) in Namibia.

The research Question are therefore:

Research Question 1: To what extent do different customer categories contribute to or benefit from electricity tariff cross-subsidization within Regional Electricity Distributors (REDs) in Namibia?

Research Question 2: What policies and regulations influence electricity tariff cross-subsidization in Namibia?

1.6 Significance of the study

Namibia's electricity sector faces unique challenges due to its vast territory, sparse population, and pronounced economic inequalities. Ensuring equitable access to electricity is not only a matter of social justice but also a prerequisite for national development (Electricity Control Board, 2019). Despite the progress made by the Electricity Control Board (ECB) in implementing differentiated tariffs, there remains a notable lack of academic research on the dynamics of cross-

subsidization within Namibia's electricity sector. This study seeks to fill this gap by providing a comprehensive analysis of cross-subsidization practices across different regions and consumer categories.

The findings of this research are expected to have significant implications for policymakers, regulators, and electricity distributors. By shedding light on the socio-economic impacts of current tariff policies, the study aims to inform energy policy discussions, particularly in addressing imbalances in electricity distribution and promoting inclusive energy access. Furthermore, the research will contribute to the academic discourse on equitable electricity distribution, offering valuable insights that can guide future policy and regulatory reforms in Namibia and similar contexts.

1.7 Research methodology

This study adopts a mixed-methods approach, combining quantitative and qualitative research methods to provide a holistic understanding of cross-subsidization practices within Namibia's Regional Electricity Distributors (REDs). The quantitative component involves the analysis of secondary data from tariff application sheets submitted by the REDs and the ECB over a 10-year period (2014/15–2024/25). This data will be used to determine the extent of cross-subsidization across different consumer categories and to identify regional variations in tariff structures.

The qualitative component involves structured interviews with key stakeholders, including representatives from the Ministry of Mines and Energy (MME), the ECB, and the REDs. These interviews aim to provide deeper insights into the policy frameworks, regulatory challenges, and operational dynamics that shape cross-subsidization practices. By integrating both quantitative and qualitative analyses, the study seeks to offer a comprehensive understanding of the financial, social, and regulatory dimensions of cross-subsidization in Namibia's electricity sector.

1.8 Delimitations of the study

This study focuses on the analysis of cross-subsidization within Namibia's Regional Electricity Distributors (REDs), specifically CENORED, Erongo RED, and NORED. The research examines residential, commercial, industrial, and institutional electricity consumers over a 10-year period (2014/15–2024/25).

The study is limited to formal regional distribution areas recognized by the ECB and does not extend to off-grid or self-generated power solutions. This delimitation ensures a focused and detailed analysis of cross-subsidization practices within the national electricity distribution system, while acknowledging that future tariff changes or regulatory reforms beyond the study period are beyond its scope.

1.9 Definition of terms

The following are the definitions of the commonly used terms in this study:

- **Consumer Categories:** Distinct groups of electricity customers, typically classified as residential, commercial, industrial and institutional (typical government institutions) users, each with unique energy consumption patterns and tariff rates.
- **Cost Reflectivity:** The principle that tariffs should accurately reflect the actual costs incurred in the generation, transmission, and distribution of electricity.
- **Cross-Subsidization:** The practice of charging different customer categories varying rates for electricity services, where one group's rates are cross-subsidized by the higher rates paid by another group.
- **Electricity Control Board of Namibia (ECB):** The regulatory authority overseeing the electricity sector in Namibia, responsible for ensuring fair practices and setting guidelines for electricity distribution and consumption. The ECB was established under the Electricity Act 2 of 2000

(Act No. 2 of 2000), which was subsequently repealed and replaced by the Electricity Act, 2007 (Act No. 4 of 2007).

- **Electricity Tariffs:** The structured pricing rates set for the supply of electricity to consumers, which may vary based on consumer category, usage, and time of use. These rates are set by the regulator in consultation with the electricity supply industry.
- **Independent Power Producer (IPP):** This is a private entity that develops and finances power projects, operating under a Power Purchase Agreements with a designated off-takers.
- **Multi-Part Pricing:** A tariff structure where the total cost to the customer is divided into several components, such as a fixed charge, an energy-based charge, and a demand-based charge.
- **Regional Electricity Distributors:** These entities distribute electricity within designated regions and are commonly owned by local authorities, or regional councils, or NamPower.
- **Unbundling of Electricity Tariffs:** The division of a utility's functions and costs into generation, transmission, and distribution categories.

1.10 Assumptions

This study is based on several key assumptions essential for its analysis and results:

- **Stable customer groups:** The study presupposes that customer classifications, i.e. residential, commercial, and industrial remain unchanged during the period of the study, which is vital for a valid analysis.
- **Dependable data:** The study hinges on the assumption that data from electricity distributors is accurate, comprehensive, and consistently entered for the years under study, as this data's integrity is critical for reliable findings.

- Minor role of unregulated electricity: The study assumes that unlicensed electricity generation from small-scale sources like rooftop solar panels and battery storage is of minor consequence.

By acknowledging these assumptions, the research delineates the boundaries of its analytical framework and provides a clear understanding of the conditions under which the study's conclusions are drawn.

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

Electricity tariffs encompass a composite of costs associated with electricity generation, transmission, retail services, administrative functions, and taxes. These costs are subsequently transferred to customers through tariff rates. The pricing process is intricate, considering the expenses related to power plant construction, financing, maintenance, and the operation of the electricity grid, which is in most cases a complex network of transmission and distribution lines. Additionally, for sustainably driven utilities, consideration is given to financial returns for owners and shareholders when determining electricity prices.

Over time, changes in energy production methods, inflation rates, and regional supply-demand dynamics have significantly shaped electricity pricing. In the field of energy economics, a central area of focus involves comprehending how pricing has evolved over time and how it aligns with underlying costs, a concept commonly known as cost reflectivity (Verwiebe, Seim, Simon, Schulz, & Müller-Kirchenbauer, 2021)

This chapter offers a comprehensive analysis of the evolution of electricity tariffs across various regions globally, examining the historical and contemporary factors that have influenced tariff structures. Additionally, the chapter explores the relevance of tariff unbundling to enhance transparency and cost reflectivity. A significant portion is devoted to the concept of cross-subsidization, where certain customer categories are charged higher rates to cross-subsidize lower tariffs for others. This discussion aims to raise awareness and draw comparisons and contrasts with Namibia regarding the application of cross-subsidization of electricity tariffs and the associated regulations. The chapter concludes with the research questions and hypotheses that guide this study.

2.2 Historical context in electricity pricing

According to Joskow and Wolfram (2012), a regulator and academic Fred Kahn, championed dynamic pricing within the electricity sector during the 1970s, the electricity pricing approach involves charging end-use customers based on the fluctuating marginal costs of electricity generation. Despite technological advancements that have led to cost reductions and improved meter functionality, the adoption of dynamic pricing has been sluggish in the United States. Kahn also advocated for peak-load pricing, recognizing that more efficient pricing could reduce peak demand, minimize the need for capacity expansion, and enhance overall economic welfare.

The emergence of competitive wholesale markets, where spot prices change frequently, has underscored significant fluctuations in electricity spot prices due to shifting supply and demand conditions. In European markets, the dynamics of merit order and price-setting have evolved. Notably, fossil fuel power plants, including renewable and low-carbon technologies, play a crucial role in mitigating customers' exposure to high prices and volatility (Blume-Werry, et al., 2021).

The intricate landscape of electricity pricing and cost reflectivity is notably shaped by regional variations and historical context. Factors such as inflation rates, shifts in energy production methods, and disparities in local energy supply and demand play a significant role in this multifaceted domain.

2.3 The development of electricity pricing strategies

According to Haiming Li and Jia He (2016), the electricity sector has witnessed a transformative shift in pricing strategies, moving from the static Ramsey pricing model, primarily suitable for monopolistic environments, towards more dynamic approaches like time-of-use and real-time pricing. These newer models aim to enhance operational efficiency, ensure equitable cost distribution, and better align prices with preferences. In the context of the electricity market, the Ramsey pricing model has been adapted to set tariffs that reflect demand elasticity, thereby promoting efficient resource allocation and consumer welfare (Li & He, 2016). Nevertheless, the evolving competitive and technological landscape

necessitates the adoption of more flexible pricing mechanisms to optimize market outcomes.

The Ramsey pricing model, while instrumental in addressing inefficiencies in monopolistic markets, focuses on optimizing prices based on demand elasticity. By applying higher markups to products with inelastic demand, the model seeks to minimize welfare losses. However, its effectiveness is constrained by the monopolistic market framework, particularly in the context of power generation technologies with limited ramping capabilities and non-liberalized markets. This limitation underscores the need for alternative pricing models in increasingly dynamic market conditions.

The liberalization of electricity markets has precipitated a shift towards multi-part pricing structures. This pricing strategy involves decomposing the total cost into distinct charges, thereby enabling suppliers to capture additional revenue by aligning prices with consumers' varying valuations for supplementary services and informing consumers what they are paying for. Such an approach is particularly effective in competitive markets characterized by narrow profit margins on core products and diverse consumer preferences for ancillary offerings. Electricity tariff models, designed to balance cost recovery, equity, and energy efficiency objectives, are increasingly compatible with this pricing framework within competitive market environments and with rapidly evolving technologies (Gerpott, et al., 2022).

Electricity pricing strategies have evolved significantly in response to changing market dynamics and policy objectives. Traditional volumetric pricing, based on energy consumption measured in kilowatt-hours (kWh), has been complemented by more complex models aimed at optimizing resource allocation and consumer behaviour.

Time-of-use (TOU) pricing introduces time-varying rates to incentivize load shifting, thereby alleviating grid congestion during peak demand periods. Tiered pricing structures, with escalating rates for higher consumption levels, encourage energy efficiency. Demand charges, levied on peak electricity usage, are commonly applied to large consumers to reflect the costs associated with

maintaining peak capacity. Conversely, flat rate pricing, while administratively simple, does not promote conservation. Real-time pricing directly links electricity costs to supply and demand conditions, offering potential cost savings for consumers but requiring sophisticated metering and pricing infrastructure. The three-part tariff, combining fixed, volumetric, and time-based charges, provides flexibility and is widely implemented across various sectors.

Utilities often employ a combination of these pricing models to balance revenue generation, cost recovery, and policy goals. The selection of pricing mechanisms significantly influences consumer behaviour, energy efficiency, and overall market efficiency.

In Namibia, the Electricity Control Board (ECB) regulates the electricity sector, including pricing structures. The ECB employs a diverse range of tariffs to accommodate different customer segments. The segments are residential, general (commercial, industrial) and institutional consumers. The employed tariffs typically consist of basic charges to cover fixed network costs, energy charges based on consumption, and demand charges for large consumers. Additionally, time-of-use and seasonal tariffs are implemented to large power users to reflect varying electricity costs throughout the year (Electricity Control Board, 2001).

While efforts to reduce electricity prices are ongoing, the high costs of generation in Namibia and in Africa as whole, contribute to relatively high tariff rates compared to other regions of the world. The ECB conducts annual reviews and adjusts tariffs to ensure their alignment with the evolving cost structure of the electricity industry and to maintain the financial viability of electricity providers.

2.4 Electricity markets liberalization and tariffs unbundling

The restructuring and liberalization of energy markets over the past three decades has produced varied outcomes. While wholesale market competition has advanced, retail market competition remains largely stagnant (Joskow, 2008). A notable reform in this domain is tariff unbundling, which entails the separation of generation, transmission, and distribution components within the

electricity sector. This strategy aims to enhance efficiency in the supply chain, stimulate private investment, and promote robust competition.

According to Poudineh, Brandstätt, and Billimoria (2022), the unbundling generation and transmission assets is relatively straightforward, however, distribution networks present a more complex challenge due to their inherent characteristics. Nevertheless, lessons derived from managing transmission systems can also be applied to distribution systems. Therefore, it is crucial to focus on tariff cross-subsidization studies within distribution environments to ensure effective and equitable policy implementation.

Tariff unbundling and cross-subsidization are intrinsically linked in the context of electricity pricing. Tariff unbundling involves separating the various components of electricity tariffs, such as generation, transmission, and distribution costs, to provide greater transparency and efficiency in pricing. This process is crucial for identifying and addressing cross-subsidization, where certain consumer groups, such as residential consumers, benefit from lower tariffs at the expense of other groups, like industrial users. By unbundling tariffs, policymakers can accurately allocate costs and ensure that each consumer group pays a fair price reflective of their actual consumption and the associated costs. Tariff unbundling in a cross-subsidization study is important because it highlights the mechanisms through which subsidies are distributed and the potential inefficiencies that arise from bundled tariffs (USAID, 2022). Given that this study focuses on tariff cross-subsidization in Namibia, it is helpful to understand tariff structures and unbundling developments in Africa, and Namibia in particular, to establish a foundational context.

2.4.1 *Market liberalization and tariffs unbundling in Africa*

Electricity tariff unbundling is a pivotal aspect of the energy sector reforms being introduced in various African countries. This restructuring aims to dismantle the traditional monopolies held by state-owned utilities. Although the process has been generally slow, there has been progress in some countries.

A review paper by Klug, et al. (2022) gave a summary of electricity reform progress in several African countries, including Zambia, Ghana, Nigeria, Kenya, and Uganda that have pioneered this endeavour, each adopting tailored approaches based on their specific national circumstances and challenges. For instance, Zambia embarked on privatization in the late 1990s and early 2000s to stimulate the sector with fresh capital and extend electricity services to underserved rural areas. Zambia's unbundling strategy involved divesting shares in different segments of the sector to private entities while ensuring regulatory supervision. This move aimed at cost reduction and broadening electricity availability, particularly in rural locales. This Zambian case highlights the necessity for appropriate risk distribution within contracts, balancing local content stipulations with market competitiveness, and establishing stringent regulatory frameworks (Klug et al., 2022).

Ghana's unbundling efforts, commencing in the 1990s, were also structured to foster private sector involvement, especially in electricity generation, thereby enhancing the sector's overall efficacy. The Ghanaian methodology underscores the importance of clear and consistent policies, coupled with active community stakeholder involvement, to ensure successful reform implementation (Klug, et al., 2022; le Grange, et al., 2023).

Kenya, Nigeria, and Uganda have similarly progressed towards unbundling and deregulating their electricity sectors. Nigeria's efforts, which began in 2001, culminated in the segmentation of the state-owned Power Holding Company of Nigeria into distinct entities responsible for generation, transmission, and distribution (Mburu, 2017).

In South Africa, the concept of electricity tariff unbundling can be traced back to the early monopolistic structure dominated by the state-owned enterprise Eskom. Over the years, Eskom's near monopoly over generation, transmission, and distribution led to a vertically integrated utility model. This model persisted for decades, with tariffs set to cover the average cost of supply, often obscuring the true cost of each segment of the electricity value chain. However, inefficiencies and lack of transparency prompted calls for reform, particularly as South Africa

transitioned to a democratic government in 1994 (Department of Minerals and Energy, 1998; Baker & Phillips, 2018).

It is further stated by Mohlakoana and Wolpe (2023) that, the process gained momentum in the late 1990s and early 2000s, aiming to create a more competitive environment, improve operational efficiencies, and attract private investment. This envisaged separating Eskom's functions into distinct entities, each responsible for its own accounting and tariff setting. Despite significant challenges, including stakeholder resistance and concerns over job losses, the South African government made a small step towards implementing unbundling, with the establishment of a transmission company as an Eskom subsidiary by 2024 (BusinessLive, 2024). This entity operates the national grid and is intended to facilitate a competitive electricity market. However, the unbundling of tariffs remains contentious, balancing cost-reflective pricing with the need to keep electricity affordable for low-income households evidenced by a review of the country's electricity pricing policy in 2024. The ongoing evolution of South Africa's electricity tariff structure continues to be a critical and emotional aspect of the country's energy policy discourse.

2.4.2 Market liberalization and tariffs unbundling in Namibia

The Namibian White Paper on Energy Policy of 1998 laid the groundwork on electricity sector reform and has been pivotal in outlining the strategic overhaul of Namibia's electricity industry. It emphasized the establishment of an electricity regulator through the Electricity Act (Act No. 4 of 2007), with the aim of assisting in the governing and regulating tariffs and setting electrification targets via a licensing system. This regulatory framework was designed to foster a more competitive market while ensuring the provision of electricity to underserved rural areas through a dedicated electrification fund.

The unbundling of electricity tariffs in Namibia reflects a deliberate effort to reform the electricity sector, dating back to the Cabinet's decisions on Electricity Supply Industry (ESI) reform in November 2000 (Electricity Control Board, 2001). This initiative was significantly advanced with the commencement of the National Electricity Tariff Study by the ECB in March 2001 which sought to dismantle

existing tariff structures and recommend a new, fair, and sustainable system. That study resulted in new focus intended to facilitate the creation of an electricity market conducive to competition among multiple generators, thereby enhancing the sector's diversity and resilience. The ECB has in the meantime continued to refine the tariff structure, attempting to balance affordability for all Namibians with the actual costs of electricity supply (Electricity Control Board, 2001).

In 2019, the Namibian Electricity Control Board (ECB) conducted another tariff study focusing on the assessment of the presence of cross-subsidization within the electricity distribution industry, advocating for tariff reforms to promote a more equitable distribution of electricity costs (Electricity Control Board, 2019).

This study builds upon these efforts and is intended to provide a valuable platform to position Namibia within the academic discourse, highlighting its unique market frameworks. As Namibia, along with other African countries, continues to refine its electricity market structures, it contributes to the expanding body of knowledge on effectively transitioning towards a more liberalized and modern energy sector.

2.4.3 Global Trends in Market Liberalization and Tariff Unbundling

Globally, electricity market liberalization and tariff unbundling have become central to energy sector reforms, driven by the goals of enhancing efficiency, attracting private investment, and integrating renewable energy (IEA, 2023). These reforms typically involve separating generation, transmission, and distribution functions; introducing competition in generation and retail; and implementing cost-reflective pricing.

In Asia, reform outcomes vary. China has transitioned toward competitive generation and limited retail choice, though transmission and distribution remain state-controlled (Phoumin et al., 2023). India's electricity sector reform has been shaped by the Electricity Act of 2003, which mandated functional unbundling of state electricity boards to promote competition and transparency. While generation and transmission have seen increased private participation, distribution remains largely under state control, with vertically integrated distribution companies dominating most regions (Pfeiffer, et al., 2025). The

reform trajectory reflects a deliberate balance between liberalization and social equity, prioritizing affordability and universal access. Regulatory challenges, financial instability of distribution companies, and limited consumer choice continue to hinder tariff rationalization and market efficiency. Recent policy discourse advocates for modern contractual frameworks and enhanced regulatory independence to stimulate investment and improve reliability (Kumar & Sharma, 2025). India's gradual and context-sensitive approach underscores the complexity of transitioning toward a fully liberalized electricity market while safeguarding developmental objectives.

Singapore has established a fully competitive electricity market, while the Philippines has liberalized its generation and retail sectors with mixed results. Other ASEAN nations remain in transitional phases with vertically integrated utilities still dominant (Ali, et al. 2022).

In South America, Chile pioneered privatization and liberalization in the 1980s, though full wholesale competition was not achieved due to residual vertical integration. Argentina's reforms initially improved efficiency but were later undermined by macroeconomic instability. Brazil adopted a hybrid model, combining regulated and competitive segments, and successfully used capacity auctions to promote renewables (Nepal, et al., 2012).

These experiences highlight that successful electricity market liberalization depends on context-specific approaches, robust regulation, infrastructure investment, and political commitment. Namibia can draw key lessons from these global cases as it refines its own market structure and tariff policies.

2.5 Cross-subsidization in electricity markets

This section serves as the foundation for this literature review, from which the research questions are derived, with a specific focus on regional electricity distribution companies in Namibia. It examines tariff cross-subsidization practices, beginning with international experiences and followed by African experiences. Subsequently, it delves into Namibian experiences, focusing on the market setup, the number of consumers, the classification of the three

established Regional Electricity Distributors (REDs), and the geographic differences between the jurisdictions of the different REDs.

Cross-subsidization in electricity markets refers to the practice where one category of consumers pays higher prices to cross-subsidize the costs for another category. This is often implemented to ensure affordability and accessibility of electricity for certain customer categories, such as low-income households or rural areas. General practices of cross-subsidization typically involve setting higher tariffs for industrial and commercial users to cross-subsidize residential consumers. This approach is justified on the grounds that industrial and commercial entities have a greater capacity to absorb higher costs and can pass these costs onto their customers through the pricing of goods and services. Additionally, this practice aims to promote social equity by making electricity more affordable for vulnerable populations, thereby supporting broader socio-economic development goals (Leschinskaya et al., 2023).

Another common practice is the geographic cross-subsidization, where urban consumers cross-subsidize rural consumers. Urban areas, with their higher population densities and more developed infrastructure, generally have lower per-unit costs of electricity distribution. By contrast, rural areas often face higher distribution costs due to lower population densities and greater distances between consumers. Geographic cross-subsidization helps to balance these disparities, ensuring that rural consumers are not disproportionately burdened by higher electricity costs, which can be crucial for rural development and poverty alleviation (Leschinskaya et al., 2023).

2.5.1 *Global trends and impacts of cross-subsidization in electricity tariffs*

Substantial research has been undertaken by Bhattacharyya and Ganguly (2016), Li, Jiang, and Dong (2020), and Tyagi and Tongia (2023) and others on the evolution of electricity tariff cross-subsidization worldwide. Developing nations such as Russia, China, India, and Brazil, among others, have implemented these strategies. Cross-subsidization within the electricity sector entails a strategic redistribution of costs among different consumer groups to soften the burden on lower-income consumers. Historically, this strategy has

facilitated reduced tariffs for specific consumer segments, albeit at the economic expense of others, resulting in a form of price discrimination

According to a policy working paper by the Advisory Board of Pakistan, FPCCI (2021), small residential and agricultural consumers receive subsidies at varying levels from industrial, commercial, and larger residential consumers. These subsidizing commercial and industrial consumers pay up to 63% above their actual cost of supply. This cross-subsidization of the residential and agricultural sectors by the industrial and commercial sectors is impeding overall economic growth. High electricity prices negatively impact power consumption, potentially leading to reduced industrial growth and, consequently, a slowdown in economic development (FPCCI, 2021).

India has implemented a more complex system of cross-subsidization within its electricity tariff structure. This policy involves a strategic redistribution of costs across different consumer categories to ensure affordable electricity access for residential and agricultural consumers, while also promoting equitable social outcomes. The management of the electricity sector is shared between the central and state governments, with significant autonomy granted to state authorities in determining tariffs, cross-subsidy levels, and beneficiary selection (Bhattacharyya & Ganguly, 2016).

The cross-subsidy model in India typically imposes higher tariffs on industrial and commercial consumers to offset costs for residential and agricultural sectors. This approach aims to maintain affordability for targeted consumer groups while recovering costs from others. The National Tariff Policy of 2016 however introduced a cap on cross-subsidies at 20% of the average cost of power supply, seeking to balance financial sustainability for electricity distribution companies with the provision of affordable electricity to all consumers (Tyagi & Tongia, 2023).

Recent reforms in India however have focused on enhancing transparency, efficiency, and equity within the electricity sector. These initiatives include stricter regulations on cross-subsidization, the implementation of time-of-use pricing to align consumption with renewable energy generation, and the introduction of

progressive tariffs to encourage energy conservation (Aggarwal, et al., 2020). These measures collectively aim to create a more sustainable, equitable, and efficient electricity market. According to The Energy and Resources Institute (2023), prior to the recent reforms in India, the level of cross-subsidization was significant. Residential consumers were paying approximately 20-30% less than the actual cost, while industrial consumers were paying 20-50% more than the actual cost of supply (The Energy and Resources Institute, 2023).

In China, the practice of electricity tariff cross-subsidization has been a significant policy tool aimed at promoting social equity. This policy, referred to as reverse Ramsey pricing ensures that residential electricity tariffs are lower than those for industrial consumers (Yumin Li, et al., 2020). This means that residential consumers, who typically have more elastic demand, are charged lower prices, while industrial consumers, who generally have less elastic demand, are charged higher prices. The primary objective of this pricing mechanism is to support low-income households by providing affordable electricity, thereby ensuring a basic standard of living. The government's commitment to equity is demonstrated through its efforts to make electricity accessible to all societal levels, particularly the economically disadvantaged. However, this pricing strategy has sparked considerable debate regarding its effectiveness and potential economic distortions.

According to an Asian Development Bank Report by Li, Jiang and Dong (2020), residential electricity consumers in China benefit from significant government subsidies, resulting in them underpaying by approximately 20-30% compared to the actual cost of supply. These subsidies are co-funded by higher tariffs imposed on industrial consumers, who overpay about a 5-10% premium to compensate for the lower rates provided to residential consumers. This cross-subsidization highlights the disparities in electricity pricing, where industrial consumers effectively cross-subsidize residential electricity costs to ensure affordability for households. Critics however argue that such subsidies may lead to excessive electricity consumption among residential users and result in underinvestment in the energy sector. Additionally, the financial burden on industrial consumers

could undermine their competitiveness and have broader economic implications (Li, Jiang, & Dong, 2020).

Brazil has also implemented cross-subsidization policies within its electricity sector, involving significant subsidies to support renewable energy sources such as biomass, run-of-river hydropower, wind, and solar (dos Santos Benso Maciel, et al., 2020). This strategy aims to promote the development of renewable energy while ensuring that electricity remains affordable for low-income households. The Brazilian electricity sector features a mix of public and private ownership, with substantial state involvement in regulation and policymaking. The country's interconnected system facilitates the redistribution of electricity across different regions, ensuring that even remote areas benefit from cross-subsidization policies. However, like other countries, Brazil faces challenges in balancing economic efficiency with social equity.

Based on the challenges discussed in the reviews above, it can be concluded that while electricity tariff cross-subsidization provides short-term relief for low-income consumers, long-term sustainability requires careful consideration of its impact on overall energy efficiency, investment, and market dynamics. According to Sotkiewicz (2002), contemporary global trends, therefore, indicate a shift towards more equitable and economically sustainable methods of cross-subsidization. These approaches aim to create economic incentives that foster the development of economically marginalized regions while also contributing to the formulation of an effective national tariff policy. Ongoing academic research and iterative policy reforms highlight the critical need to balance economic efficiency, social equity, and the long-term viability of the electricity sector (Sotkiewicz, 2002).

Leschinskaya, Kirillova, and Palyanov (2023) provide a comprehensive examination of cross-subsidization within the electric power industry, with a particular focus on the Russian context. Their article highlights both historical practices and contemporary reforms aimed at achieving economic efficiency and social equity. The authors also underscore that cross-subsidization of electricity tariffs can lead to unintended consequences, particularly in terms of social equity. They highlight that affluent client, who typically consume more electricity, often

end up benefiting disproportionately from these subsidies. This occurs because the cross-subsidy structure is usually designed to lower the overall cost of electricity, which inadvertently provides greater financial relief to those with higher consumption levels. As a result, the intended goal of supporting lower-income households is undermined, and the principles of social justice are violated. Understanding these dynamics is crucial for policymakers aiming to design more equitable and effective cross-subsidy programs (Leschinskaya, et al., 2023).

2.5.2 The Impact of electricity tariff cross-subsidization in Africa

Electricity tariff cross-subsidization has been widely employed in Africa as a policy tool to enhance energy access and affordability, particularly for low-income and rural populations (Reber, et al., 2018). This mechanism typically involves higher-income urban and industrial consumers subsidizing the energy costs of lower-income rural and urban households. While intended to mitigate socioeconomic disparities in energy access, this practice presents challenges such as potential overconsumption by cross-subsidized sectors, underinvestment in the electricity industry due to distorted price signals, and inequitable burden sharing among consumer groups (Klug et al., 2022).

The successful implementation of cross-subsidization requires careful consideration of country-specific economic conditions and regulatory frameworks. Research by Musonda, Dougherty, Davies, and Lovin (2021), highlights significant variations in electricity tariffs, structures, and methodologies across African countries, emphasizing the need for tailored approaches. Balancing the social imperative of energy access with the economic imperatives of a sustainable electricity sector is crucial (Musonda, et al., 2021)

Recent trends indicate a growing recognition of the need for electricity tariff reforms to ensure fairness, efficiency, and sustainability (Gray, 2024). This involves reducing regressive subsidies, targeting support to the most vulnerable, and leveraging technology and private sector participation. The case of Ghana's recent tariff reform illustrates the complexities of balancing competing interests and the potential impacts on different consumer groups.

2.5.3 *The Dynamics of electricity tariff cross-subsidization in Namibia*

This research delves into the intricate relationship between diverse consumer categories and electricity tariff cross-subsidization within Namibia's REDs. The investigation seeks to quantify the extent to which specific consumer groups contribute to or benefit from this practice. To achieve this, a comprehensive exploration of key concepts is imperative.

2.5.4 *Consumer categories in Namibia and electricity consumption patterns*

Understanding the diverse nature of electricity consumers is fundamental to the effective design and implementation of electricity tariffs. This section delves into the categorization of consumers within Namibia's regional electricity distribution landscape, exploring their distinct consumption patterns and the implications for electricity pricing and policy.

2.5.4.1. *Consumer categories in Namibia electricity sector*

Namibia's electricity providers categorize their consumers into different groups based on their electricity usage. While specific categories may vary slightly between companies, the main groups are typically:

- *Residential consumers*: Domestic users with standard household energy consumption patterns.
- *Social consumers*: Low-demand domestic users with capped usage or restricted breaker sizes, benefiting from cross-subsidized tariffs.
- *General consumers*: Commercial entities with higher energy demand for business activities.
- *General-demand consumers*: Large commercial entities with high peak demands, subject to maximum demand charges.
- *Institutional consumers*: Government or private institutions (e.g., schools, hospitals) with distinct energy needs.

- *Institutional-demand consumers*: Large institutional users with high peak demands, subject to maximum demand charges.

Each of these consumer groups has different electricity usage patterns, which affect when and how much electricity is needed. This information is important for planning how much electricity to produce and for setting electricity prices.

2.5.4.2. Electricity Consumption Patterns

Consumer behaviour exerts a significant influence on electricity consumption patterns. Key determinants of electricity demand include time-of-use variations, load factors, and demand elasticities. Comprehending these patterns is essential for effective load management and the formulation of appropriate tariff structures. The load factor, calculated as the ratio of average load to peak load, serves as an indicator of electricity utilization efficiency. High load factors signify consistent electricity consumption, while low load factors denote fluctuating demand patterns.

To effectively address the research question of how different consumer categories contribute to or benefit from electricity tariff cross-subsidization in Namibia, it is essential to examine the specific characteristics of the country's electricity sector, including consumer demographics, tariff structures, and regional demand patterns. By analysing the experiences of other African countries, particularly those with almost similar markets, valuable insights can be gained to inform policy decisions in Namibia. In countries, where consumers are widely dispersed like Namibia, cross-subsidization of electricity tariffs has adverse implications for economic equity and sustainability. The National Electricity Tariff Study for the Electricity Distribution Industry Report by the Electricity Control Board (2019) states differences between costs of connection for different consumer categories in various distribution areas.

Despite potential economic inefficiencies associated with the cross-subsidization policies, it remains a critical tool for enhancing equitable access to electricity in developing countries like Namibia. With a relatively low electrification rate of just about half of the total population (Ministry of Mines and Energy, 2021), Namibia can leverage cross-subsidization to accelerate electrification, reduce income disparities, and stimulate economic growth in underserved regions. This policy is instrumental in poverty alleviation by supporting essential services and fostering entrepreneurship. While a transition to wholly cost-reflective tariffs is a long-term goal, maintaining cross-subsidization is crucial for achieving Namibia's broader development objectives.

2.5.5 *The established Regional Electricity Distributors in Namibia*

The geographical distribution of electricity consumption and infrastructure influences tariff structures and cross-subsidization patterns. Regional disparities in population density, economic development, and network characteristics can lead to variations in pricing and cost recovery challenges. Analysing cross-subsidization within specific regional distribution areas is essential to understanding its localized effects.

Namibia's electricity sector underwent restructuring in the early 2000s to address the inefficiencies stemming from a fragmented distribution landscape (Electricity Control Board, 2005). The establishment of Regional Electricity Distributors (REDs) was envisioned to consolidate the over 70 existing distribution licensees and improve service delivery. While three REDs have been successfully implemented, challenges in consolidation and stakeholder alignment have hindered the formation of the remaining two. Consequently, certain regions continue to rely on local and regional authorities for electricity distribution.

The three established Regional Electricity Distributors in Namibia are, Northern Regional Electricity Distributor (NORED), Central North Regional Electricity Distributor (CENORED) and Erongo Regional Electricity Distributor (Erongo RED). This study only focuses on these established REDs.

NORED serves a significant portion of Namibia's northern population. Operating across the Oshana, Ohangwena, Omusati, Oshikoto, Kavango East, and Kavango West regions, with parts of Kunene included, the distributor serves a predominantly rural population characterized by lower income levels. This demographic profile suggests the potential need for cross-subsidization of electricity tariffs in certain areas.

CENORED, responsible for electricity distribution in central-northern Namibia, operates across a vast and sparsely populated region. The company's service area, characterized by extensive agricultural land and few urban centres, presents significant challenges in terms of infrastructure development and service delivery. The low population density and dispersed consumer base result

in elevated costs per consumer for electricity distribution, necessitating cross-subsidization mechanisms to ensure equitable tariff structures.

Erongo RED is the electricity distributor for the Erongo Region, encompassing key urban centres such as Walvis Bay and Swakopmund. The region serves as a significant industrial hub for Namibia, with a substantial consumer base comprising residential, commercial, and industrial clients. The presence of large-scale industries, including fish processing plants and port operations, contributes to this industrial prominence. However, the region also includes numerous smaller towns and rural areas, which present unique challenges in terms of electricity distribution and may necessitate possibility of tariff cross-subsidization.

Most of Namibia's mines including few cement factories are situated within the Erongo RED service area, yet these mining operations are classified as transmission customers, directly supplied by NamPower. Consequently, the impact of these mines on the electricity distribution network is beyond the scope of this study. Including mining consumers would, however, have benefited the connecting REDs and, subsequently, the consumers in that distribution area in terms of contribution to the cross-subsidization.

Table 2.1 Shows the number of consumers in each RED according the 2022 Electricity Control Board's Statistical Bulletin publication (*ESI Statistical Bulletin, 2022*).

In this table, the count of residential consumers encompasses both standard residential and social consumers, while the commercial category includes businesses as well as government institutions.

Table 2-1: Number of Residential, Commercial and Industrial Consumers in the REDs (2022)

Category	CENORED	Erongo RED	NORED
Residential	30 411	40 265	90 895
Commercial	2 552	4 005	7 989
Industrial	56	265	660

This research thus aims to identify the application of electricity tariff cross-subsidization within the Namibian context by examining the specific geographical and demographic characteristics of the areas served by NORED, CENORED, and Erongo RED. The study will provide insights into the implications of this practice for different consumer categories within these Regional Electricity Distributors (REDs). It is anticipated that consumers located further from generation sources, particularly in less densely populated areas, will benefit the most from cross-subsidization. This benefit is attributed to the high infrastructure costs associated with servicing these remote clients and the economies of scale related to the operations and maintenance of these dispersed customers.

The first **Research Question** and set of corresponding **Hypotheses** are therefore:

2.5.6 Research Question 1:

To what extent do different consumer categories contribute to or benefit from, electricity tariff cross-subsidization within regional electricity distribution areas in Namibia?

2.5.6.1. Hypothesis 1a

Residential consumers especially those in rural areas are net beneficiaries of electricity tariff cross-subsidization in Namibia, with commercial and industrial consumers contributing to the cross-subsidy.

2.5.6.2. *Hypothesis1b*

There are significant variations in the extent of cross-subsidization between different REDs Namibia, with some REDs experiencing higher levels of cross-subsidization from commercial and industrial consumers to residential consumers than others.

2.6 Policies and regulations influencing electricity tariff cross-subsidization in Namibia

2.6.1 *Relevant electricity policies*

According to Ferrão and Pinto (2014), electricity tariff policy is a cornerstone in shaping the application of cross-subsidization within the electricity sector. Tariffs, the pricing mechanisms employed by utilities, are instrumental in cost recovery, demand management, and revenue generation. Cross-subsidization arises when tariff structures redistribute costs among different consumer groups, often with the intention of achieving specific policy objectives (Ferrão & Pinto, 2014). The Namibian electricity sector, characterized by its unique geographical and socio-economic conditions, has adopted specific tariff structures to address the challenges of service delivery. Understanding policies and tariff structures is essential for analysing the extent and impact of cross-subsidization within a country.

Namibia has several policy documents and regulations that serve as guidelines for the industry regarding electricity pricing, including cross-subsidization. These documents are explained below (Ministry of Mines and Energy, 1998; Ministry of Mines and Energy, 2021):

- Namibia's White Paper on Energy Policy of 1998: This policy addresses cross-subsidization primarily in the context of ensuring equitable access to electricity. It emphasizes the need for tariff structures that support social upliftment, particularly for historically underserved rural and urban households.

- **National Electrification Policy (2021):** It outlines the government's role and priorities in electrification, including economic, planning, and implementation principles. It aims to provide universal access to electricity in Namibia by 2040.

The government's commitment to social equity and access to electricity for vulnerable populations can drive the use of cross-subsidization as a policy driver. However, political pressures and economic constraints may also limit the scope and effectiveness of such policies.

2.6.2 Relevant electricity regulations and applications

The regulatory environment significantly influences the implementation and effectiveness of cross-subsidization policies. In Namibia, the Electricity Control Board (ECB) oversees the electricity sector, setting tariff guidelines, approving cross-subsidy mechanisms, and monitoring their impact. The ECB's regulatory framework, including its powers, independence, and enforcement mechanisms, plays a crucial role in shaping the cross-subsidization landscape (Joskow & Schmalensee, 1983). The ECB relies on the industry-accepted Operating and Reporting Manual to guide the determination of electricity tariffs.

The California electricity reforms of the early 2000s exemplify the potential pitfalls of inadequate regulatory oversight, offering valuable lessons on cross-subsidization and tariff structures in deregulated markets. Initially, California's deregulation aimed to foster competition and lower prices, but insufficient oversight led to market manipulation and price spikes (Joskow, 2001). This crisis highlighted the importance of transparent and equitable tariff structures that prevent excessive cross-subsidization, where industrial and commercial consumers disproportionately cross-subsidize residential users. Effective regulatory frameworks must ensure tariffs reflect the true cost of supply while protecting vulnerable consumer groups from price volatility (Borenstein, 2002). Namibia should learn from this by ensuring robust regulatory oversight to prevent market manipulation and protect all consumer groups.

Another critical lesson from California's reforms is the pivotal role of regulatory bodies in managing cross-subsidization and ensuring fair tariff practices. The California Public Utilities Commission (CPUC) faced significant challenges in overseeing the transition to a competitive market, particularly in managing cross-subsidization among different consumer categories (Blumstein, Friedman, & L.S. & Green, 2002). This experience underscores the need for robust regulatory mechanisms that can adapt to market changes and enforce equitable tariff policies. Additionally, the crisis emphasized the importance of stakeholder engagement in tariff design to ensure that the interests of all consumer groups are considered (Sweeney, 2002). By learning from California's experience, Namibia can develop more resilient and equitable electricity markets that balance the needs of diverse consumer groups while promoting economic efficiency. This research will thus shed light on the specific policies and regulatory interventions that influence the application of electricity tariff cross-subsidization within Namibia's REDs.

The second **Research Question** and corresponding **Hypothesis** is therefore:

2.6.3 Research Question 2:

What policies and regulations influence electricity tariff cross-subsidization in Namibia?

2.6.3.1. Hypothesis 2 a

Government policies, regulations, and economic conditions are the primary determinants of electricity cross-subsidization patterns among consumer categories within Namibia's REDs.

2.7 Theoretical Framework

This study is situated within the field of energy economics and public utility regulation. Its analytical approach is guided by a theoretical framework that synthesises three interconnected conceptual domains: Ramsey pricing theory, equity theory, and regulatory economic theory. This tripartite framework provides the necessary lenses to critically examine the structure, efficacy, and socio-economic implications of cross-subsidisation within Namibia's electricity tariff regime. This section delineates each theoretical component and elucidates their integrated application to the present study.

2.7.1 *Ramsey Pricing Theory - The Efficiency Imperative*

First formalised by Frank Ramsey (1927), Ramsey pricing theory offers a solution for a natural monopoly requiring maximising social welfare while simultaneously meeting a budget constraint, typically a zero-profit condition (Brown & Sibley, 1986). The theory posits that to minimise deadweight loss, prices for different services or customer classes should be set inversely proportional to their respective price elasticities of demand.

Within the context of electricity distribution, this provides an economic justification for imposing higher mark-ups, and thus higher tariffs, on consumer categories with relatively inelastic demand, such as industrial and large commercial users. The resultant surplus revenue can then be utilised to cross-subsidise tariffs for consumer segments with more elastic demand, typically residential users, thereby supporting broader consumption and access. This study employs Ramsey theory as a benchmark to analyse the economic efficiency of the existing cross-subsidisation model in Namibia's Regional Electricity Distributors (REDs), interrogating the extent to which the current tariff structure aligns with welfare-maximising principles.

2.7.2 *Equity Theory - The Social Justice Imperative*

While Ramsey pricing addresses economic efficiency, it does not inherently incorporate normative judgements on distributive justice. Equity theory, drawn

from social psychology (Adams, 1965) and applied welfare economics, introduces this critical dimension. It emphasises perceptions of fairness and justice in the allocation of costs and benefits (Lambert, Clark, Durtschi, Fincham, & Graham, 2010).

In public utility economics, equity theory translates into the principle of affordability and the ethical mandate that tariff structures should reflect the differential ability to pay among consumer groups. This theory advocates for progressive tariff designs where consumers with greater financial capacity contribute more substantially to the system's fixed costs, thereby enabling access for economically disadvantaged and vulnerable groups. This framework is utilised to evaluate the social rationality of Namibia's cross-subsidisation policy, assessing its alignment with national objectives of poverty reduction, inclusive electrification, and redistributive justice.

2.4 Regulatory Theory and Cost Reflectivity: The Institutional Mechanism

Theoretical principles are operationalised through regulatory institutions. Regulatory theory concerns itself with the design of rules and institutions that govern monopolies to achieve public policy goals (Baldwin, Cave, & Lodge, 2012). A cornerstone of modern utility regulation is the principle of cost reflectivity, which mandates that tariffs should accurately signal the marginal cost of supplying a specific customer class at a specific location and time (Vogelsang, 2002). This promotes allocative efficiency and provides efficient investment signals.

However, pure cost reflectivity may conflict with social equity objectives. Regulatory theory therefore acknowledges the role of the regulator in sanctioning and managing deviations from strict cost reflectivity, such as cross-subsidies, to achieve broader societal goals. The Electricity Control Board (ECB) of Namibia, operating under mandates detailed in its Operating and Reporting Manual (ORM), embodies this institutional compromise. This study will apply regulatory theory to analyse the ECB's role in mediating the tension between the efficiency imperative of cost reflectivity and the social equity imperative driving cross-subsidisation.

2.8 Conclusion

In conclusion, this literature review has highlighted the issues that can influence electricity tariff cross-subsidization within Namibia's regional distribution areas. The research underscores the significant role that different consumer categories play in both contributing to and benefiting from cross-subsidization practices. Residential, commercial, and industrial consumers exhibit distinct electricity consumption patterns, which influence the design and implementation of tariff structures.

The evolution of electricity pricing strategies, from traditional volumetric pricing to more sophisticated models like time-of-use and real-time pricing, reflects the need for efficient resource allocation and consumer behaviour optimization. The Electricity Control Board's regulatory framework in Namibia ensures that tariffs are reviewed every year and adjusted to align with the changing cost structures and to maintain the financial viability of electricity providers.

According to the Ministry of Mines and Energy (2021), Cross-subsidization remains a crucial policy tool in Namibia, aimed at enhancing energy access and affordability for low-income and rural populations. However, it can also present challenges such as potential overconsumption by cross-subsidized consumers and social injustice and economic burden on the subsidizing consumers. Addressing these challenges requires a balanced approach that considers the diverse needs and consumption patterns of different consumer categories.

Overall, the findings of this review provide valuable insights into the possible interplay between consumer behaviour, tariff structures, and cross-subsidization in Namibia's electricity sector. These insights can inform future policy decisions and contribute to the development of more equitable and efficient electricity pricing mechanisms.

From the literature review the hypotheses of this study were therefore drawn up, there are:

2.8.1 Hypothesis 1a

Residential consumers especially those in rural areas are net beneficiaries of electricity tariff cross-subsidization in Namibia, with commercial and industrial consumers contributing to the cross-subsidy.

2.8.2 Hypothesis 1b

There are significant variations in the extent of cross-subsidization between different regions in Namibia, with some regions experiencing higher levels of cross-subsidization from commercial and industrial consumers to residential consumers than others.

2.8.3 Hypothesis 2a

Government policies, regulations, and economic conditions are the primary determinants of electricity cross-subsidization patterns among consumer categories within Namibia's REDs.

2.9 Consistency Table: Research Questions and Propositions

The Table below shows the consistency Table containing research questions and objectives of the study.

Table 2-2: Consistency Table - Research Questions and Propositions

RQ #	Research Question	Hyp #	Hypothesis
1	To what extent do different consumer categories contribute to or benefit from electricity tariff cross-subsidization within regional electricity distribution areas in Namibia?	1a	Residential consumers especially those in rural areas are net beneficiaries of electricity tariff cross-subsidization in Namibia, with commercial and industrial consumers contributing disproportionately to the cross-subsidy.
		1b	There are significant variations in the extent of cross-subsidization between different regions in Namibia, with some regions experiencing higher levels of cross-subsidization from commercial and industrial consumers to residential consumers than others.
2	What Policies and Regulations Influence Electricity Tariff Cross Subsidization? influence the application of electricity cross-subsidization among different consumer categories within Namibia's Regional Electricity Distribution Areas (REDs)?	2a	Government policies, regulations, and economic conditions are the primary determinants of electricity cross-subsidization patterns among consumer categories within Namibia's REDs.

CHAPTER 3. RESEARCH METHODOLOGY

3.1 Introduction

The effectiveness of any research endeavor is fundamentally contingent upon the robustness of its methodological framework. This chapter delineates the research methodology adopted for this study, which is designed to comprehensively investigate the dynamics of electricity tariff cross-subsidization within Namibia's Regional Electricity Distributors (REDs). The research design is meticulously crafted to ensure a thorough examination of the extent and determinants of cross-subsidization across various consumer categories, including residential, social, general, general-demand, institutional, and institutional-demand consumers. By employing a mixed-methods approach, this study integrates both quantitative and qualitative analyses to provide a holistic understanding of the financial, social, and regulatory dimensions of cross-subsidization practices in Namibia's electricity sector.

The chapter begins with an explanation of the research design, which serves as the blueprint for the study. It then outlines the data collection methods, tailored to capture the multifaceted nature of cross-subsidization within the REDs. Subsequently, the analytical techniques employed to dissect and interpret the collected data are detailed. Collectively, these components form a comprehensive methodology poised to address the research questions accurately and provide valuable insights for policymakers, regulators, and electricity distributors.

3.2 Research design

This study adopted a mixed-methods research design, which combined both quantitative and qualitative approaches to investigate the extent and determinants of electricity tariff cross-subsidization within Namibia's REDs. The mixed-methods approach is particularly suited to this research as it allows for the triangulation of data, thereby enhancing the validity and reliability of the findings. The quantitative component of the study was designed to provide statistical

evidence of cross-subsidization patterns over a 10-year period (2014/15–2024/25), while the qualitative component aims to capture the contextual richness and stakeholder perspectives, particularly from policymakers and regulators.

The quantitative analysis focused on the examination of secondary data derived from tariff application sheets submitted by the REDs to the Electricity Control Board (ECB). These sheets provided detailed information on approved tariff structures for various consumer categories over the study period. The quantitative data was analyzed to determine the extent of cross-subsidization across different consumer categories, identify regional variations in tariff structures, and assess the financial flows between contributing and beneficiary consumer groups.

The qualitative analysis, on the other hand, involved structured interviews with key stakeholders, including representatives from the Ministry of Mines and Energy (MME), the ECB, and the REDs. These interviews aim to provide deeper insights into the policy frameworks, regulatory challenges, and operational dynamics that shape cross-subsidization practices. By integrating both quantitative and qualitative analyses, the study seeks to offer a comprehensive understanding of the financial, social, and regulatory dimensions of cross-subsidization in Namibia's electricity sector.

3.3 Tariff review method in Namibia

The determination of electricity tariffs is a critical component of the regulatory framework governing the electricity supply industry in Namibia. The Electricity Control Board (ECB) serves as the primary regulatory authority responsible for overseeing this process. The tariff review method employed by the ECB is intended to ensure that electricity tariffs remain cost-reflective, transparent, and equitable, thereby promoting economic efficiency and protecting consumer interests. This section provides an overview of the tariff review method in Namibia, detailing the regulatory framework, the tariff determination process, and the role of special charges and adjustments.

3.3.1 3.7.2 Regulatory framework

The ECB's regulatory framework is designed to promote cost-reflectivity of electricity tariffs, meaning that the costs incurred in providing electricity services are accurately reflected in the tariffs charged to consumers. The ECB's tariff determination methodology is detailed in the Operating and Reporting Manual (ORM), which provides guidelines for licensees on how to establish costs of supply, report revenue requirements, and calculate tariffs. The ORM serves as a critical tool for ensuring consistency and transparency in the tariff-setting process, enabling the ECB to maintain a balance between affordability for consumers and financial sustainability for electricity distributors.

The regulatory framework emphasizes the importance of cost reflectivity, which is the principle that tariffs should accurately reflect the actual costs incurred in the generation, transmission, and distribution of electricity. This principle is essential for promoting economic efficiency and rational consumption, as it ensures that consumers pay a fair price for the electricity they consume. Additionally, the ECB's regulatory framework includes provisions for stakeholder engagement, ensuring that the interests of all consumer groups are considered in the tariff-setting process.

3.3.2 Tariff determination process

The tariff determination process in Namibia is guided by several key considerations to ensure that tariffs are fair, transparent, and reflective of actual costs. The process involves the following steps:

- 1) The first step in the tariff determination process is the allocation of costs across different consumer categories. This involves identifying the costs associated with generation, transmission, and distribution, and allocating these costs to the relevant consumer groups based on their consumption patterns and infrastructure usage.
- 2) Once the costs have been allocated, the next step is to calculate the revenue requirement for each consumer category. This involves

determining the total revenue needed to cover the costs of supplying electricity to each group, including operational expenses, maintenance costs, and capital investments.

- 3) Based on the revenue requirement, tariffs are set for each consumer category. The ECB employs a multi-part tariff structure, which includes fixed charges, energy-based charges, and demand-based charges. This structure ensures that tariffs are aligned with the actual costs of supply and provides flexibility in pricing to accommodate the diverse needs of different consumer groups.
- 4) The tariff-setting process includes consultations with key stakeholders, including the REDs, consumer groups, and industry representatives. These consultations provide an opportunity for stakeholders to provide feedback on the proposed tariffs and ensure that the interests of all parties are considered.
- 5) Once the tariffs have been finalized, they are submitted to the ECB for approval. The ECB reviews the proposed tariffs to ensure that they are cost-reflective and equitable, and once approved, the tariffs are implemented by the REDs.
- 6) After approval, the tariffs are published to ensure transparency and inform all stakeholders, including consumers, about the new tariff rates. This publication helps maintain transparency and allows consumers to understand the basis of their electricity charges.

The tariff determination process is designed to ensure that tariffs are set in a manner that promotes economic efficiency, fairness, and transparency. By adhering to these principles, the ECB aims to maintain a balance between affordability for consumers and the financial sustainability of electricity distributors.

3.4 Data collection

The data collection process for this study was designed to gather both quantitative and qualitative data to provide a comprehensive understanding of electricity tariff cross-subsidization within Namibia's Regional Electricity Distributors (REDs). The methods were tailored to capture the financial, social, and regulatory dimensions of cross-subsidization practices, ensuring that the research questions were addressed thoroughly and accurately. This section outlines the sources, methods, and procedures used to collect both quantitative and qualitative data.

3.4.1 Quantitative data

The quantitative data for this study was sourced from secondary data, specifically the Tariff Application Sheets submitted by the REDs to the Electricity Control Board (ECB). These sheets provided detailed information on approved tariff structures for various consumer categories over a 10-year period (2014/15–2024/25). The dataset included indicative tariffs (cost-reflective rates without subsidies) and actual tariff rates for consumer categories such as residential, social, general, general-demand, institutional, and institutional-demand consumers. Additionally, the data provided the percentage of cross-subsidization, quantifying the extent to which each category contributed to or benefited from subsidization.

3.4.1.1 Data source

The primary sources of quantitative data were the REDs and the ECB. The Tariff Application Sheets, which had been consistently used in the tariff review process over the past decade, served as the foundation for the quantitative analysis. These sheets were comprehensive documents that reflected the true cost of supplying electricity, including detailed breakdowns of costs associated with generation, transmission, and distribution. The historical use of these datasets in regulatory reviews underscored their reliability and relevance for this study.

3.4.1.2. *Method of collection*

The quantitative data was collected from the REDs and the ECB using the standard Tariff Application Sheets. To maintain the credibility and accuracy of the data, a cross-verification process was conducted. This involved comparing the data obtained from the REDs with records from the ECB to identify and rectify any discrepancies. The data collection process was meticulously documented, detailing each step taken to gather, verify, and analyze the data. This rigorous approach provided a robust foundation for the study's conclusions, ensuring that the findings were based on accurate and consistent information.

3.4.2 *Qualitative data*

The qualitative data for this study was collected through structured interviews with key stakeholders in Namibia's electricity sector. These stakeholders included representatives from the Ministry of Mines and Energy (MME), the ECB, and the REDs. The qualitative data collection aimed to corroborate the secondary data obtained from the Tariff Application Sheets and provide deeper insights into the policy frameworks, regulatory challenges, and operational dynamics that shaped cross-subsidization practices.

3.4.2.1. *Targeted stakeholders*

The following institutions were approached for interviews:

- Ministry of Mines and Energy plays a pivotal role as the policy maker, shaping the overarching framework within which the electricity sector operates. This will also assist in obtaining a deeper comprehension of the intended policy direction and its implications on the subsidization levels and tariff structures. The Director responsible for Energy, will be the targeted respondent.
- The Electricity Control Board (ECB), serves as the regulator, ensures compliance with the set policies and standards. The targeted respondent is the Executive for Economic Regulation.

The REDs provide insights into their operational practices and the internal cross-subsidization mechanisms. The targeted respondents will be Executives responsible for tariff applications in the finance sections. The method of communication will be face to face and telephonic. In all cases, the tariff specialists in the respective REDs responded to the questionnaires as assigned by their organizations.

Below is a Table showing the level of respondents within the respective organizations.

Table 3-1 Level of Respondents from each Organization

Organization	Number of Respondents	Level of Respondents
Ministry of Mines and Energy	1	Executive
Electricity Control Board	1	Executive
Regional Electricity Distributors	1 respondent per RED	specialists

3.4.2.2. *Method of communication*

The interviews were conducted through face-to-face and telephonic methods, depending on the availability and preferences of the respondents. The structured interviews followed a predefined set of questions designed to explore the policy frameworks, regulatory challenges, and operational dynamics of cross-subsidization practices.

3.4.3 *Stakeholders' interview guide*

The stakeholders' interview guide was a critical component of the data collection process, designed to gather comprehensive insights from key stakeholders involved in Namibia's electricity sector. This section outlines the purpose, design,

administration, and analysis of the questionnaire, providing a detailed account of its role in this research.

3.4.3.1. Purpose of the Questionnaire

The primary objective of the stakeholders' questionnaire was to obtain qualitative data that complements the quantitative analysis of electricity tariff cross-subsidization. The questionnaire aims to capture the perspectives, experiences, and insights of stakeholders regarding the implementation, challenges, and impacts of cross-subsidization practices within Namibia's Regional Electricity Distributors (REDs). By engaging with stakeholders, the research seeks to understand the socio-economic and regulatory factors influencing cross-subsidization and to identify potential areas for policy improvement.

3.4.3.2. Questionnaire Design

The questionnaire was meticulously designed to elicit detailed and relevant information from stakeholders. It comprises a mix of open-ended and structured questions, organized into key thematic areas:

- 1) Policy and Regulatory Frameworks: Questions explore the existing policies and regulations guiding cross-subsidization, their objectives, and their perceived effectiveness.
- 2) Implementation Challenges: Stakeholders are asked to identify and elaborate on the challenges they face in implementing cross-subsidization practices, including financial, operational, and infrastructural issues.
- 3) Impact Assessment: The questionnaire seeks stakeholders' views on the socio-economic impacts of cross-subsidization, particularly on different consumer categories.
- 4) Future Directions: Questions are designed to gather suggestions for improving cross-subsidization practices, including potential policy reforms and innovative approaches.

The interview guides used are provided in Appendix A of this research report.

3.5 Data analysis

The data analysis for this study involved both quantitative and qualitative techniques to provide a comprehensive understanding of the dynamics of electricity tariff cross-subsidization within Namibia's REDs. The analysis was conducted systematically, with the quantitative data providing statistical evidence of cross-subsidization patterns and the qualitative data offering contextual insights into the policy and regulatory frameworks.

3.5.1 *Quantitative analysis*

The quantitative data was analyzed using statistical methods to determine the extent of cross-subsidization across different consumer categories and identify regional variations in tariff structures. The analysis involved the following steps:

- A comparative analysis was conducted to examine the differences between various consumer categories. This analysis utilized tables and graphs to systematically compare the extent of cross-subsidization across different consumer categories, namely residential, commercial, and industrial, as well as across different distribution areas. The tabulated results provided a clear and concise representation of the disparities in cross-subsidization, facilitating a deeper understanding of the financial dynamics within and between these categories and distribution areas.
- The study also conducted a trend analysis to examine the changes in cross-subsidization levels over the 10-year period. This involved plotting the cross-subsidization levels for each consumer category over time to identify any significant trends or patterns. The trend analysis provided valuable insights into the long-term dynamics of cross-subsidization practices within Namibia's REDs.

3.5.2 *Qualitative analysis*

The qualitative data was analyzed using thematic analysis to identify recurring themes, concepts, and patterns in the interview responses. The analysis focused on understanding the policy frameworks, regulatory challenges, and operational

dynamics that shaped cross-subsidization practices. The qualitative analysis involved the following steps:

3.5.2.1. Data coding and categorization

The interview responses were transcribed, and the research subsequently identified recurring themes, concepts, and patterns. The data was then categorized based on topics such as policy direction, subsidization levels, and tariff structures. A comprehensive list of identified codes and themes is provided in Appendix B.

3.5.2.2. Thematic analysis

The study explored the implications of policy decisions in the energy sector. Specifically, the investigation assessed how policies implemented by the Ministry of Mines and Energy (MME) impacted subsidization levels and influenced tariff structures. Additionally, the study analyzed the role of the Electricity Control Board (ECB) in enforcing policies and standards. Furthermore, the practices of Regional Electricity Distributors (REDs) were examined to understand their impact on subsidies.

3.5.2.3. Cross-validation with secondary data

The study compared the findings from the interviews with the secondary data obtained from the Tariff Application Sheets. The objective was to assess consistency or discrepancies between primary and secondary data sources. Conclusions drawn from both primary (interviews) and secondary (Tariff Application Sheets) data were validated or refined through this cross-validation process.

3.5.2.4. Interpretation and conclusion

The qualitative analysis revealed the social considerations within the energy sector, focusing on policymaking, regulatory compliance, operational practices, and internal cross-subsidization. By identifying recurring themes from interview responses and cross validating these findings with secondary data, the study highlighted the significant impact of policies by the MME and the enforcement

role of the ECB. The analysis also examined the practices of the REDs and their influence on subsidies. The findings provided a robust foundation for understanding the sector's financial landscape and informing future policy and regulatory strategies.

3.6 Ethical considerations

This study adhered to the highest ethical standards throughout its execution, ensuring the protection of participants' rights and the integrity of the research process. Ethical considerations were central to the design and implementation of the study, particularly in the collection and handling of data. The following measures were taken to address ethical concerns:

3.6.1 *Confidentiality and Anonymity*

All participants in the qualitative interviews were assured of the confidentiality and anonymity of their responses. Personal identifiers were removed from the data to protect the privacy of the respondents. This approach was particularly important given the sensitive nature of discussions around tariff structures and cross-subsidization practices.

3.6.2 *Informed Consent*

Prior to conducting interviews, informed consent was obtained from all participants. They were provided with detailed information about the study's objectives, the nature of their involvement, and how their data would be used. Participants were also informed that their participation was voluntary and that they could withdraw from the study at any time without any consequences.

3.6.3 *Ethical Approval*

Before commencing the research, ethical approval was sought and obtained from the University's Ethics Committee. This approval process involved a thorough review of the research design, data collection methods, and potential risks to

participants. The committee's approval confirmed that the study complied with the ethical standards and guidelines established by the institution.

3.6.4 *Data Security*

All data collected during the study, including both quantitative and qualitative data, was stored securely. Access to the data was restricted to the research team, and all electronic files were password-protected. Physical documents were kept in a locked cabinet to prevent unauthorized access.

3.6.5 *Transparency and Integrity*

Transparency throughout the study was achieved by clearly documenting all procedures and decisions. This included keeping detailed records of data collection, analysis, and interpretation. By maintaining a high level of integrity, the study aimed to produce reliable and credible findings that could inform policy and practice.

3.7 Limitations

This study on electricity tariff cross-subsidization within Namibia's REDs has several limitations that should be considered for a more comprehensive understanding. Firstly, the reliance on secondary data from Tariff Application Sheets limited the exploration of socio-economic characteristics of consumers. This constraint hindered the ability to analyze the broader social implications of cross-subsidization practices. Secondly, the qualitative interviews had a small sample size, excluding key stakeholders such as consumer advocacy groups and industrial consumers. This limited the comprehensiveness of stakeholder perspectives. Thirdly, the study focused exclusively on three REDs (CENORED, Erongo RED, and NORED), which do not represent the entire electricity distribution landscape in Namibia. Including other regions and distributors in future research could provide a more holistic view of cross-subsidization practices across the country.

The findings of this study are specific to Namibia's unique socio-economic and regulatory environment, which may limit their generalizability to other countries. Exploring cross-subsidization practices in different contexts could help identify common trends and challenges. Lastly, the mixed-methods approach presented challenges in integrating quantitative and qualitative data. The reliance on structured interviews for qualitative data collection limited the depth of insights obtained. Future research could incorporate more open-ended interviews or focus groups to explore stakeholder perspectives in greater detail. Addressing these limitations in future studies will enhance the understanding of electricity tariff cross-subsidization within Namibia's REDs.

3.8 Consistency Table: Data Collection and Analysis Methods

The Consistency Table with data collection details and analysis methods is shown below. This summarises the data collection and analysis methodologies to be used in this study.

Table 3-2: Consistency Table - Data Collection and Analysis Methods

RQ #	State Research Question or Objective	Hyp #	State Proposition or Hypothesis	Data collection detail	Data analysis method
1	To what extent do different consumer categories contribute to or benefit from electricity tariff cross-subsidization within regional electricity distribution areas in Namibia?	1a	Residential consumers especially those in rural areas are net beneficiaries of electricity tariff cross-subsidization in Namibia, with commercial and industrial consumers contributing disproportionately to the cross-subsidy.	<u>Secondary Data</u> Tariff Application Sheets Apply an Existing Cost Allocation Model	• Tariff structure analysis • Determination of cost reflectivity per category • Sensitivity Analysis
		1b	There are significant variations in the extent of cross-subsidization between different Regional Electricity Distributors (REDs) in Namibia, with some REDs experiencing higher levels of cross-subsidization from commercial and	<u>Secondary Data</u> Tariff Application Sheets Apply an Existing Cost Allocation Model	• Tariff structure analysis • Determination of cost reflectivity per category • Sensitivity Analysis

RQ #	State Research Question or Objective	Hyp #	State Proposition or Hypothesis	Data collection detail	Data analysis method
			industrial consumers to residential consumers than others.		
2	What Policies and Regulations Influence Electricity Tariff Cross Subsidization? influence the application of electricity cross-subsidization among different consumer categories within Namibia's Regional Electricity Distribution Areas (REDs)?	2a	Government policies, regulations, and economic conditions are the primary determinants of electricity cross-subsidization patterns among consumer categories within Namibia's REDs.	<u>Primary Data</u> Interviews – Electricity Control Board (Regulator) and Ministry of Mines and Energy (Policymaker)	• Thematic

CHAPTER 4. RESEARCH FINDINGS AND DISCUSSIONS

4.1 Introduction

This chapter presents a comprehensive analysis of both the quantitative and qualitative findings on electricity tariff cross-subsidization within Namibia's Regional Electricity Distributors (REDs), with a focus on CENORED, Erongo RED, and NORED. The study spans a decade, 2014/15–2024/25 financial years, and employs a mixed-methods approach to explore the financial dynamics, equity implications, and policy challenges associated with cross-subsidization practices in the electricity distribution sector.

The quantitative analysis quantifies the extent of cross-subsidization across consumer categories, identifies key beneficiaries and contributors, and examines trends within and between the REDs. By comparing tariff structures and cross-subsidization levels, this analysis provides critical insights into the financial redistribution mechanisms and their impact on equitable electricity access.

Complementing the quantitative findings, the qualitative analysis delves into the perspectives of key stakeholders, including the Regional Electricity Distributors (REDs), the Electricity Control Board (ECB), and the Ministry of Mines and Energy (MME). Data collection involved interviews with senior representatives from these institutions. Through thematic analysis of the interview responses, this section examines existing tariff structures, the impact of regulatory frameworks and policies on cross-subsidization, and the challenges in implementing equitable electricity pricing. The qualitative findings illuminate the operational dynamics and policy directions shaping Namibia's electricity distribution system.

Together, these analyses offer a holistic understanding of the complexities and challenges associated with electricity tariff cross-subsidization in Namibia. By integrating quantitative and qualitative insights, this chapter contributes to the academic and policy discourse on equitable electricity pricing and regulation. The chapter is structured to first present the quantitative findings, followed by a detailed

qualitative analysis, and concludes with a synthesis of key insights and their implications for future policy and regulatory reforms.

4.2 Consumer categories

The consumer categories in Namibia's electricity distribution sector are classified as residential, social, general, general-demand, institutional, and institutional-demand. These categories as defined by the Electricity Control Board (2019) are listed below:

1. *Residential consumers*: Domestic users with standard household energy consumption patterns.
2. *Social consumers*: Low-demand domestic users with capped usage or restricted breaker sizes, benefiting from cross-subsidized tariffs.
3. *General consumers*: Commercial entities with higher energy demand for business activities.
4. *General-demand consumers*: Large commercial entities with high peak demands, subject to maximum demand charges.
5. *Institutional consumers*: Government or private institutions (e.g., schools, hospitals) with distinct energy needs.
6. *Institutional-demand consumers*: Large institutional users with high peak demands, subject to maximum demand charges.

These classifications ensure that tariff structures and infrastructure planning align with the diverse energy consumption patterns and needs of different consumer groups.

4.3 Quantitative analysis and findings

This section presents the quantitative analysis of electricity tariff cross-subsidization within Namibia's Regional Electricity Distributors (REDs), focusing on CENORED, Erongo RED, and NORED. The study is based on data collected over a 10-year period (2014/15–2024/25) and aims to quantify the extent of cross-subsidization across consumer categories, identify beneficiaries and contributors, and analyze trends within

and between the REDs. By comparing cross-subsidization levels, the analysis highlights variations and commonalities in their approaches.

The data was sourced from the Operating Reporting Manual (ORM) Tariff Application Sheets submitted by the three REDs: Northern Regional Electricity Distributor (NORED), Central North Regional Electricity Distributor (CENORED), and Erongo Regional Electricity Distributor (Erongo RED). These sheets provide detailed information on approved tariff structures for various consumer categories for each financial year. The data, including unit costs for each consumer category, was systematically captured and tabulated for analysis, enabling a comprehensive evaluation of cross-subsidization practices.

4.3.1 *Verification and validation of quantitative data*

To ensure data credibility and accuracy, a cross-verification process was conducted by comparing data obtained from the REDs with records from the ECB. Since the data was used in the ECB tariff approval process, it was meticulously documented, outlining each step taken to gather, verify, and analyze the data, thereby establishing a robust foundation for the study's conclusions.

4.3.2 *Overview of quantitative data*

The dataset includes indicative tariffs (cost-reflective rates without cross-subsidies) and actual-approved tariff rates for consumer categories namely, Residential, Social, General, General-demand, Institutional, and Institutional-demand. It also provides the percentage of cross-subsidy, quantifying the extent to which each category contributes to or benefits from subsidization. The analysis reveals distinct patterns, with some consumer categories receiving significant subsidies while others bear the financial burden of supporting them. These findings are presented and explained in detail, offering a comprehensive understanding of the financial flows and equity implications within the sector.

4.3.3 Detailed analysis of quantitative data

This section presents a comprehensive analysis of the quantitative findings, focusing on a comparative assessment of indicative and actual tariff rates for specific consumer categories across the various Regional Electricity Distributors (REDs). Each category, including residential consumers, is examined in dedicated sub-sections to facilitate a systematic comparison across all REDs. Furthermore, the study investigates the extent and trends of tariff cross-subsidization across all consumer categories, as well as the proportional representation of each category within individual REDs. This methodological approach is crucial for identifying the share of electricity sales that benefit from subsidization and the proportion that contributes to it, offering valuable insights into the financial dynamics and equity of tariff structures within Namibian electricity distribution utilities.

4.3.3.1. Residential consumer category

The analysis of residential consumer categories across CENORED, Erongo RED, and NORED indicates consistent cross-subsidization, with residential consumers emerging as net beneficiaries in all three utilities. CENORED, however, demonstrates a notable decline in cross-subsidization, decreasing from 35% in 2020/21 to 15% by 2024/25 financial years, signalling a gradual reduction in financial support. The indicative and actual tariff rates, along with the levels of cross-subsidization, are illustrated in the graphs presented in Figure 4-1 below.

The percentage level of cross-subsidization represents the extent to which actual tariff rates are different from indicative tariff rates. A positive percentage level indicates that the consumer category is contributing to cross-subsidization, while a negative percentage level suggests that the category is a beneficiary of cross-subsidization.

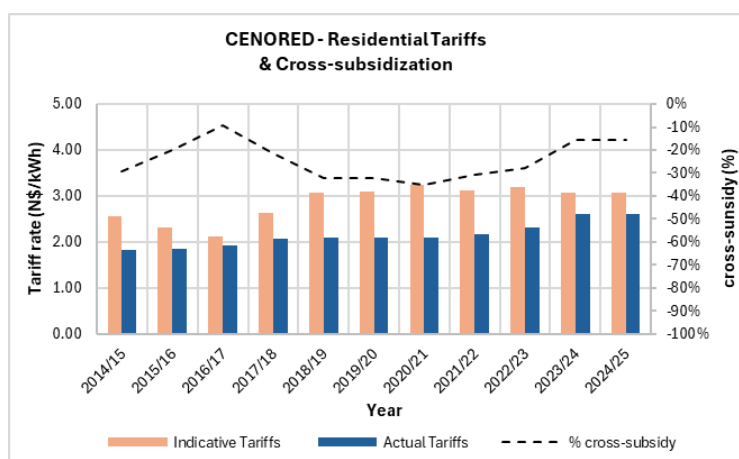


Figure 4-1 shows indicative, actual tariff rates and level of cross-subsidy for residential consumer category for CENORED.

In contrast, Erongo RED data demonstrates a notable increase, rising from 14% in 2020/21 to a stable 31% in 2023/24 and 2024/25, underscoring its commitment to affordability, this is shown with the aid of graphs in Figure 4-2 below.

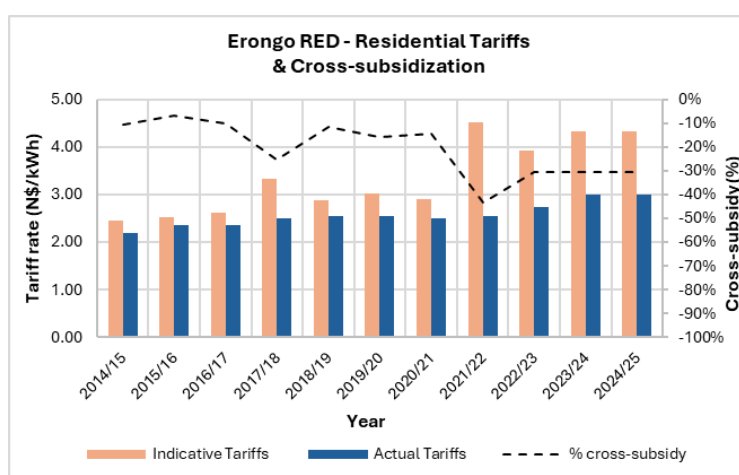


Figure 4-2 shows indicative, actual tariff rates and level of cross-subsidy for residential consumer category for Erongo RED.

Just like CENORED and Erongo RED's cross-subsidization has decreased slightly from just over 40% in 2014/15 to just over 20% in 2024/25, maintaining a focus on affordability despite the reduction. This is illustrated in Figure 4-3

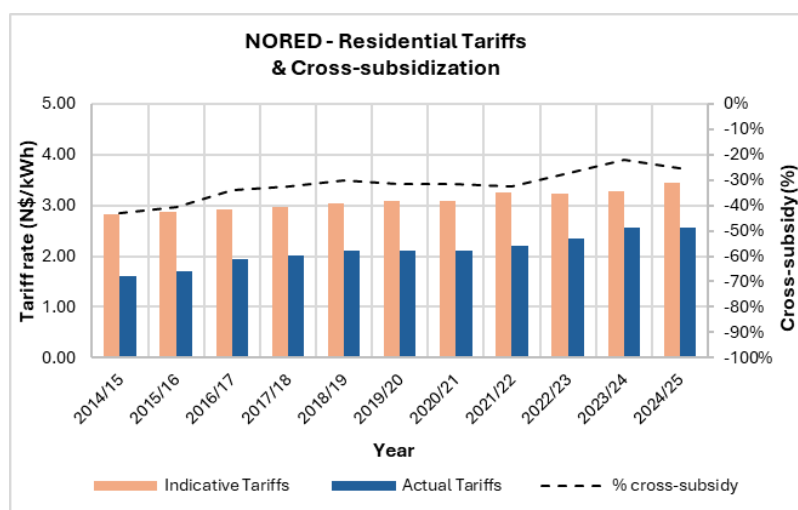


Figure 4-3 shows indicative, actual tariff rates and level of cross-subsidy for residential consumer category for NORED.

These trends illustrate diverse approaches to balancing affordability and financial sustainability across the utilities.

4.3.3.2. Social consumer category

The data from CENORED highlights substantial cross-subsidization within the social consumer category, reaching a peak of 65% in 2020/21, as depicted in Figure 4-4. Although there has been a marginal decrease in recent years, the cross-subsidy rate remains considerable at 55% in 2024/25, reflecting continued financial assistance for this economically vulnerable group.

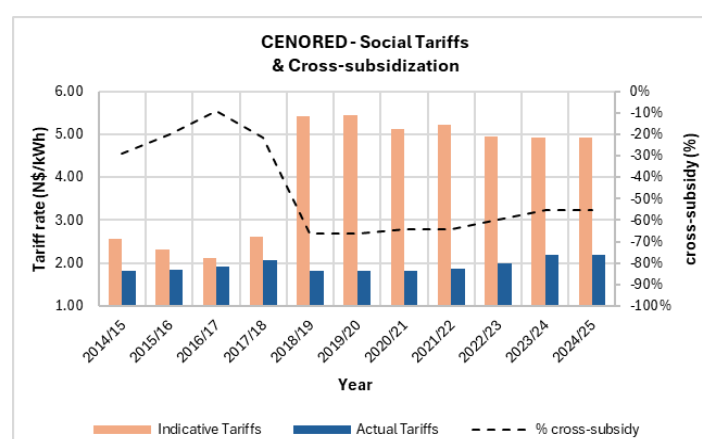


Figure 4-4 shows indicative, actual tariff rates and level of cross-subsidy for social consumer category for CENORED.

Similarly, Erongo RED's social consumer category exhibits consistently high levels of cross-subsidization, with an average of approximately 50% over the observed period, as illustrated in Figure 4-5.

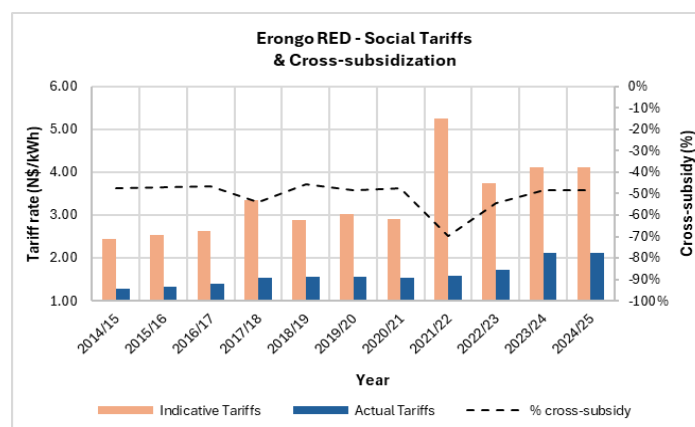


Figure 4-5 shows indicative, actual tariff rates and level of cross-subsidy for social consumer category for Erongo RED.

NORED's social consumer category also demonstrates significant cross-subsidization, maintaining an average rate of around 30% across the years, as presented in Figure 4-6.

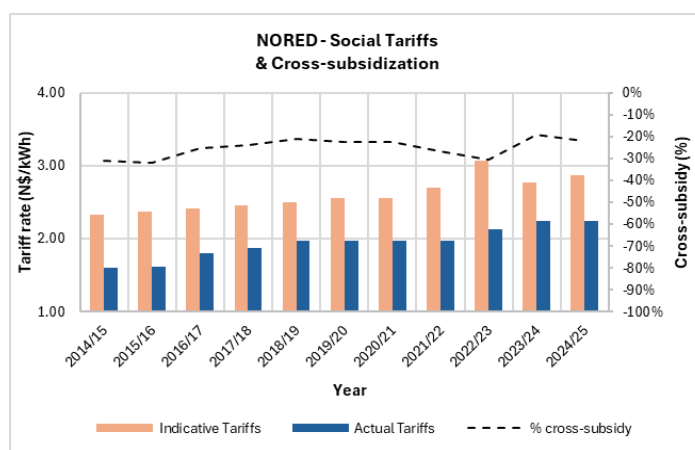


Figure 4-6 shows indicative, actual tariff rates and level of cross-subsidy for social consumer category for NORED.

Essentially, these findings underscore the consistent efforts of all three utilities to support low-income consumers through significant cross-subsidization, reflecting their commitment to ensuring affordability for economically disadvantaged households.

4.3.3.3. General consumer category

CENORED's general consumer group demonstrates minimal cross-subsidization, with actual tariffs closely aligned to indicative tariffs. The cross-subsidy percentage ranges from -8% to 0%, reflecting limited financial support compared to residential and social consumers, as illustrated in Figure 4-7 below.

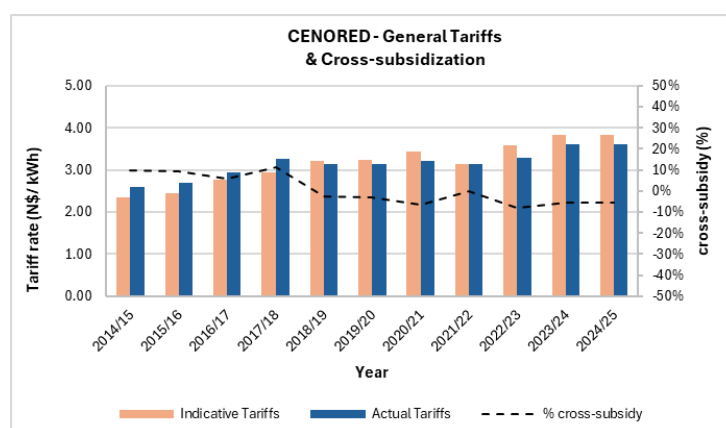


Figure 4-7 shows indicative, actual tariff rates and level of cross-subsidy for general consumer category for CENORED.

In contrast, Erongo RED's general consumer category benefits from cross-subsidization, with actual tariffs consistently below indicative tariffs, except in 2021/22 when the category contributed over 30%. Over the three-year period, the average cross-subsidization level ranged between 10% and 20%, as shown in Figure 4-8.

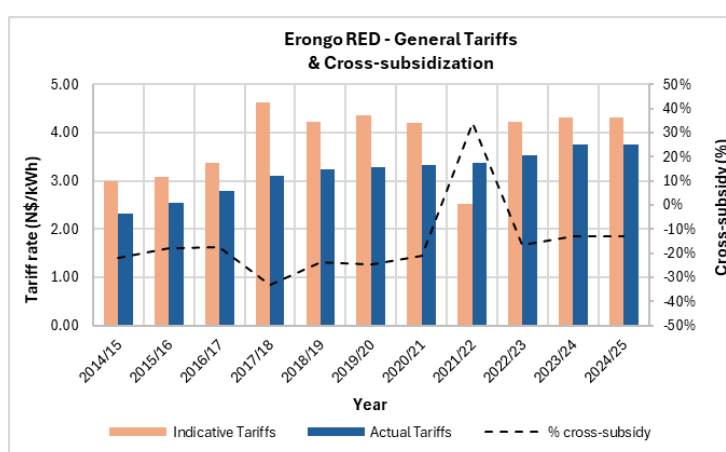


Figure 4-8 shows indicative, actual tariff rates and level of cross-subsidy for general consumer category for Erongo RED.

NORED's general consumer category initially benefited from cross-subsidization from 2016/17 to 2019/20 but transitioned to contributing to cross-subsidization from 2020/21, with the contribution rate rising to just over 30% in 2024/25, as depicted in Figure 4-9.

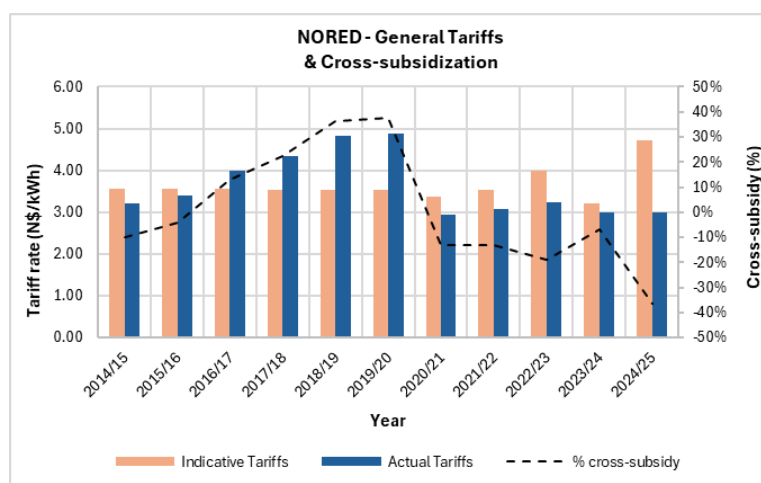


Figure 4-9 shows indicative, actual tariff rates and level of cross-subsidy for general consumer category for NORED.

4.3.3.4. General-demand consumer category

The general-demand consumer group, comprising larger businesses and enterprises under a maximum-demand charge tariff system, plays a significant role in cross-subsidization. For CENORED, this group's contribution ranges from 22% to 42% of indicative (cost-reflective) tariff rates, highlighting its substantial financial role in supporting other consumer categories, as shown in Figure 4-10.

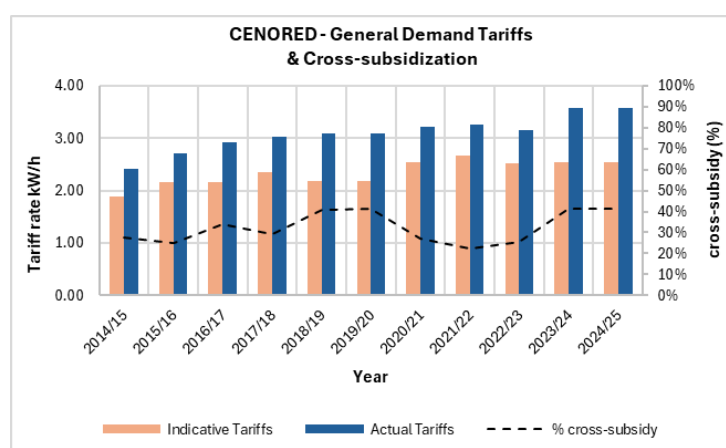


Figure 4-10 shows indicative, actual tariff rates and level of cross-subsidy for general-demand consumer category for CENORED.

Similarly, Erongo RED's general-demand consumers consistently contribute to cross-subsidization, averaging just under 40%, except for 2021/22, as illustrated in Figure 4-11.

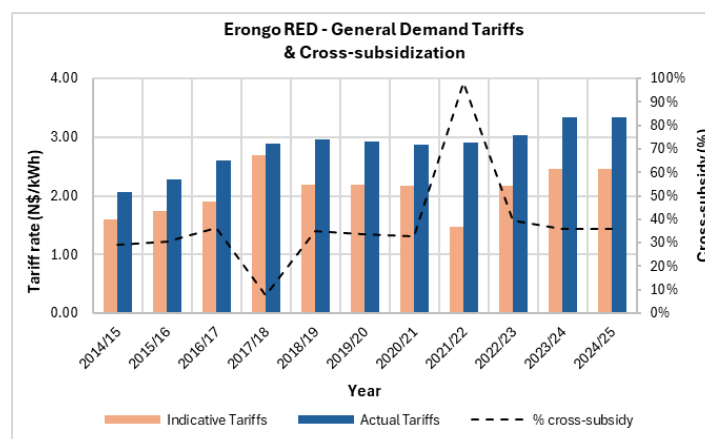


Figure 4-11 shows indicative, actual tariff rates and level of cross-subsidy for general-demand consumer category for Erongo RED.

At NORED, this group has been the largest contributor to cross-subsidization over the years, though recent trends indicate a reduction, underscoring the need to protect these customers, as detailed in Figure 4-12.

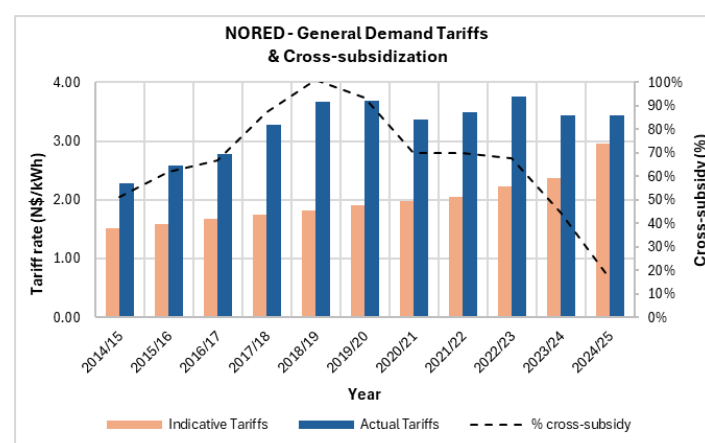


Figure 4-12 shows indicative, actual tariff rates and level of cross-subsidy for general-demand consumer category for NORED.

4.3.3.5. Institutional consumer category

CENORED's institutional consumer category, primarily consisting of government institutions with lower demand, has historically played a significant role in

subsidization. Although its contribution has declined from 75% to 50% in recent years, it remains substantial, as shown in Figure 4-13.

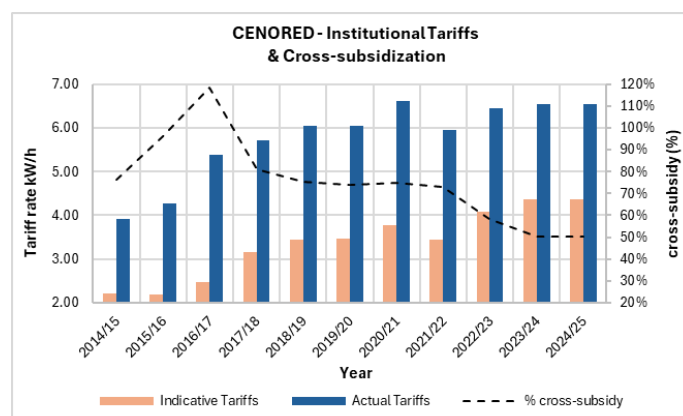


Figure 4-13 shows indicative, actual tariff rates and level of cross-subsidy for institutional consumer category for CENORED.

Erongo RED's institutional consumers transitioned from being cross-subsidized to subsidizing, with contributions of 24% and 25% in 2022/23 and 2023/24, respectively, as depicted in Figure 4-14.

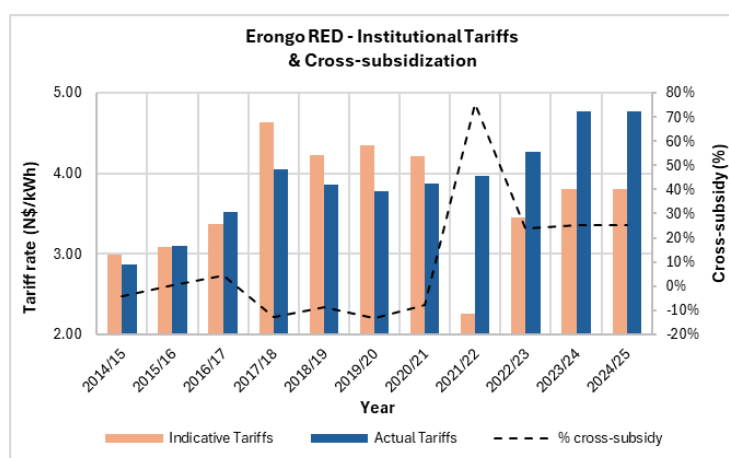


Figure 4-14 shows indicative, actual tariff rates and level of cross-subsidy for institutional consumer category for Erongo RED.

NORED introduced this category in 2023/24, recording a high contribution level peaking at around 90% in 2023/24 before declining in 2024/25, as illustrated in Figure 4-15.

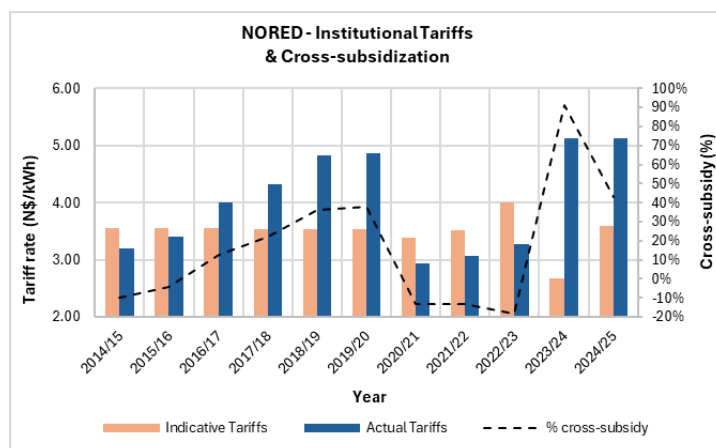


Figure 4-15 shows indicative, actual tariff rates and level of cross-subsidy for institutional consumer category for NORED.

4.3.3.6. Institutional-demand consumer category

Institutional-demand consumers, comprising government entities with high power consumption under a maximum-demand charge tariff structure, exhibit significant cross-subsidization across all REDs.

For CENORED, the cross-subsidy contribution declined from 106% in 2018/19 and 2019/20 to 32% by 2024/25, as shown in Figure 4-16.

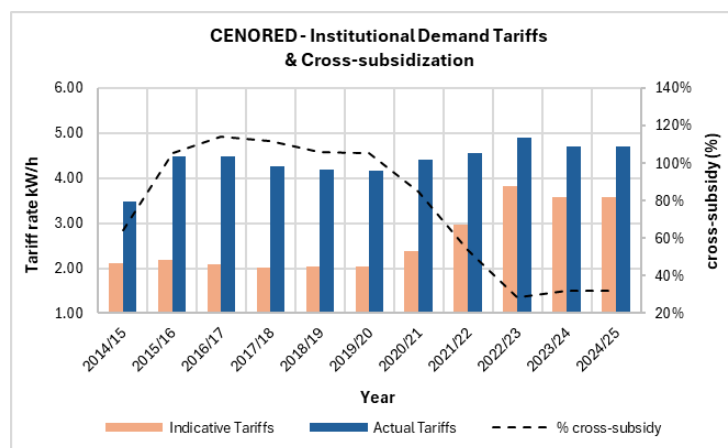


Figure 4-16 shows indicative, actual tariff rates and level of cross-subsidy for institutional-demand consumer category for CENORED.

In Erongo RED, this group is the largest contributor, with a rate of 120% in 2021/22, stabilizing at over 84% from 2022/23 to 2024/25, as illustrated in Figure 4-17.

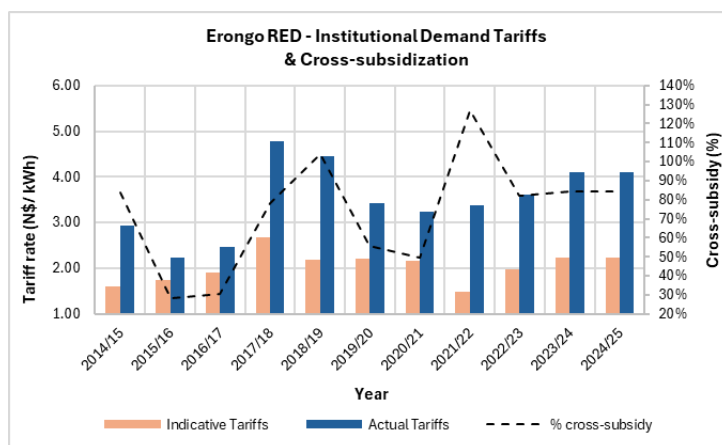


Figure 4-17 shows indicative, actual tariff rates and level of cross-subsidy for institutional-demand consumer category for Erongo RED.

NORED introduced institutional-demand tariff rates in 2023/24, recording a moderate contribution level of just over 60% in 2023/24, which decreased to 25% in 2024/25, as detailed in Figure 4-18.

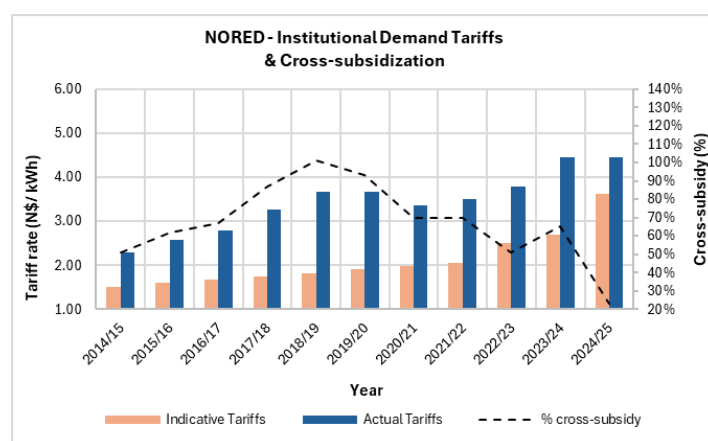


Figure 4-18 shows indicative, actual tariff rates and level of cross-subsidy for institutional-demand consumer category for NORED.

These findings collectively highlight the varying roles of consumer categories in cross-subsidization, reflecting the utilities' strategies to balance affordability for vulnerable groups with the financial sustainability of tariff structures.

4.3.4 The Contributors and beneficiaries of electricity tariff cross subsidization

Below is a presentation the levels of cross-subsidization for each consumer category, along with the quantum of electricity consumed by each category. This analysis aims

to identify the share of electricity sales that is cross-subsidized and the proportion contributing to subsidization.

4.3.4.1. CENORED

The general-demand and institutional-demand consumer categories have been the primary contributors to cross-subsidization, collectively accounting for approximately 35% of electricity consumption within the CENORED network. In contrast, the social consumer category is the biggest beneficiary, followed by residential consumers, with both groups also consuming around 35% of the electricity. The general consumer group, which has received minimal cross-subsidization benefits (ranging from -8% to 0% over the past five years), accounts for about 30% of electricity consumption. The levels of cross-subsidization and the quantum of electricity consumption for each consumer category are illustrated below in Figure 4-19 and Figure 4-20 respectively, with precise numerical values and percentages provided in the Appendices section of this report.

This analysis reflects CENORED's prioritization of affordability for residential and low-income consumers. However, this approach may present challenges for institutional and larger commercial enterprises, particularly those within the general-demand category, due to their significant contributions to subsidization.

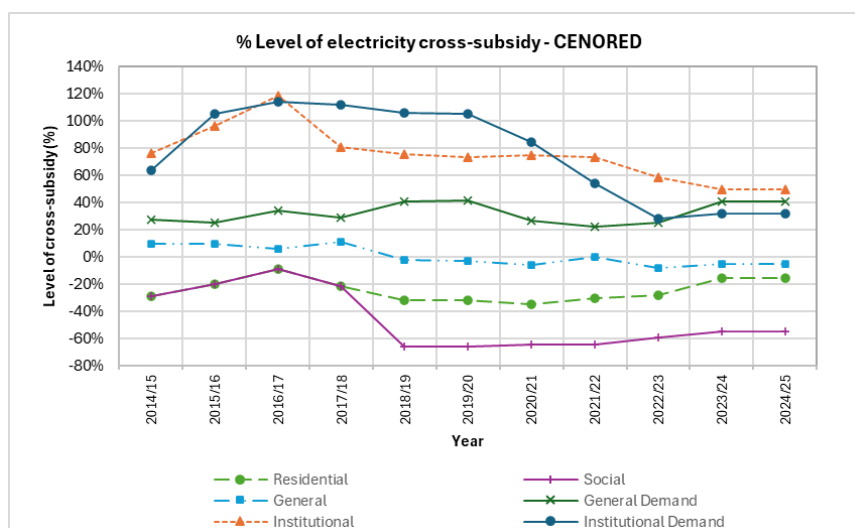


Figure 4-19 shows the trend of cross-subsidy for all consumer categories for CENORED over a 10-year period.

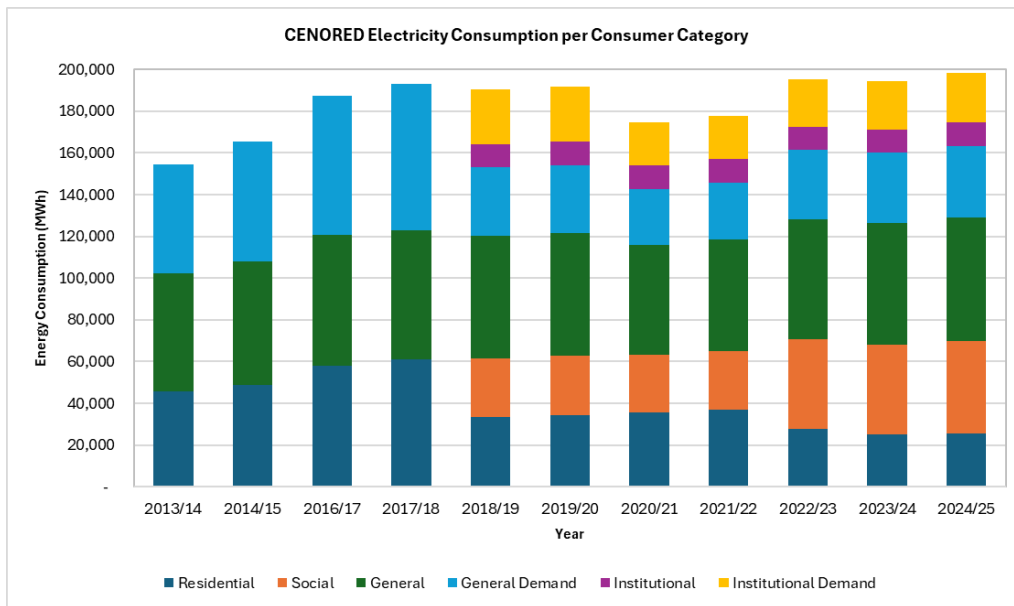


Figure 4-20 shows the quantum of electricity consumption for different consumer categories for CENORED, over a 10-year period.

4.3.4.2. Erongo RED

Until 2021/22, the general-demand and institutional-demand consumer categories were the primary contributors to cross-subsidization. However, from that year onward, the institutional category also transitioned into a contributor. Collectively, these three categories account for approximately 50% of total electricity consumption, based on 2023/24 records. Notably, Erongo RED has the highest proportion of large business and industrial electricity consumption (general-demand), representing 47% of total electricity consumption within its distribution area.

The social consumer category remains the largest beneficiary of cross-subsidization, followed by residential consumers. The levels of cross-subsidization and the quantum of electricity consumption for each consumer category are depicted below in Figure 4-21 and Figure 4-22 respectively, with detailed numerical data provided in the corresponding section. values and percentages provided in the Appendices section of this report.

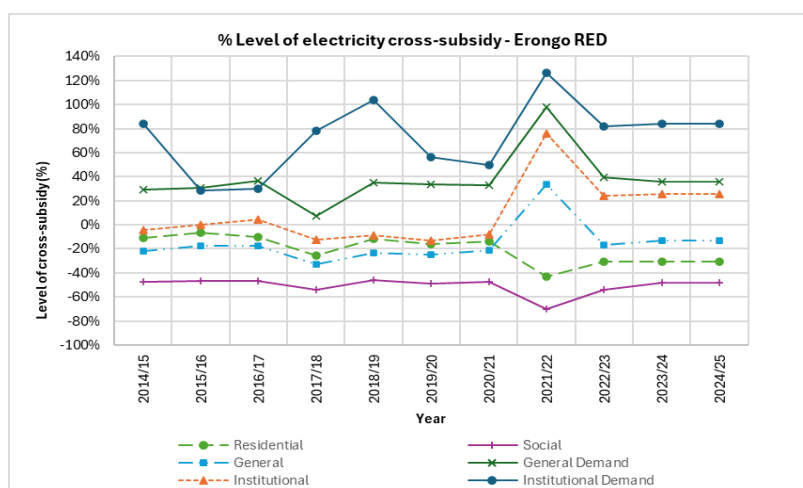


Figure 4-21 shows the trend of cross-subsidy for all consumer categories for Erongo RED over a 10-year period.

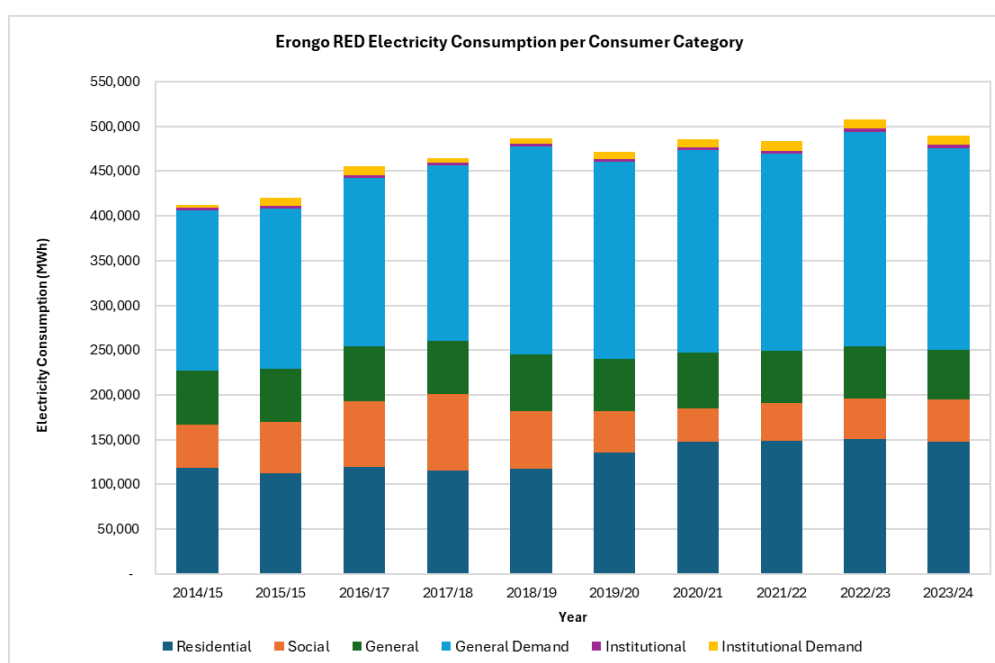


Figure 4-22 shows the quantum of electricity consumption for different consumer categories for Erongo RED, over a 10-year period.

4.3.4.3. NORED

Although the general-demand and institutional-demand categories were treated as a single entity until 2022/23, they have consistently served as the primary contributors to cross-subsidization. From 2023/24 onward, the institutional category also began contributing to cross-subsidization. Together, these three categories account for just under 40% of total energy consumption. Notably, NORED has the highest proportion

of residential consumers among the REDs, standing at 47% in 2024/25. In contrast, NORED's social consumer category is minimal, representing only 0.01% of total consumption.

The levels of cross-subsidization and the quantum of electricity consumption for each consumer category are presented below in Figure 4-23 and Figure 4-24, respectively, with detailed numerical data and percentages provided in the Appendices section of this report.

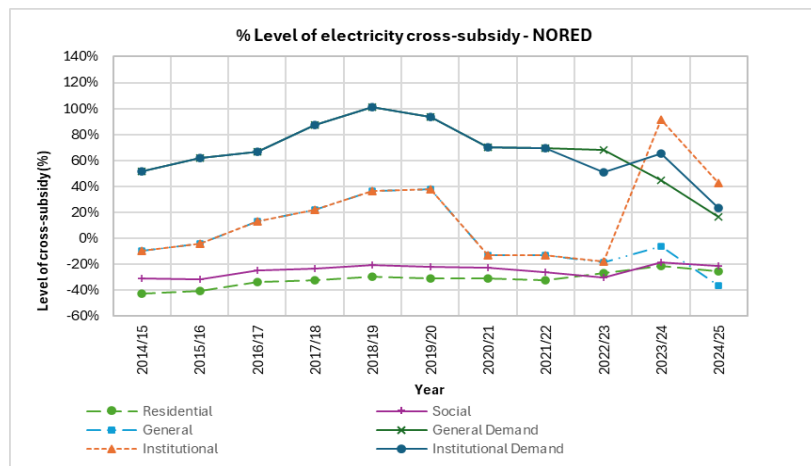


Figure 4-23 shows the trend of cross-subsidy for all consumer categories for NORED over a 10-year period.

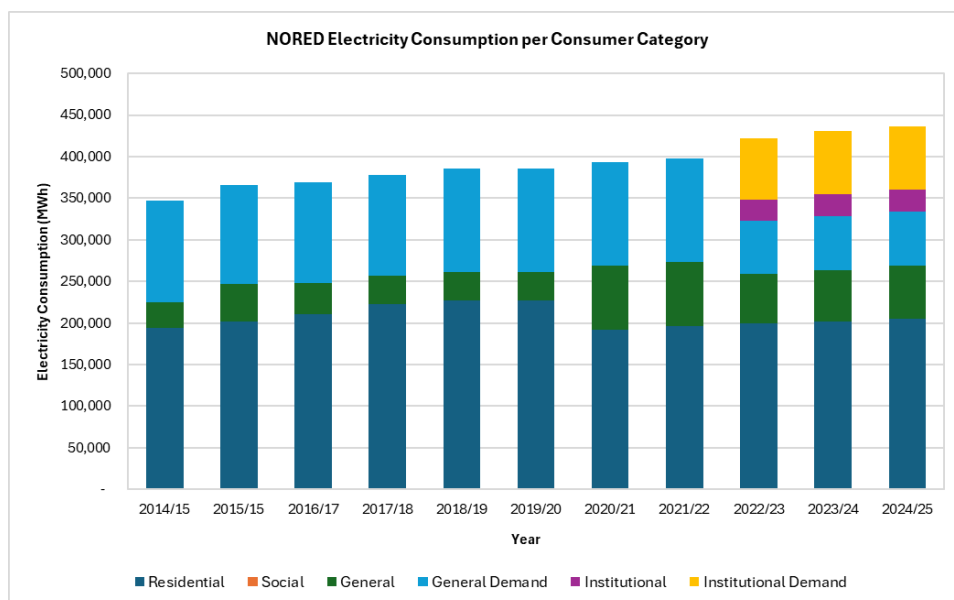


Figure 4-24 shows the quantum of electricity consumption for different consumer categories for NORED, over a 10-year period.

This analysis highlights the varying roles of consumer categories in cross-subsidization across CENORED, Erongo RED, and NORED. While general and institutional-demand categories are primary contributors, social and residential consumers remain key beneficiaries.

4.4 Analysis of qualitative data

This section presents the qualitative analysis of data collected through face-face and telephonic interviews with senior representatives from Namibia's electricity sector, including the Regional Electricity Distributors (REDs), the Electricity Control Board (ECB), and the Ministry of Mines and Energy (MME), one key representative from each institution. The analysis aims to (1) explore existing tariff structures, (2) examine the influence of regulatory frameworks on cross-subsidization, and (3) identify challenges in implementing equitable electricity pricing. Thematic analysis was employed to identify recurring themes and patterns, providing insights into the operational and policy dynamics shaping Namibia's electricity distribution. The analysis was conducted systematically, beginning with the REDs, followed by the ECB, and concluding with the MME. This sequential approach ensured alignment with the research methodology and facilitated a rigorous examination of stakeholder perspectives.

4.4.1 Analysis approach

The qualitative data analysis was structured into distinct phases, beginning with the distributors (REDs), followed by the regulator (ECB), and concluding with the policymaker (MME). This approach aligned with the methodologies outlined in the research proposal. The following steps were undertaken to ensure a rigorous and comprehensive thematic analysis:

4.4.1.1. *Familiarization with the data*

The initial phase involved an in-depth immersion into the data through a thorough review of responses from the REDs, ECB, and MME. This process facilitated a nuanced understanding of the context, key issues, and underlying dynamics within the dataset. Familiarization was critical for identifying recurring patterns, themes, and insights relevant to the research objectives.

4.4.1.2. Generating initial codes

Following familiarization, the data was systematically coded to capture significant phrases, sentences, or paragraphs that reflected key ideas or concepts articulated by respondents. Codes were developed to represent specific aspects of the data, such as tariff determination, affordability, cross-subsidization, implementation challenges, stakeholder engagement, and policy frameworks. Manual coding was employed to ensure precision and alignment with the research questions. A comprehensive list of identified codes is provided in Table B: 0-1 of the Annexures Section.

4.4.1.3. Searching for themes

The initial codes were grouped into broader themes based on recurring patterns and conceptual connections. For instance, themes such as "policy frameworks," "implementation challenges," "stakeholder engagement," and "future policy directions" emerged from the data. This step ensured that the analysis captured the diversity of perspectives and issues raised by respondents.

4.4.1.4. Reviewing themes

The identified themes were rigorously reviewed to ensure they accurately represented the data. This involved assessing coherence, consistency, and distinctiveness among the themes. Overlapping or redundant themes were refined or merged to enhance clarity and focus. The review process also entailed revisiting the raw data to confirm that the themes were grounded in the respondents' actual statements.

4.4.1.5. Defining and naming themes

Each theme was clearly defined and named to reflect its essence. Detailed descriptions were developed to explain the scope and significance of each theme. For example, the theme "policy frameworks" was defined as the set of policies and regulations guiding electricity tariff setting and cross-subsidization, while "stakeholder engagement" referred to collaborative processes involving the MME, ECB, REDs, and other stakeholders.

4.4.1.6. *Incorporating findings into the report*

The final step involved organizing the themes into a coherent narrative. This narrative provided a detailed analysis of the roles, regulations, policies, challenges, and future directions of the REDs, ECB, and MME, supported by direct quotes and examples from the responses. The report aimed to present a comprehensive understanding of the qualitative data, linking the themes to the broader research objectives and contributing to the discourse on equitable electricity distribution.

This structured approach ensured methodological rigor, enabling a thorough exploration of the qualitative data while maintaining alignment with the research objectives.

4.4.2 *Key findings from stakeholder inputs*

The integration of findings from the Regional Electricity Distributors (REDs), Electricity Control Board (ECB), and Ministry of Mines and Energy (MME) underscores the complexity of Namibia's electricity distribution tariff structures. While a balanced, transparent, and adaptive approach to tariff-setting and cross-subsidization is critical for achieving sustainable and inclusive energy access, several implementation challenges persist. These challenges include the financial burden on subsidizing consumers, the risk of grid defection, and regional disparities in infrastructure and economic activity.

Furthermore, the absence of a clear policy framework from the MME and explicit regulatory guidelines on cross-subsidization, as emphasized by the ECB and REDs, exacerbates the difficulties in effectively implementing cross-subsidization practices. Addressing these issues necessitates the refinement of cost allocation models, the introduction of targeted subsidies, and enhanced transparency to ensure equitable and sustainable electricity pricing.

4.4.2.1. *Regional Electricity Distributors (REDs)*

The REDs employ cross-subsidization as a mechanism to support low-income and rural consumers, with industrial, commercial, and government institutional consumers bearing the financial burden. Annual tariff adjustments are implemented to ensure cost

reflectivity, which involves aligning tariffs with the actual costs of electricity supply. However, this approach faces significant challenges, including the financial strain on subsidizing consumers, the risk of grid defection as businesses seek alternative energy sources, and infrastructure limitations that hinder service delivery in rural areas.

To address these issues, the REDs have proposed several improvements. These include refining cost allocation models to improve accuracy and fairness, introducing targeted subsidies for low-income consumers to alleviate the financial burden on other consumer groups, and establishing clear tariff guidelines to enhance the transparency and fairness of cross-subsidization practices. These measures aim to strike a balance between affordability for low-income households and the financial sustainability of the electricity distribution network.

4.4.2.2. Electricity Control Board (ECB)

The ECB utilizes a standardized tariff methodology to promote fair and cost-reflective pricing, supported by cost allocation models and sensitivity analyses. This approach aims to distribute costs equitably across different consumer categories while maintaining the financial sustainability of the sector. However, the ECB faces significant challenges, including balancing cost reflectivity with equitable access and addressing regional disparities in infrastructure and economic activity. A notable shortcoming is the lack of clear regulatory guidelines on cross-subsidization, which creates inconsistencies in implementation.

To address these challenges, the ECB has outlined several future directions. These include refining cost allocation methods to improve accuracy, incorporating tariff elasticity to account for varying consumption patterns, enhancing transparency in the tariff-setting process, and maintaining continuous stakeholder engagement to ensure equitable and sustainable electricity pricing. These initiatives aim to address the dual objectives of cost recovery and equitable access while mitigating regional disparities.

4.4.2.3. Ministry of Mines and Energy (MME)

Guided by the *White Paper on Energy Policy (1998)* and the *National Electrification Policy (2021)*, the MME prioritizes equitable access to electricity and advocates for

cross-subsidization as a means of achieving this goal. However, the absence of a clear policy specifically addressing tariff cross-subsidization remains a critical gap, leading to inconsistencies in implementation. The MME faces several challenges, including balancing cost-reflective tariffs with equitable access and addressing infrastructure limitations in rural areas, which hinder the expansion of electricity services.

To overcome these challenges, the MME collaborates with the ECB and REDs through regular consultations and joint planning initiatives. Future initiatives proposed by the MME include implementing targeted subsidies for low-income consumers, exploring innovative funding mechanisms for rural electrification, and striving to achieve universal electricity access by 2040. These efforts aim to balance cost-reflective pricing with equitable access, fostering sustainable and inclusive energy development.

4.4.3 *Future improvements and policy directions*

To address the challenges identified in the findings, the REDs, ECB, and MME have proposed several policy directions and improvements aimed at enhancing the sustainability and equity of Namibia's electricity distribution system. These initiatives reflect a commitment to creating a more transparent, equitable, and sustainable electricity sector.

4.4.3.1. *REDs' proposed improvements*

The REDs propose refining cost allocation models to improve accuracy and fairness, ensuring that tariffs reflect the true cost of electricity supply while maintaining affordability for low-income consumers. Additionally, the introduction of targeted subsidies for low-income households is seen to alleviate the financial burden on subsidizing consumers, such as industrial and commercial users. To enhance transparency, the REDs emphasize the need for clear tariff guidelines that outline the principles and practices of cross-subsidization.

Furthermore, strategies to prevent grid defection by key customers are being developed to ensure the sustainability of the electricity distribution network. These measures aim to strike a balance between affordability for low-income households and the financial viability of the electricity sector.

4.4.3.2. ECB's future plans and suggestions

The ECB aims to refine its regulatory framework by improving cost allocation models and incorporating demand elasticity for different consumer categories. This approach seeks to design tariffs that are responsive to changes in consumption patterns, ensuring that pricing remains equitable and sustainable. Enhancing transparency in the tariff-setting process is another key initiative, aimed at building trust among stakeholders and ensuring that all parties understand how tariffs are determined.

The ECB also emphasizes the importance of maintaining ongoing dialogue with stakeholders, including REDs, consumer groups, and industry representatives, to address emerging issues and ensure that electricity pricing remains aligned with socio-economic development goals. These initiatives aim to address the challenges of balancing cost reflectivity with equitable access while mitigating regional disparities in infrastructure and economic activity.

4.4.3.3. MME's future plans and initiatives

The MME plans to implement targeted subsidies for low-income consumers, ensuring that electricity remains affordable for vulnerable households while reducing the financial burden on other consumer groups. Additionally, the MME is exploring innovative funding mechanisms for rural electrification, aiming to address infrastructure limitations and expand access to underserved communities. A key long-term goal is to achieve universal electricity access by 2040, which requires a coordinated effort to balance cost-reflective pricing with equitable access.

By collaborating with the ECB and REDs, the MME seeks to refine policies, strengthen regulatory mechanisms, and ensure that electricity distribution aligns with national socio-economic goals. These initiatives aim to foster sustainable and inclusive energy development, ensuring that all Namibians have access to reliable and affordable electricity.

4.4.6 Summary of key findings and stakeholders' recommendations

The Table below presents a summary of key findings and recommendations and initiatives from the key stakeholders (REDs, ECB and MME).

Table 4-1: Summary of Overall Qualitative Findings and Stakeholders Recommendations

Stakeholder	Summary of Findings	Recommendations
REDs	- Cross-subsidization supports low-income and rural consumers, with industrial, commercial, and government institutional consumers bearing the burden. - Annual tariff adjustments ensure cost reflectivity. - Challenges include financial burdens on subsidizing consumers, grid defection risks, and infrastructure limitations.	- Refine cost allocation models to improve accuracy and fairness. - Introduce targeted subsidies for low-income consumers to reduce the financial burden on general and institutional users. - Enhance transparency in the tariff-setting process. - Develop strategies to prevent grid defection. - Establish clear tariff guidelines to provide clarity on cross-subsidization practices.
ECB	- Employs a standardized tariff methodology to ensure fair, cost-reflective pricing. - Uses cost allocation models and sensitivity analyses for tariff determination. - Challenges include balancing cost reflectivity with equitable access and addressing regional disparities. - Absence of clear regulatory guidelines on cross-	- Refine cost allocation methods to ensure tariffs are more reflective of actual costs. - Introduce tariff elasticity to design tariffs responsive to consumption patterns. - Enhance transparency in the tariff-setting process. - Maintain continuous stakeholder engagement to ensure equitable and sustainable electricity pricing.

Stakeholder	Summary of Findings	Recommendations
	subsidization is a significant shortcoming.	
MME	- Guided by key policies such as the White Paper on Energy Policy (1998) and the National Electrification Policy (2021), which emphasize equitable access to electricity and advocate for cross-subsidization. - Need for a clear policy specifically addressing tariff cross-subsidization. - Challenges include balancing cost-reflective tariffs with equitable access and addressing infrastructure limitations in rural areas. - Collaborates with the ECB and REDs through regular consultations and joint planning initiatives.	- Implement targeted subsidies for low-income consumers to enhance affordability. - Explore innovative funding mechanisms for rural electrification to ensure infrastructure development is adequately financed. - Aim to achieve universal electricity access by 2040, balancing cost-reflective pricing with equitable access to foster sustainable and inclusive energy development. - Establish a clear policy specifically addressing tariff cross-subsidization.

4.5 Discussion of quantitative and qualitative findings

This section provides a comprehensive summary of the analyses conducted on electricity tariff cross-subsidization within Namibia's Regional Electricity Distributors (REDs), focusing on CENORED, Erongo RED, and NORED, over the period from 2014/15 to 2024/25. The study employed a mixed-methods approach, combining

quantitative and qualitative analyses to explore the financial dynamics, equity implications, and policy challenges associated with cross-subsidization practices. The findings reveal significant insights into the distribution of costs and benefits across different consumer categories, as well as the operational and regulatory challenges faced by the REDs.

4.5.1 *Quantitative findings*

The quantitative analysis highlights that residential and social consumers are consistently the primary beneficiaries of cross-subsidization across all REDs. These groups, which include low-income households and rural consumers, receive substantial financial support through cross-subsidized tariffs, ensuring their access to affordable electricity. Additionally, general consumers, typically smaller commercial enterprises, also benefit from cross-subsidization in most cases, although the extent of this support varies depending on the specific RED.

On the other hand, general-demand and institutional-demand consumers, such as industrial, commercial, and government institutions, are the primary contributors to cross-subsidization. These groups bear the financial burden of maintaining affordable tariffs for residential and social consumers, as well as smaller enterprises. The analysis reveals that these institutional consumers pay higher tariffs, effectively subsidizing the electricity costs for more vulnerable groups.

The study also identifies significant regional variations in cross-subsidization levels among the REDs, reflecting differences in consumer composition, economic conditions, and REDs general approaches. For example, Erongo RED demonstrates a notably high level of cross-subsidization towards residential consumers, which can be attributed to its relatively high proportion of general-demand consumers, that are industrial and commercial consumers. This demographic structure allows Erongo RED to more effectively redistribute costs from higher-paying consumer categories, such as industrial and commercial users, to support residential consumers. This is illustrated in section 4.3.4.2. In contrast, CENORED and NORED exhibit different patterns, with CENORED showing a gradual reduction in cross-subsidization levels over time, while NORED maintains a more stable approach.

These regional disparities underscore the importance of tailoring cross-subsidization strategies to local contexts. A one-size-fits-all approach may not be effective, as the economic and demographic conditions vary significantly across regions. The findings highlight the need for a nuanced understanding of regional dynamics in designing equitable and sustainable electricity tariff structures. These dynamics are brought about by level of industrialization and density of customers.

4.5.2 Qualitative findings

The qualitative analysis complements the quantitative findings by providing deeper insights into the policy frameworks, implementation challenges, stakeholder engagement, and future policy directions related to cross-subsidization.

Key themes emerging from the qualitative data include:

- i. **Policy Frameworks:** Stakeholders, particularly the REDs, emphasize the importance of clear regulatory guidelines on cross-subsidization. The absence of a specific policy addressing tariff cross-subsidization has led to inconsistencies in implementation across regions. There is a strong call for robust policies that provide a clear framework for how cross-subsidization should be applied, ensuring that it aligns with national goals of equitable access and financial sustainability.
- ii. **Implementation Challenges:** The qualitative findings reveal several challenges in implementing cross-subsidization, including the financial strain on subsidizing consumers, the risk of grid defection by industrial and commercial users, and infrastructure limitations in rural areas. These challenges highlight the need for a balanced approach that addresses affordability for vulnerable groups while ensuring the financial sustainability of the electricity distribution network.
- iii. **Stakeholder Engagement:** Effective stakeholder engagement is critical for the successful implementation of cross-subsidization policies. The REDs, ECB, and MME all stress the importance of collaborative processes involving policymakers, regulators, and industry representatives. Regular consultations

and joint planning initiatives are seen as essential for addressing emerging issues and ensuring that electricity pricing remains aligned with socio-economic development goals.

- iv. **Future Policy Directions:** Stakeholders propose several future initiatives to improve the sustainability and equity of cross-subsidization practices. These include refining cost allocation models, introducing targeted subsidies for low-income consumers, and enhancing transparency in the tariff-setting process. Additionally, there is a focus on innovative funding mechanisms for rural electrification and achieving universal electricity access by 2040.

The qualitative findings underscore the importance of a dual focus on supporting less-affording consumers while ensuring that larger consumers, who contribute significantly to cross-subsidization, are not overburdened. This balance is critical for maintaining both equity and financial stability within the electricity distribution sector.

4.5.3 Additional Insights

The findings reveal that while the policy intention, as outlined in the White Paper on Energy Policy (Ministry of Mines and Energy, 1998), is to target rural poor consumers with cross-subsidization to ensure equitable access to electricity, the actual beneficiaries include not only the rural poor but also urban residential consumers and general consumers. This discrepancy highlights a significant challenge in the implementation of cross-subsidization policies.

Specifically, the data indicates that urban residential consumers, who may have a higher capacity to afford electricity, are also benefiting from subsidized tariffs. Similarly, general consumers, which include commercial entities, receive financial support through cross-subsidization. This unintended consequence suggests that the current cross-subsidization model may not be targeted as intended, potentially leading to inefficiencies and inequities in the distribution of subsidies.

These findings underscore the need for a more refined approach to cross-subsidization that better aligns with the policy's original goals. Targeted subsidies for low-income and rural consumers, coupled with enhanced transparency in the tariff-

setting process, could help address these imbalances and ensure that the financial support reaches those who need it most.

4.6 Response to research questions and objectives

The findings of this study directly address the research questions and objectives outlined in Chapter 1. The primary objective was to analyze the extent of cross-subsidization in Namibia's electricity tariffs across the three Regional Electricity Distributors (REDs) and to identify the key factors influencing cross-subsidization decisions.

4.6.1 Research Question 1

To what extent do different consumer categories contribute to or benefit from electricity tariff cross-subsidization within Namibia's REDs?

The quantitative findings reveal that residential and social consumers are the primary beneficiaries of cross-subsidization, receiving significant financial support through cross-subsidized tariffs. This aligns with the objective of promoting equitable access to electricity. In contrast, general-demand and institutional-demand consumers bear a disproportionate financial burden, subsidizing other categories. These findings underscore the trade-offs inherent in achieving social equity within the electricity sector.

Objective 1: Determine the extent of cross-subsidization across different customer categories within Namibia's REDs.

The study provides a detailed analysis of cross-subsidization levels across consumer categories, revealing significant regional variations. For instance, Erongo RED exhibits high levels of cross-subsidization toward residential consumers, reflecting its demographic and economic context. In contrast, CENORED shows a gradual reduction in cross-subsidization over time, while NORED maintains a more stable approach. These variations highlight the influence of regional factors on cross-subsidization practices.

4.6.2 Research Question 2

What policies and regulations influence electricity tariff cross-subsidization in Namibia?

The qualitative findings highlight the critical role of government policies, regulatory frameworks, and economic conditions in shaping cross-subsidization patterns. Key policies, such as the *White Paper on Energy Policy (1998)* and the *National Electrification Policy (2021)*, drive cross-subsidization by prioritizing social equity and universal access to electricity. However, the lack of clear regulatory guidelines on cross-subsidization creates implementation challenges, emphasizing the need for more robust and adaptive policy frameworks.

Objective 2: Identify and understand the factors influencing cross-subsidization decisions within Namibia's REDs.

The qualitative analysis identifies several key factors shaping cross-subsidization decisions, including policy frameworks, regulatory challenges, stakeholder engagement, and economic conditions. The study emphasizes the importance of clear regulatory guidelines, targeted subsidies, and enhanced transparency in the tariff-setting process to address cross-subsidization imbalances and promote social equity.

4.7 Consistency Table: comparison of literature review and own findings

Below is a table that provides a summary of a comparison of the literature review and the findings of the study. The table compares the research questions, propositions/hypotheses from the literature review, and the findings from the study.

Table 4-2: Consistency Table - Comparison of Literature Review and Findings

RQ #	State Research Question or Objective	Prop / hyp #	State Proposition or Hypothesis (literature review response to RQ)	Findings from Own Study
1	To what extent do different consumer categories contribute to or benefit from electricity tariff cross-subsidization within Regional Electricity Distributors (REDs) in Namibia?	1a	Residential consumers, especially those in rural areas, are net beneficiaries of electricity tariff cross-subsidization in Namibia, with commercial and industrial consumers contributing to the cross-subsidy.	Residential and social consumers are the primary beneficiaries of cross-subsidization, while general-demand and institutional-demand consumers bear the financial burden. This aligns with the hypothesis.
		1b	There are significant variations in the extent of cross-subsidization between different REDs in Namibia, with some REDs experiencing higher levels of cross-subsidization from commercial and industrial consumers to residential consumers than others.	Significant variations exist between REDs. For example, Erongo RED shows higher cross-subsidization levels for residential consumers compared to CENORED and NORED, reflecting regional economic and demographic differences.

RQ #	State Research Question or Objective	Prop / hyp #	State Proposition or Hypothesis (literature review response to RQ)	Findings from Own Study
2	What policies and regulations influence electricity tariff cross-subsidization within Namibia's Regional Electricity Distribution Areas (REDs)?	2a	Government policies, regulations, and economic conditions are the primary determinants of electricity cross-subsidization patterns among consumer categories within Namibia's REDs.	Policies such as the <i>White Paper on Energy Policy (1998)</i> and the <i>National Electrification Policy (2021)</i> drive cross-subsidization, but the absence of clear regulatory guidelines leads to implementation challenges.

4.7.1 Critical Insights from the comparison

The following are the critical takeaways from the comparison of the literature review and the findings of the study.

- i. The findings largely align with the literature, confirming that residential and social consumers benefit from cross-subsidization, while commercial and industrial consumers bear the financial burden. The study also supports the literature's assertion that regional variations in cross-subsidization levels are influenced by economic and demographic factors.
- ii. The study identifies a gap in the literature regarding the lack of clear regulatory guidelines for cross-subsidization, which leads to implementation challenges. This finding contributes to the academic discourse by highlighting the need for more robust policy frameworks to ensure equitable and sustainable electricity pricing.
- iii. The study provides new insights into the regional variations in cross-subsidization levels, which were not extensively covered in the literature. This underscores the importance of tailoring cross-subsidization strategies to local contexts.

4.8 Discussion of implications from the findings

The findings of this study carry significant implications for both policy and practice within Namibia's electricity distribution sector. The quantitative analysis sheds light on the financial dynamics and equity implications of cross-subsidization, revealing how different consumer categories contribute to or benefit from these practices. Meanwhile, the qualitative insights provide a deeper understanding of the operational and policy-related challenges faced by the REDs, offering a detailed perspective on the complexities of implementing and sustaining cross-subsidization mechanisms. Together, these findings highlight the need for a balanced approach that addresses affordability for vulnerable groups while ensuring the financial sustainability of electricity distribution networks.

4.8.1 *Policy implications*

On the policy front, the study highlights the need to refine cost allocation models and clear regulatory guidelines to ensure that tariffs are both cost-reflective and equitable. Current frameworks often struggle to balance affordability and financial sustainability, leading to inconsistencies in cross-subsidization practices. Implementing targeted subsidies for economically disadvantaged consumers can address cross-subsidization imbalances, promoting social equity without overburdening contributing groups. Additionally, enhancing transparency in the tariff-setting process is essential for building stakeholder trust and ensuring fairness. Clear and consistent regulatory guidelines will help align cross-subsidization practices with national socio-economic goals.

4.8.2 *Practical implications*

Over-reliance on cross-subsidization risks straining contributing consumers, particularly industrial and commercial users, who may seek alternative energy sources or reduce their electricity consumption. This potential for grid defection poses a threat to the stability of cross-subsidization mechanisms, necessitating dynamic tariff-setting mechanisms that can adapt to changing market conditions and consumer behavior. Stakeholders emphasize the importance of strategic, context-sensitive approaches to ensure equitable and sustainable electricity distribution.

CHAPTER 5. CONCLUSIONS & RECOMMENDATIONS

5.1 Introduction

This chapter serves as the culmination of the study, synthesizing its findings to address the research questions and objectives initially outlined in Chapter 1. By integrating insights from both quantitative and qualitative data analyses, it provides a comprehensive understanding of the extent and implications of electricity tariff cross-subsidization within Namibia's Regional Electricity Distributors (REDs). Specifically, the chapter examines how cross-subsidization practices are shaped by existing policies, regulatory frameworks, and regional economic conditions, offering a nuanced perspective on their impact across different consumer categories.

The conclusions drawn are grounded in a rigorous evaluation of the data, highlighting key trends, disparities, and challenges associated with cross-subsidization. These insights not only address the study's core research questions but also contribute to the broader discourse on equitable and sustainable electricity pricing in developing economies.

In addition to summarizing the findings, this chapter provides actionable recommendations for key stakeholders, including policymakers, regulators, and electricity distributors. These recommendations aim to address the identified imbalances in cross-subsidization practices, promote financial sustainability, and enhance equity in electricity access. Furthermore, the chapter identifies critical gaps in the current understanding of cross-subsidization and proposes specific areas for further research. These future research directions are designed to build on the findings of this study, offering opportunities to deepen the knowledge base and inform more effective policy and regulatory interventions in Namibia's electricity sector.

Overall, this chapter not only consolidates the study's contributions but also lays the groundwork for ongoing efforts to achieve a more equitable electricity distribution tariff system in Namibia.

5.2 Conclusions regarding Research Question 1

Research Question 1: To what extent do different consumer categories contribute to or benefit from electricity tariff cross-subsidization within Regional Electricity Distributors (REDs) in Namibia?

The study reveals that residential and social consumers, along with general (small enterprise) consumers to a lesser extent, are the primary beneficiaries of cross-subsidization across all REDs. In contrast, general-demand, institutional, and institutional-demand consumers bear the financial burden of these subsidies. Specifically, residential consumers, particularly in rural areas, benefit significantly from subsidized tariffs, while general-demand and institutional-demand consumers contribute disproportionately to the subsidy pool.

The findings reveal that while the policy intention, as outlined in the White Paper on Energy Policy (Ministry of Mines and Energy, 1998), is to target rural poor consumers with cross-subsidization to ensure equitable access to electricity, the actual beneficiaries include not only the rural poor but also urban residential consumers and general consumers. This discrepancy highlights a significant challenge in the implementation of cross-subsidization policies.

Specifically, the data indicates that urban residential consumers, who may have a higher capacity to afford electricity, are also benefiting from subsidized tariffs. Similarly, general consumers, which include commercial entities, receive financial support through cross-subsidization. This unintended consequence suggests that the current cross-subsidization model may not be as targeted as intended, potentially leading to inefficiencies and inequities in the distribution of subsidies.

These findings underscore the need for a more refined approach to cross-subsidization that better aligns with the policy's original goals. Targeted subsidies for low-income and rural consumers, coupled with enhanced transparency in the tariff-setting process, could help address these imbalances and ensure that the financial support reaches those who need it most.

Key findings reveal significant disparities in cross-subsidization practices across Namibia's Regional Electricity Distributors (REDs). Residential and social consumers emerge as the primary beneficiaries, though the extent of support

varies by region. For instance, in CENORED, social consumers received the highest level of subsidies, peaking at 65% in 2020/21, reflecting a strong policy emphasis on supporting vulnerable groups. In Erongo RED, residential consumers benefited from consistent cross-subsidization, with levels stabilizing at 31% in recent years, indicating a sustained commitment to affordability. Meanwhile, in NORED, residential consumers also benefited, though cross-subsidization levels showed a gradual decline, suggesting evolving economic conditions or a shift in balancing the needs of subsidized and contributing consumers. These variations underscore the influence of regional economic conditions and policy priorities on subsidy distribution, while also highlighting the financial burden borne by other consumer categories to sustain these practices.

These findings confirm the initial hypothesis that residential consumers, especially in rural areas, are net beneficiaries of cross-subsidization, while general-demand and institutional-demand consumers are the primary contributors. However, the study also highlights significant variations in cross-subsidization levels between REDs, reflecting regional economic disparities and differences in consumer demographics.

This research contributes to the literature by providing a detailed, decade-long analysis of cross-subsidization trends within Namibia's REDs, addressing a gap in understanding how cross-subsidization impacts different consumer categories in a developing country context.

5.3 Conclusions regarding Research Question 2

Research Question 2: What policies and regulations influence electricity tariff cross-subsidization in Namibia?

The study identifies government policies, regulatory frameworks, and economic conditions as the primary drivers of cross-subsidization patterns within Namibia's electricity sector. Key policies, such as the White Paper on Energy Policy (1998) and the National Electrification Policy (2021), prioritize equitable access to electricity, particularly for low-income and rural consumers, who are predominantly residential and social consumers. These policies underscore the

government's commitment to social equity, which is operationalized through cross-subsidization mechanisms. The Electricity Control Board (ECB) plays a pivotal role in this process, ensuring that tariffs remain cost-reflective while aligning with broader national development goals.

The analysis reveals several critical insights:

Policy Influence: Policies aimed at promoting social equity drive cross-subsidization practices but simultaneously impose financial burdens on general-demand, institutional, and institutional-demand consumers, who bear the cost of subsidizing residential and social consumers.

Regulatory Challenges: The ECB faces significant challenges in balancing the dual objectives of cost reflectivity and equitable access, particularly in regions marked by pronounced economic disparities. This tension highlights the complexity of designing regulatory frameworks that cater to diverse consumer needs.

Future Directions: Stakeholders have emphasized the need for targeted subsidies for residential and social consumers, greater transparency in tariff-setting processes, and the adoption of dynamic tariff-setting mechanisms to address existing imbalances in cross-subsidization practices.

This research underscores the necessity for adaptive regulatory frameworks that can simultaneously ensure affordability for residential and social consumers and maintain financial sustainability for general and institutional consumers. By doing so, the study provides a foundation for more equitable and efficient electricity distribution systems in Namibia and similar contexts.

5.4 Recommendations

Based on the findings of this study, the following recommendations are proposed to address the challenges and imbalances associated with electricity tariff cross-subsidization in Namibia. These recommendations are divided into general measures applicable across the sector and specific actions tailored to key stakeholders.

5.4.1 General recommendations:

- i. Develop and implement a clear, comprehensive policy framework with detailed guidelines on the application of cross-subsidization. This framework should define eligibility criteria, cross-subsidy levels, and mechanisms for monitoring and evaluation to ensure transparency and consistency.
- ii. Design cost allocation models that ensure tariffs are both cost-reflective and equitable, balancing affordability for residential and social consumers with financial sustainability for contributing consumer categories.
- iii. Improve transparency in the tariff-setting process to build stakeholder trust and ensure fairness across all consumer categories.
- iv. Implement dynamic tariff-setting mechanisms supported by clear guidelines to enhance adaptability and responsiveness to changing economic and social conditions.
- v. Encourage operational improvements across electricity distributors to minimize costs and enhance service delivery for all consumer categories.
- vi. Investigate and adopt innovative funding mechanisms, such as public-private partnerships, to reduce reliance on cross-subsidization and support rural electrification.

5.4.2 Stakeholder-specific recommendations:

5.4.2.1. For the policymaker (Ministry of Mines and Energy):

- Introduce targeted subsidies for low-income and rural consumers to alleviate the financial burden on general-demand, institutional, and institutional-demand consumers.
- Develop and enforce a clear policy framework with guidelines on the application of cross-subsidization, ensuring alignment with national development goals and social equity objectives.

5.4.2.2. For the regulator (Electricity Control Board):

- Strengthen stakeholder engagement to address regional disparities and promote inclusive decision-making, particularly for underserved residential consumers.
- Regularly monitor cross-subsidization levels to prevent overburdening contributing consumer categories and maintain a balanced tariff structure.
- Ensure compliance with the established policy and guidelines on cross-subsidization, providing oversight to maintain fairness and transparency.

5.4.2.3. For Regional Electricity Distributors (REDs):

- Collaborate with policymakers and regulators to develop sustainable tariff structures that balance the needs of beneficiary and contributing consumer categories.
- Adhere to the policy and guidelines on cross-subsidization, ensuring consistent and equitable application across all regions.

5.5 Suggestions for Further Research

This study identifies several avenues for future research to deepen the understanding of electricity tariff cross-subsidization and its implications for Namibia's REDs. The following areas are recommended for further exploration:

- i. Investigating the long-term impacts of cross-subsidization on contributing consumer categories and assessing their price elasticities in response to tariff changes.
- ii. Exploring alternative funding mechanisms to reduce reliance on cross-subsidization.
- iii. Conducting a regional comparative analysis to identify disparities in cross-subsidization practices and their underlying drivers.
- iv. Examining consumer behavior in response to tariff changes, particularly for subsidised consumers, to inform more effective policy design.

- v. Evaluating the effectiveness of policy and regulatory reforms, including the implementation of clear guidelines on cross-subsidization, in achieving equitable and sustainable electricity access.

These above research areas aim to build on the current study's findings and contribute to the development of more equitable, efficient, and sustainable electricity pricing system in Namibia.

5.6 Consistency Table: Research questions, conclusions & contribution to knowledge

The Table below shows consistency between research questions, conclusions from the research as well as the differences.

Table 5-1: Consistency Table - Research Question, Conclusions & Contribution to Knowledge

RQ #	State Research Question or Objective	State Literature-Based Proposition or Hypothesis	State Conclusion or Answer Based on Own Research	Highlight Key Differences – Contribution to Knowledge
1	To what extent do different consumer categories contribute to or benefit from electricity tariff cross-subsidization within REDs in Namibia?	Residential consumers, especially in rural areas, are net beneficiaries, with commercial and industrial consumers contributing disproportionately.	Residential and social consumers are the primary beneficiaries of cross-subsidization, while general-demand (large commercial enterprises) and institutional-demand consumers bear the financial burden. Variations exist between REDs.	The study provides a detailed, decade-long analysis of cross-subsidization trends, highlighting regional variations and their implications.
2	What policies and regulations influence electricity tariff cross-	Government policies, regulations, and economic conditions are the primary	Policies and regulations drive cross-subsidization, but challenges remain in balancing	The research underscores the need for adaptive regulatory frameworks and targeted subsidies to

RQ #	State Research Question or Objective	State Literature-Based Proposition or Hypothesis	State Conclusion or Answer Based on Own Research	Highlight Key Differences – Contribution to Knowledge
	subsidization within Namibia's REDs?	determinants of cross-subsidization patterns.	affordability and financial sustainability.	address cross-subsidization imbalances.

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CHAPTER 6. REFERENCES

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APPENDICES

Appendix A1: Interview guide for qualitative data collection – REDS



University of the Witwatersrand

Faculty of Commerce, Law and Management

Master of Management in Energy Leadership

Interview Questions for Qualitative Data Collection

Research Title: Electricity Tariff Cross-Subsidization within Regional Electricity Distributors in Namibia

Researcher: Set-son K. Shifidi

Contact Details: 2515624@students.wits.ac.za | +264 81 127 7236

Questions for Regional Electricity Distributors (REDs)

1. General Information

- Can you provide an overview of your role and responsibilities within the RED?
- How long have you been working in the electricity distribution sector?

2. Tariff Structures and Cross-Subsidization

- How are electricity tariffs structured for different consumer categories (residential, commercial, industrial) within your RED?
- What factors influence the determination of these tariffs?
- Can you explain the extent of cross-subsidization among different consumer categories within your RED?
- How do you ensure cost reflectivity in your tariff structures?

3. Impact and Challenges

- What are the main challenges you face in implementing cross-subsidization policies?
- How do cross-subsidization practices impact different consumer groups within your distribution area?
- Are there any significant regional variations in cross-subsidization within your RED?

4. Policy and Regulation

- How do government policies and regulations influence your tariff structures and cross-subsidization practices?
- What role does the Electricity Control Board play in regulating and approving your tariffs?

5. Future Outlook

- What changes or improvements would you suggest for the current cross-subsidization model?
- How do you foresee the future of electricity tariff structures and cross-subsidization in Namibia?

Appendix A2: Interview guide for qualitative data collection – ECB



UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

University of the Witwatersrand

Faculty of Commerce, Law and Management

Master of Management in Energy Leadership

Interview Questions for Qualitative Data Collection

Research Title: Electricity Tariff Cross-Subsidization within Regional Electricity Distributors in Namibia

Researcher: Set-son K. Shifidi

Contact Details: 2515624@students.wits.ac.za | +264 81 127 7236

Questions for the Electricity Control Board (ECB)

1. Regulatory Framework

- Can you provide an overview of the ECB's role in regulating electricity tariffs in Namibia?
- How does the ECB ensure fair and equitable tariff structures across different REDs?

2. Tariff Approval Process

- What is the process for reviewing and approving tariff applications from REDs?
- How does the ECB assess the cost reflectivity and fairness of proposed tariffs?

3. Cross-Subsidization Policies

- What are the ECB's policies regarding cross-subsidization in electricity tariffs?
- How does the ECB monitor and evaluate the impact of cross-subsidization on different consumer categories?

4. Challenges and Solutions

- What are the main challenges the ECB faces in regulating cross-subsidization practices?
- How does the ECB address these challenges to ensure sustainable and fair electricity pricing?

5. Future Directions

- What future policy directions or regulatory changes are being considered to improve cross-subsidization practices?
- How does the ECB plan to balance the need for cost reflectivity with the goal of equitable access to electricity?

Appendix A3: Interview guide for qualitative data collection – MME



UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

University of the Witwatersrand

Faculty of Commerce, Law and Management

Master of Management in Energy Leadership

Interview Questions for Qualitative Data Collection

Research Title: Electricity Tariff Cross-Subsidization within Regional Electricity Distributors in Namibia

Researcher: Set-son K. Shifidi

Contact Details: 2515624@students.wits.ac.za | +264 81 127 7236

Questions for the Ministry of Mines and Energy (MME)

1. Policy Framework

- Can you provide an overview of the MME's role in shaping electricity policies in Namibia?
- How do these policies address the issue of cross-subsidization in electricity tariffs?

2. Impact of Policies

- How do government policies influence the tariff structures and cross-subsidization practices of REDs?
- What are the intended socio-economic impacts of these policies on different consumer groups?

3. Challenges and Considerations

- What are the main challenges in implementing policies related to electricity tariff cross-subsidization?
- How does the MME address these challenges to ensure effective policy implementation?

4. Stakeholder Engagement

- How does the MME collaborate with the ECB and REDs to develop and implement electricity policies?
- What role do stakeholders play in shaping and refining these policies?

5. Future Policy Directions

- What future policy initiatives are being considered to improve cross-subsidization practices?
- How does the MME plan to ensure that electricity tariffs remain fair and equitable for all consumer categories?

Appendix B: Codes and themes development for qualitative analysis

Table B: 0-1: Codes and Themes for the Qualitative Analysis

Codes	Themes
Policies and regulations	Policy Framework
Electricity tariff setting	
Cross-subsidization	
Implementation challenges	Challenges in Implementation
Financial sustainability	
Infrastructure limitations	
Collaboration processes	Stakeholder Engagement
Public consultations	
Feedback mechanisms	
Proposed improvements	Future Policy Directions
Targeted subsidies	
Transparency in tariff-setting	
Inflation rates	Economic Conditions
Energy production costs	
Regional economic activity	
Allocation of supply costs	Cost Allocation Models
Consumption patterns	
Associated costs	
Compliance with ECB guidelines	Regulatory Compliance
Fair and cost-reflective tariffs	
Alignment with national goals	

Appendix C: REDs' 2014/15 – 2024/25 tariff rates

C1 CENORED

Table C-1: CENORED Tariff Rates and Percentage Cross-subsidization

	CENORED Tariffs																	
	Residential			Social			General			General Demand			Institutional			Institutional Demand		
Year	Indicative Tariffs	Actual Tariffs	% cross-subsidy	Indicative Tariffs	Actual Tariffs	% cross-subsidy	Indicative Tariffs	Actual Tariffs	% cross-subsidy	Indicative Tariffs	Actual Tariffs	% cross-subsidy	Indicative Tariffs	Actual Tariffs	% cross-subsidy	Indicative Tariffs	Actual Tariffs	% cross-subsidy
2014/15	2.565	1.818	-29%	2.565	1.818	-29%	2.350	2.584	10%	1.884	2.406	28%	2.212	3.903	76%	2.120	3.477	64%
2015/16	2.310	1.848	-20%	2.310	1.848	-20%	2.450	2.682	9%	2.170	2.712	25%	2.180	4.280	96%	2.180	4.484	106%
2016/17	2.127	1.931	-9%	2.127	1.931	-9%	2.780	2.940	6%	2.170	2.911	34%	2.460	5.374	118%	2.096	4.491	114%
2017/18	2.625	2.066	-21%	2.625	2.066	-21%	2.930	3.261	11%	2.350	3.032	29%	3.159	5.722	81%	2.012	4.266	112%
2018/19	3.084	2.092	-32%	5.414	1.824	-66%	3.211	3.131	-2%	2.186	3.079	41%	3.453	6.054	75%	2.032	4.188	106%
2019/20	3.093	2.103	-32%	5.437	1.829	-66%	3.228	3.136	-3%	2.183	3.090	42%	3.474	6.036	74%	2.026	4.165	106%
2020/21	3.244	2.099	-35%	5.130	1.830	-64%	3.428	3.210	-6%	2.531	3.214	27%	3.775	6.608	75%	2.387	4.407	85%
2021/22	3.127	2.170	-31%	5.229	1.863	-64%	3.140	3.135	0%	2.667	3.260	22%	3.438	5.953	73%	2.957	4.554	54%
2022/23	3.199	2.302	-28%	4.942	1.985	-60%	3.582	3.290	-8%	2.514	3.152	25%	4.079	6.460	58%	3.827	4.908	28%
2023/24	3.081	2.607	-15%	4.914	2.201	-55%	3.823	3.613	-6%	2.531	3.571	41%	4.369	6.554	50%	3.570	4.713	32%
2024/25	3.081	2.607	-15%	4.914	2.201	-55%	3.823	3.613	-6%	2.531	3.571	41%	4.369	6.554	50%	3.570	4.713	32%

C2: Erongo RED

Table C-2: Erongo RED Tariff Rates and Percentage Cross-subsidization

	Erongo RED Tariff																	
	Residential			Social			General			General-demand			Institutional			Institutional-demand		
Year	Indicative Tariffs	Actual Tariffs	% cross-subsidy	Indicative Tariffs	Actual Tariffs	% cross-subsidy	Indicative Tariffs	Actual Tariffs	% cross-subsidy	Indicative Tariffs	Actual Tariffs	% cross-subsidy	Indicative Tariffs	Actual Tariffs	% cross-subsidy	Indicative Tariffs	Actual Tariffs	% cross-subsidy
2014/15	2.454	2.192	-11%	2.454	1.285	-48%	2.991	2.331	-22%	1.591	2.056	29%	2.991	2.863	-4%	1.591	2.924	84%
2015/16	2.530	2.356	-7%	2.530	1.340	-47%	3.088	2.539	-18%	1.745	2.280	31%	3.088	3.099	0%	1.745	2.242	28%
2016/17	2.621	2.355	-10%	2.621	1.400	-47%	3.370	2.782	-17%	1.900	2.595	37%	3.370	3.518	4%	1.900	2.476	30%
2017/18	3.343	2.494	-25%	3.343	1.546	-54%	4.630	3.103	-33%	2.683	2.882	7%	4.630	4.045	-13%	2.683	4.776	78%
2018/19	2.880	2.548	-12%	2.880	1.564	-46%	4.230	3.235	-24%	2.191	2.955	35%	4.230	3.864	-9%	2.191	4.464	104%
2019/20	3.023	2.549	-16%	3.023	1.553	-49%	4.351	3.289	-24%	2.197	2.933	34%	4.351	3.778	-13%	2.197	3.427	56%
2020/21	2.918	2.507	-14%	2.918	1.540	-47%	4.209	3.329	-21%	2.163	2.873	33%	4.209	3.877	-8%	2.163	3.232	49%
2021/22	4.522	2.562	-43%	5.246	1.586	-70%	2.517	3.372	34%	1.469	2.911	98%	2.255	3.962	76%	1.484	3.366	127%
2022/23	3.930	2.739	-30%	3.751	1.717	-54%	4.233	3.523	-17%	2.168	3.027	40%	3.446	4.274	24%	1.980	3.602	82%
2023/24	4.324	2.997	-31%	4.107	2.119	-48%	4.312	3.758	-13%	2.464	3.345	36%	3.811	4.776	25%	2.231	4.112	84%
2024/25	4.324	2.997	-31%	4.107	2.119	-48%	4.312	3.758	-13%	2.464	3.345	36%	3.811	4.776	25%	2.231	4.112	84%

C3: NORED

Table C-2: NORED Tariff Rates and Percentage Cross-subsidization

	NORED Tariffs																	
	Residential			Social			General			General-demand			Institutional			Institutional-demand		
Year	Indicative Tariffs	Actual Tariffs	% cross-subsidy	Indicative Tariffs	Actual Tariffs	% cross-subsidy	Indicative Tariffs	Actual Tariffs	% cross-subsidy	Indicative Tariffs	Actual Tariffs	% cross-subsidy	Indicative Tariffs	Actual Tariffs	% cross-subsidy	Indicative Tariffs	Actual Tariffs	% cross-subsidy
2014/15	2.820	1.610	-43%	2.332	1.610	-31%	3.557	3.198	-10%	1.514	2.289	51%	3.557	3.198	-10%	1.514	2.289	51%
2015/16	2.873	1.710	-40%	2.375	1.620	-32%	3.553	3.406	-4%	1.591	2.579	62%	3.553	3.406	-4%	1.591	2.579	62%
2016/17	2.926	1.930	-34%	2.419	1.810	-25%	3.548	4.000	13%	1.669	2.785	67%	3.548	4.000	13%	1.669	2.785	67%
2017/18	2.979	2.010	-33%	2.463	1.880	-24%	3.544	4.330	22%	1.747	3.270	87%	3.544	4.330	22%	1.747	3.270	87%
2018/19	3.033	2.120	-30%	2.507	1.980	-21%	3.540	4.830	36%	1.825	3.670	101%	3.540	4.830	36%	1.825	3.670	101%
2019/20	3.086	2.120	-31%	2.551	1.980	-22%	3.536	4.870	38%	1.903	3.680	93%	3.536	4.870	38%	1.903	3.680	93%
2020/21	3.096	2.120	-32%	2.559	1.980	-23%	3.377	2.935	-13%	1.981	3.366	70%	3.377	2.935	-13%	1.981	3.366	70%
2021/22	3.268	2.200	-33%	2.694	1.980	-27%	3.521	3.063	-13%	2.059	3.494	70%	3.521	3.063	-13%	2.059	3.494	70%
2022/23	3.222	2.350	-27%	3.070	2.130	-31%	4.000	3.240	-19%	2.235	3.751	68%	4.000	3.266	-18%	2.503	3.776	51%
2023/24	3.288	2.570	-22%	2.766	2.240	-19%	3.204	2.991	-7%	2.380	3.440	45%	2.678	5.121	91%	2.702	4.461	65%
2024/25	3.444	2.570	-25%	2.866	2.240	-22%	4.727	2.991	-37%	2.951	3.440	17%	3.588	5.121	43%	3.630	4.461	23%

Appendix D: Electricity Consumption per consumer category

D1: CENORED

Table D-1: CENORED Electricity Consumption per consumer category

	CENORED consumption per category (MWh)											
Year	Residential		Social		General	General-demand			Institutional		Institutional-demand	
	MWh	% of total	MWh	% of total	MWh	% of total	MWh	% of total	MWh	% of total	MWh	% of total
2013/14	45,777	30%		0%	56,691	37%	51,869	34%		0%		0%
2014/15	48,858	29%		0%	59,308	36%	57,466	35%		0%		0%
2015/15	61,900	35%		0%	58,626	33%	54,768	31%		0%		0%
2016/17	57,830	31%		0%	63,117	34%	66,288	35%		0%		0%
2017/18	61,025	32%		0%	61,712	32%	70,376	36%		0%		0%
2018/19	33,485	18%	27,937	15%	59,005	31%	32,572	17%	11,308	6%	26,140	14%
2019/20	34,130	18%	28,496	15%	59,005	31%	32,572	17%	11,308	6%	26,140	14%
2020/21	35,782	20%	27,385	16%	52,653	30%	26,863	15%	11,266	6%	20,841	12%
2021/22	36,825	21%	28,207	16%	53,461	30%	27,353	15%	11,266	6%	20,841	12%
2022/23	27,832	14%	42,872	22%	57,553	29%	33,089	17%	11,106	6%	23,004	12%
2023/24	24,986	13%	43,301	22%	58,330	30%	33,420	17%	11,217	6%	23,234	12%
2024/25	25,486	13%	44,167	22%	59,497	30%	34,088	17%	11,442	6%	23,698	12%

D2: Erongo RED

Table D-2: Erongo RED Electricity Consumption per consumer category

	Erongo RED Electricity Consumption per consumer category											
Year	Residential		Social		General		General-demand		Institutional		Institutional-demand	
	MWh	% of total	MWh	% of total	MWh	% of total	MWh	% of total	MWh	% of total	MWh	% of total
2013/14	126,792	31.77%	27,591	6.91%	57,526	14.42%	180,838	45.32%	1,376	0.34%	4,942	1.24%
2014/15	118,872	28.80%	47,784	11.58%	60,253	14.60%	179,704	43.54%	2,351	0.57%	3,742	0.91%
2015/15	111,996	26.67%	57,424	13.67%	59,957	14.28%	179,052	42.64%	2,343	0.56%	9,149	2.18%
2016/17	119,561	26.25%	73,791	16.20%	60,794	13.35%	188,646	41.41%	2,480	0.54%	10,237	2.25%
2017/18	115,207	24.82%	85,388	18.40%	59,407	12.80%	196,870	42.42%	2,281	0.49%	4,968	1.07%
2018/19	117,697	24.20%	64,365	13.23%	63,316	13.02%	232,633	47.84%	2,727	0.56%	5,585	1.15%
2019/20	135,973	28.83%	45,794	9.71%	58,798	12.47%	219,673	46.57%	2,826	0.60%	8,607	1.82%
2020/21	147,893	30.44%	37,331	7.68%	62,035	12.77%	226,456	46.60%	2,733	0.56%	9,465	1.95%
2021/22	149,077	30.81%	41,648	8.61%	58,107	12.01%	221,131	45.69%	3,092	0.64%	10,874	2.25%
2022/23	150,983	29.71%	45,332	8.92%	57,536	11.32%	240,304	47.28%	3,314	0.65%	10,739	2.11%
2023/24	148,056	30.23%	47,290	9.65%	55,083	11.25%	225,487	46.04%	3,247	0.66%	10,639	2.17%
2024/25	151,017	30.23%	48,236	9.65%	56,185	11.25%	229,997	46.04%	3,312	0.66%	10,851	2.17%

D3: NORED

Table D-3: NORED Electricity Consumption per consumer category

	NORED consumption per consumer category (MWh)											
Year	Residential		Social		General		General Demand		Institutional		Institutional Demand	
	MWh	% of total	MWh	% of total	MWh	% of total	MWh	% of total	MWh	% of total	MWh	% of total
2013/14	164,193	53.40%	-	0.00%	36,524	11.88%	106,778	34.73%		0.00%		0.00%
2014/15	193,925	55.91%	-	0.00%	31,486	9.08%	121,445	35.01%		0.00%		0.00%
2015/15	201,902	55.15%	-	0.00%	44,567	12.17%	119,631	32.68%		0.00%		0.00%
2016/17	210,990	57.13%	-	0.00%	37,107	10.05%	121,224	32.82%		0.00%		0.00%
2017/18	222,412	58.85%	-	0.00%	34,156	9.04%	121,391	32.12%		0.00%		0.00%
2018/19	226,860	58.85%	27	0.01%	34,793	9.03%	123,819	32.12%		0.00%		0.00%
2019/20	226,860	58.85%	27	0.01%	34,793	9.03%	123,819	32.12%		0.00%		0.00%
2020/21	192,044	48.82%	23	0.01%	76,782	19.52%	124,548	31.66%		0.00%		0.00%
2021/22	195,885	49.26%	23	0.01%	77,216	19.42%	124,548	31.32%		0.00%		0.00%
2022/23	199,813	47.40%	44	0.01%	59,523	14.12%	63,090	14.97%	26,075	6.19%	73,003	17.32%
2023/24	201,586	46.81%	44	0.01%	61,494	14.28%	65,179	15.13%	26,938	6.26%	75,421	17.51%
2024/25	205,026	47.02%	44	0.01%	63,465	14.55%	65,179	14.95%	26,938	6.18%	75,421	17.30%