An Analysis of the Effect of the Intermittent Supply of Electricity to Consumers in The North West Province, South Africa

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Keywords

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Abstract

Electricity is one of the contributions that has impacted the lives of everyone in the country. It is an essential part of modern technology; however, the inconsistency of electricity supply becomes a challenge to consumers and the country. It is, therefore, essential to ensure that electricity is always provided consistently in all parts of the country.

The research study specifically focused on two geographical areas of the north west province, Brits and Maboloka, and a qualitative approach was used to examine the unavailability of electricity in these two areas.

Based on the outcome of the study, the following themes emerged:

•To upgrade its infrastructure, specifically the old power stations, to improve the electricity supply.

•Consider partnering with private service providers to supplement its power supply. In so doing, Eskom should consider opening up to other players with the financial capacity to contribute to power generation.

•Provision of training to personnel to better run the entity's affairs to minimize disruptions.

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1. Introduction

In South Africa, electricity is supplied solely by the utility, Eskom. The company was founded in 1923 by a parliamentary act, namely, the Electricity Act of 1922. Eskom is a company that generates, transmits, and distributes electricity to the country and extends to other countries outside South Africa. the utility is mandated to provide sustainable electricity to stimulate economic growth to improve the quality of life of people in South Africa. However, the utilities' ability to fulfil this mandate has declined in recent years due to the intermittent electricity supply, so-called load shedding. The intermittent supply started in April 2008 and is caused by the constrained generation capacity (Integrated Report, 2015: 4).

2. The research problem

One of the biggest challenges faced in Africa is the lack of electricity (Hafner et al., 2018:1). According to Kaygusuv (2012: 1119), this acute lack of power has contributed to many problems in Africa's industrial sector. He further states that Africa has also continuously struggled to electrify rural areas, properly resulting in poor rural development. South Africa is no exception. South Africa is one of Africa's economic and industrial powerhouses; therefore, electricity should always be consistently supplied in all parts of the country (Ateba et al., 2019: 1324).

According to the Department of Economic Development, Environment, Conservation and Tourism (2012), the North West province is the 4th largest electricity-consuming province in South Africa. According to Ateba et al. (2019: 1327), the North West province consumes approximately 12% of the available electricity, mainly due to the high demand for electrical energy-intensive mining and related industrial sectors. Ateba et al.

The South African electricity infrastructure has been degrading in the past decade, with both scheduled and unscheduled power outages increasing (Winkler, 2022). Furthermore, the intermittent supply of electricity in the North West province has adverse effects on the consumers, including disruptions to their day-to-day functionalities. This leads to anger and frustration among the public and handicaps businesses in their productivity.

Based on the discussion above, this study's problem is a lack of consistent electricity supply in the North West province, affecting various society-based functionalities.

3. Research Objectives

Electricity was a key contributor during the "second industrial revolution" by the last quarter of the 19th century and the beginning of the 20th century (Ateba et al., 2019:1325). This seeks to show the importance of electricity in the development process, especially considering that this age demands a lot of energy in various sectors of the national economy.

Based on the above, the research objectives were formulated:

Primary objective:

- to determine the importance of curbing the intermittent supply of electricity to consumers.

The Secondary Objectives:

- To determine the importance of the North West province to the South African economy.
- To determine the importance of electricity supply to the economy of the North West province.
- To identify challenges faced by electricity consumers in the North West province.
- To identify measures that can be considered to alleviate the electricity problem.
- To identify alternative methods of sourcing electricity supply by consumers.

4. Literature Review

The problems of intermittent electricity supply are not unique to South Africa alone, as it is clear that a large part of Africa still experiences an erratic supply of electricity. According to Forkuoh and LI (2015: 312), the poor quality of electricity supply has been recorded as a major problem hampering the operations of Small and Medium Enterprises (SMEs) in developing countries. In recent times, access to reliable electricity supply and associated high tariffs is creeping into the top spot of SMEs in Ghana, with SMEs in the country losing over US$ 686.4 million in sales annually since the beginning of 2009 (Forkuoh & Li, 2015: 313).

According to Newberry (2002:8), the electricity supply industry is highly capital-intensive, and its success depends upon its investment management. In most developing countries, investment is managed and maintained poorly. It is, therefore, clear that the intermittent supply of electricity that bedevils most of Africa in general and parts of South Africa such as the North West province in particular, may be intertwined with the poor management of the investments in the energy sector and in most cases, corruption is often at the heart of the lack of electricity (EPA,2021).

According to Ateba et al. (2019: 1327), South Africa's industrial decline is directly associated with decreasing electricity sustainability, as the industrial sector is the main economic contributor to South Africa's GDP. It should be taken into account that electricity is at the centre of development and all technology exists on the availability of energy. Therefore, failure of a country to ensure dependable electricity supplies in the 21st century can have adverse effects on the economy.

Ahmad and Othman (2014: 155) postulate that electricity is currently the most demanded necessity in the world. The huge demand for electricity stems from the dire need for power in industries that consume a lot of energy in production. The demand for electricity in South Africa has risen sharply, and the sole power supplier, Eskom, has faced many challenges in meeting the demand. Various loopholes have been noted within the company. These have arguably led to the electricity challenges faced in South Africa, particularly in the North West province (Inglesi & Pouris, 2010:51).

According to Ebenhard (2021), Eskom, South Africa's state-owned power utility, is facing many challenges. Eskom's power stations' performance and availability has declined from above 90% in the early 2000s, to an average of 64% in the 2021 financial year (Ebenhard, 2021). The other primary challenge Eskom faces is its use of outdated coal-fired power stations. Ebenhard (2021) states that Eskom's fleet of coal-fired power stations, excluding Medupi and Kusile, are, on average, 41 years old, and these power stations have been run over capacity than international norms and have not been maintained as they should have been.

South Africa is plagued by constant load shedding due to insufficient capacity that does not meet demand (Hlongwane & Daw, 2022:1). As a result of the load shedding, some households have had to look for alternative energy sources, including fuel wood in rural areas, gas and solar panels (Chidembo, Francis & Kativhu, 2022:8). The authors further claim that it has also led to a decrease in electricity consumption as people switch to alternative energy sources (Chidembo et al., 2022:8).

Another cause of electricity shortages highlighted is the use of household appliances that consume a lot of electricity, for example, stoves, heaters and geysers (Viljoen & Struweg, 2016: 07). Against these backdrops, it is improbable that the South African energy sector will revive unless robust measures are taken within the Eskom management and the country through the encouragement of energy-saving techniques and investment in alternative energy sources (Green Carbon SA, 2008).

According to Fakih et al. (2020:1), power supply in developing countries is often characterised by unreliability and inefficiency, resulting in disruption costs for operating firms. Ineffective privatisation policies, increasing fuel costs, lack of public investment, political instability, and poor infrastructure are among the factors that cause the inadequate supply of electricity in developing countries (Um et al., 2009:23). According to Fakih et al. (2020:3), power outages generally have direct and indirect effects on the overall performance of firms, causing increases in economic costs, reductions in produced quantities and eventually decreases in sales and productivity. According to Attigah and Mayer-Tasch (2019:4), of all modern types of energy, electricity is the most undisputable category that is considered frequently in the strategic objectives of industrial growth. According to Ateba et al. (2019:1325), the electricity grid system was designed in the image of the "first industrial revolution", with the greed modelled to enable mass production and to attain economies of scale.

4.1 Historical Facts about Electricity in SA

It is paramount to trace the historical developments to understand the state and situation of the electric power supply in South Africa. It is an undeniable fact that electricity is essential for economic growth in modern countries. However, South Africa is plagued by constant load shedding due to insufficient capacity that does not meet demand (Hlongwane & Daw, 2022:1). As a result of the load shedding, some households have had to look for alternative energy sources, including fuel wood in rural areas, gas and solar panels (Chidembo, Francis & Kativhu, 2022:8).

In South Africa, municipalities took the initiative in supplying energy. In 1882, shortly after the discovery of diamonds in Kimberley, the first electric streetlights were installed in this rapidly expanding mining town (Covary 2020:14). Kimberley municipality established its reticulation service in 1890, Johannesburg in 1891, Pretoria in 1892, Cape Town in 1895, Durban in 1897, East London in 1899 and Bloemfontein in 1900 (Buraimoh et al., 2020).

According to Horwitz (1993), the electricity supply industry saw four main phases of development. The first stage was from 1906 to 1922 and had a mixture of private and public firms in the industry. After 1922, a national public organisation, the Electricity Supply Commission (Eskom), collaborated with commercial and municipal suppliers (Horwitz 1993). The third period came after 1948 when Escom monopolised energy generation and transmission by acquiring Victoria Falls and Transvaal Power Company. After a dismal performance in the fourth and final period, Eskom underwent a considerable restructuring in 1985.

The Electricity Control Board was established to control the supply of electricity by the commission and private undertakings (Department of Minerals and Energy, 2010:12). The Act stipulated that the electricity supply could not be undertaken without a licence issued by the board (Department of Minerals and Energy, 2010:12). Eskom and private undertakings were thus obliged to apply for licences, but local authorities and government departments (including the SAR&H) were once again exempted.

Until the mid-1970s, Eskom progressed successfully as the central electricity supply organisation. It enjoyed the benefits of improving technology and continued demand growth. However, towards the end of the 1970s, inflation, higher financing costs and the reduced financial returns of new technology contributed to poor performance and high tariff increases (De Villiers 1984). In 1984, the State President appointed the "Commission of Inquiry into the Supply of Electricity in the Republic of South Africa" under the leadership of Dr W. J. de Villiers in response to these concerns and the significant share of South Africa's foreign debt owing to Eskom.

4.2 Domestic Electricity Supply

South Africa has a total net generating capacity of about 37 000 MW and in 1992 produced 149 427 GWh of electricity (Wright et al., 2017:5.). The percentage of electricity use per sector during 1990/91 is illustrated in Figure 2.1.

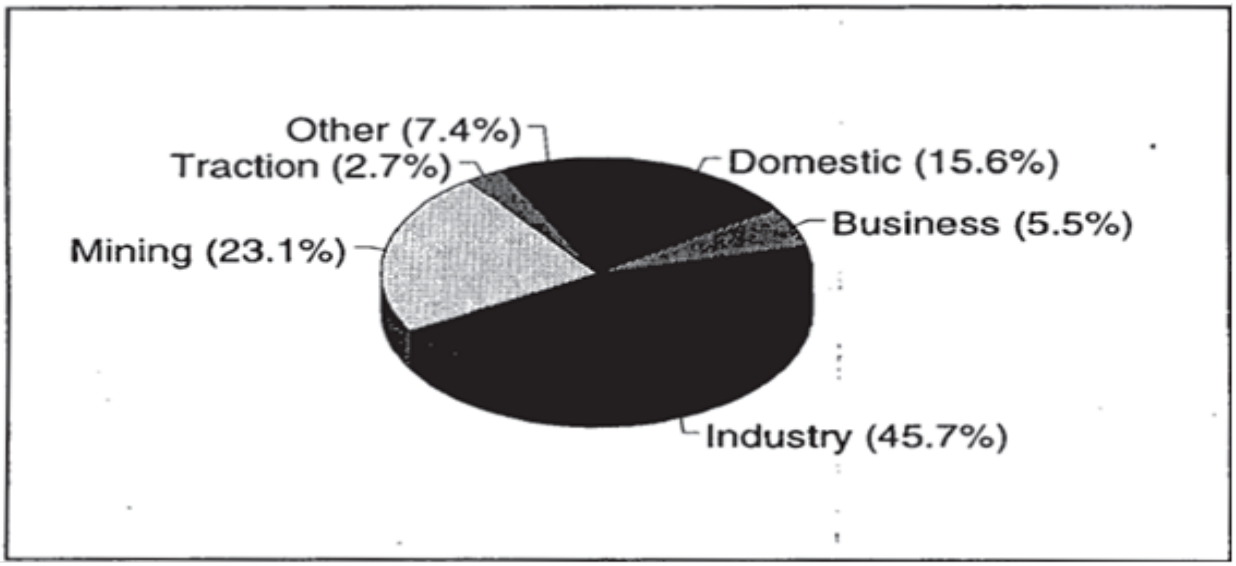


Figure 4.2.2: Electricity use in South Africa
Source: Compiled by (Wright et al., 2017:6)

The above shows that mining and industry consume just under 70 per cent of the electricity produced in South Africa, while the domestic sector consumes only 16 per cent. As a result, total annual domestic electricity consumption is in the region of 23 310 GWh.

4.3 The Present Electricity Supply Industry

South Africa has a long history of depending on the S.O.E.s. The S.O.E.s have contributed significantly to the development of the economy but have been distressed by structural and operational difficulties (Todes & Turok, 2018:6). The current electricity supply structure in South Africa is illustrated in Figure 1. Eskom has the monopoly of being the sole generator of electricity in South Africa. Figure 2 also shows that the transmission sector is under Eskom's complete control (Wright et al., 2017). The distribution sector is dominated by Eskom too, but the municipalities do some distributions. This model has been criticised for allowing too much government intervention (Wright et al., 2017).

Furthermore, when government officials are in control, they make decisions knowing they will not bear future consequences, as another ruling party would have taken over. This model has cost South Africa its new path of growth. For instance, a study by Wait (2012:6) observed that the country loses approximately 3.3-3.5% of GDP under the current electricity structure.

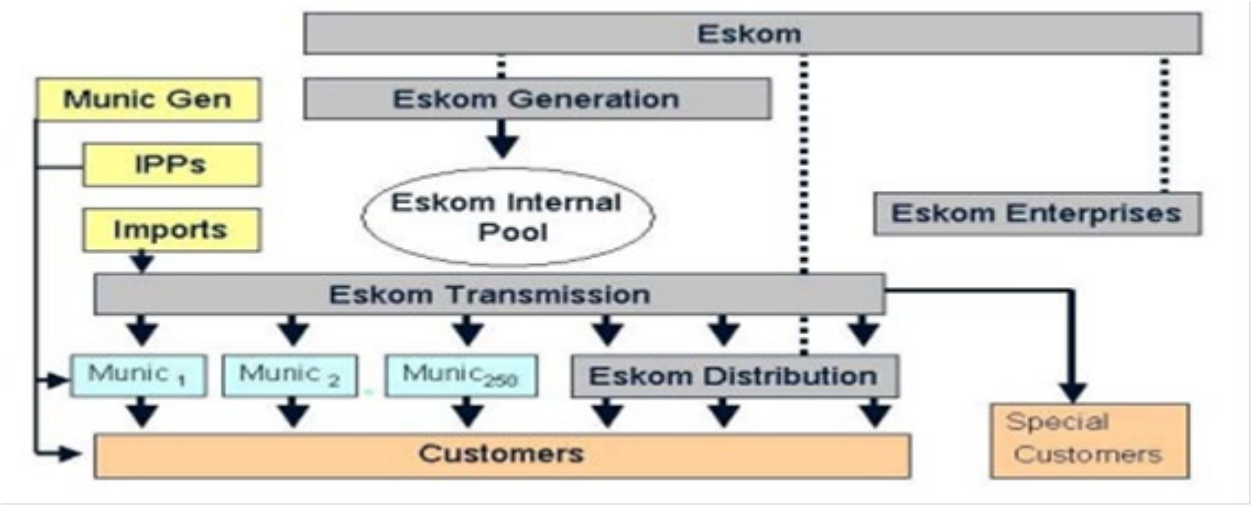


Figure 4.3.1: Current South African E.S.I. structure
Source: Hlongwane and Daw (2022)

4.3.2 Existing Industry Structure

Figure 4.3.1 shows the growth rates in the electricity supply and consumption for the period between 1981 and 2011. It can be viewed that electricity consumption has been steadily increasing throughout the period. The country has been experiencing a rise and fall in electricity generation (Figure 2). From 2006 the electricity supply showed a declining trend up to 2008, when it was very close to electricity consumption, leaving the utility with small reserves (Hlongwane & Daw, 2022:7).

The power disruptions were anticipated, but Eskom did not make adequate efforts to increase electrical supplies promptly. The implemented policies cost industrial farming (The National Energy Regulator of South Africa, 2008).

And mining consumers' production, while household consumers lost their leisure time (Matsebula, 2018). These views, therefore, raised many questions for policymakers and the public. What impact did the electricity supply and demand imbalance have on economic growth? Do electricity supply and economic growth have a long-run relationship? Between economic growth and electricity, which one supersedes the other? Has the termination of the restructuring of the electricity supply industry affected the electricity supply? What is the impact of electricity price and trade openness on electricity supply and economic growth? (World Bank, 2022:8).

4.4 The Scope for Regional Integrated Resource Planning

South African Power Pool. (SAPP) (2017) suggest that the scope for regional development and for optimising the electricity system from a regional perspective is enormous. And the creation of S.A.P.P. clearly marked an important step toward realising the benefits of such regional electricity planning. Trading arrangements between South Africa and the hydro-rich northern countries could be mutually beneficial, providing cheaper electricity for the former and revenue-boosting for the latter (S.A.P.P. 2017). According to the World Bank (2018), examples of regional cooperation would include the hydroelectric potential of

the D.R.C., Mozambique, Zambia and Zimbabwe; the Pande, Temane and Kundu fields in Mozambique and Namibia; and the oil industry and hydroelectric potential of Angola.

Recent studies utilising the optimisation model R.I.E.P. (Regional Integrated Electricity Planning) developed at the University of Stuttgart quantified the benefits of regional cooperation in Southern Africa to savings of at least US$2.2 billion or 5 per cent of the expected total costs over 20 years. Furthermore, under a high electricity demand growth scenario, savings of over US$ 4 billion could be realised through regional planning (Hlongwane & Daw, 2021:15).

Monyei (2022:159) suggests that a structural issue that might have significant implications for introducing competition in S.A.P.P. is the extent to which Eskom dominates the regional electricity market. Lawrence and Ballard (2020) noted that in 2005, Eskom accounted for 83 per cent of the installed capacity and 85 per cent of electricity sales of S.A.P.P. member countries. n South Africa, pressing domestic policy concerns about looming power shortages seem to outweigh any regionalisation initiatives far, although regional cooperation could be very effective in resolving Eskom's inadequate generation capacity (Steyn et al., 2021:4).

4.5 Electricity Policy is South Africa

The political economy of South Africa's electricity policy has been characterised by the country's minerals-energy complex (M.E.C.) (Fine, 2018), a system that is both electricity and carbon-intensive. In descriptive terms, this refers to an evolving system of production and consumption based on the country's historical dependence on cheap and abundant coal supplies and cheap labour to produce cheap electricity for an export-oriented industry based on raw and semi-processed mineral products such as coal, platinum, iron ore, steel, and aluminium. Analytically, the M.E.C. offers a framework that can be used to address the economic legacy of apartheid and the nature of power relations, politics and policy-making in contemporary South Africa (Padayachee 2010:2).

Fine (2018) explained that before 1994, energy policies were designed to provide energy services based on 'separate development', the apartheid government's euphemism for racial discrimination. High priority was given to the needs of the industrial sector because of its role in economic and political security (Gielen et al., 2019:38). In general, this meant concentrating on electricity and liquid fuels, as these were crucial to economic and political interests. Security, secrecy and control characterised most general policies (Rahman, 2017:39).

Security of the liquid fuel supply was the main driver here. At the same time, it was decided to refine crude oil locally. Up to 1954, all refined oil products had been imported and distributed by Lott (2017), but now the growing demand for liquid fuels justified the development of refineries. Liquid fuel production started at Sasol in 1954, and the Mossgas plant was built in 1992.

In 1987, some major changes took place, still significantly affecting power sector reforms today. Two key statutes were introduced: the Eskom Act of 1987 and the Electricity Act of 1987. Eskom (the Electricity Supply Commission, forerunner of Eskom) had been producing electricity for a long time, supplying the

industrial structure, including the military complex and a number of several mainly white households (Lewis, 2019).

4.6 After the 1994 Elections

The government that took office after the first democratic elections was committed to democratic governance and a new constitution. It was determined to provide essential services to the poor and disadvantaged majority of South Africans. Modern energy, especially electricity, was considered one of the main components of such services. The government focused its attention on electrification and liquid fuels (Aklin et al., 2018)

From 1992 to 1994, although a period of political uncertainty, was a time of several negotiating forums between governments, businesses, labour and opposition groups on policy-making and governance in many economic sectors, including energy. Energy and Development Research Centre (E.D.R.C.) researchers participated in several African National Congress policy committees (Ramukosi, 2018). These and other forums led to the developing of an energy section, including an electrification programme, within the ANC's Reconstruction and Development Programme (RDP). This formed the basis of all energy programmes that followed, including current programmes (Ngeva, 2019:10).

4.7 The National Electrification Programme

The National Electrification Programme was implemented between 1994 and 1999. Its objective was to electrify rural and urban low-income households that had been deprived of electricity during the apartheid period (Davidson & Mwakasonda 2004:26).

5. Research Methodology

Research methodology is a systematic approach to problem-solving. In essence, researchers use methods to describe, explain, and make predictions (Goundar, 2012:10). Research is about answering unanswered questions or creating that which does not currently exist (Goddard & Melville, 2004:1). It is the scientific study of how research should be conducted.

Research methodology attempts to answer the following questions: why a research study was conducted, how the research problem was defined, how and why the hypothesis was formulated, what data were collected and what method was used, why a particular technique of data analysis was employed, and a host of similar questions (Goundar, 2012:13).

5.1 The research philosophy

This research seeks to bring empirical evidence about the challenges faced by people in the North West province due to the intermittent electricity supply. There are various research philosophies, including pragmatism, positivism, realism and interpretivism. research philosophy is associated with the study's assumption, knowledge and nature, and it deals with a specific way of developing knowledge. This matter

needs to be addressed because researchers may have different assumptions about the nature of truth and knowledge in philosophy helps us about the nature of truth and knowledge and philosophy helps us to understand their assumptions (Carnaghan, 2013).

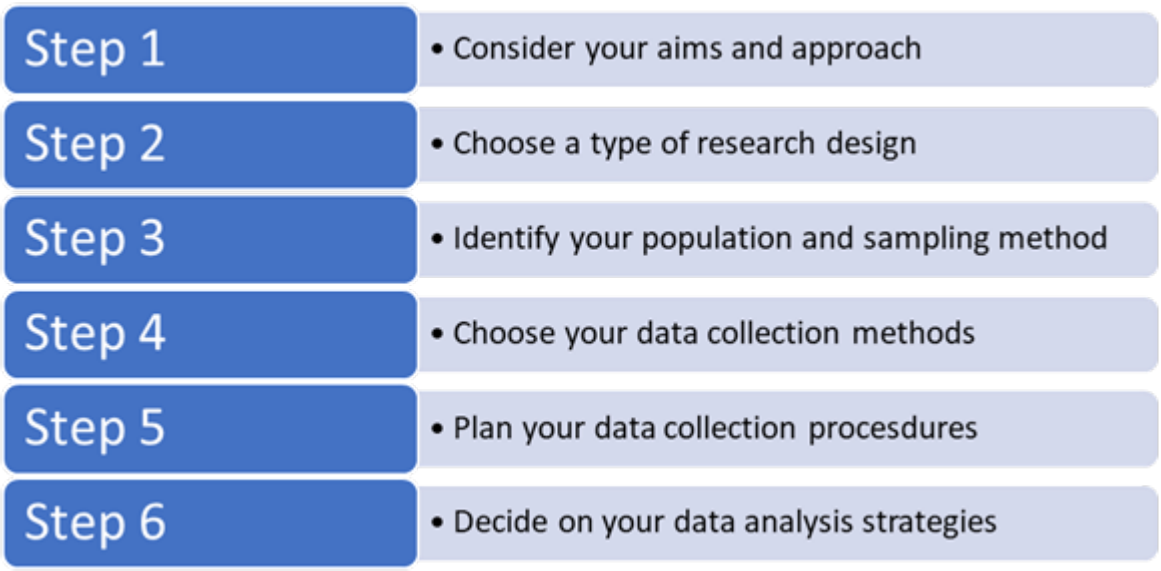
5.2 Research design.

Several research designs work well with a quantitative type of research. These include the following:

- Experimental
- Quasi-experimental
- Descriptive
- Correlational

There are six research design steps to follow when conducting research. Table illustrates the research design steps below.

Research design methods



Source: Bhandari & McCombes (2021)

However, this research will adopt the descriptive research design, which, according to Bhandari (2021), will allow the researcher to describe characteristics, averages and trends, among other things and permit the researcher to measure variables without influencing them.

5.3 Research Approach

Quantitative, qualitative, and mixed methodologies are the standard research approaches. Typically, researchers use the quantitative technique to address research issues requiring numerical data, the qualitative approach to address research questions requiring textual data, and the mixed methodologies approach to address research problems requiring both numerical and textual data (Williams, 2007:65).

In this study, we convened with a quantitative research methodology. Leedy and Ormrod (2001) argued that quantitative research is specific in its surveys and experiments because it draws on previously established hypotheses. “Quantitative researchers seek answers and predictions applicable to other people and locations. The purpose is to establish, confirm, or validate correlations and build generalisations that add to theory.” (Leedy & Ormrod, 2001:102).

5.4 Sampling and Target Population

A sampling at random is a standard practice in quantitative research. This refers to methods that give each member of the population a fair shot at being included in the final data set. Due to the nature of quantitative research, this is crucial if the results are to be generalised from the sample to the overall population (Saunders et al., 2012:135).

The population in the Brits geographic area in the North West province will be the one that will be the focus of this investigation. This specific group can serve as a representative example for the greater North West province. The targeted population was 169, and the surveys were distributed to 250 respondents throughout the Brits and Maboloka geographical areas through online platforms and site visits to residential areas and shopping centres.

5.5 Sampling Size

A representative portion of a given population is known as a sample. According to McCombes (2022), when one researches a group of people, it is rarely possible to collect data from every person in that group. As a result, one must select a sample, and this sample is the group of individuals that will participate in the research.

This study used a convenience sample constructed as follows: The estimated population is 96,226 (65,113 + 31,113), as was previously mentioned. The same percentage of the entire population corresponds to 67%, rather than 33% if a confidence level of 95% and a margin of error (accuracy) of 0.05% is used. We represented urban communities with 43626 potential respondents and rural communities with 10267 potential respondents, respectively. The total size of the sample was calculated to be 383 according to the methodology of scientific sampling. As a result, the urban sample equals 257 sample respondents, while the rural sample equals 126 sample respondents. Both samples are representative of the chosen geographic area. The survey was distributed to 250 participants; only 132 were received back for analysis.

5.6 Pilot Study

A pilot study was executed to ensure that the people answering the questions have a firm grasp of the technicalities involved, especially concerning terminology and units of measurement (Sekaran, 2000:248). In this study, a pre-set self-administered survey questionnaire was developed and designed to ensure that respondents could understand the questions. The pilot study revealed that the survey questionnaire was quick, convenient, and easy to follow. It took the respondents about 2 to 5 minutes to complete. However,

the 5-point Likert scale had to be amended to begin with “Strongly agree” to “Strongly disagree” as opposed to beginning with “Strongly disagree” to Strongly agree” to create a flow throughout all the questions.

6. Data Collection

Data collection can refer to the various methods used in the data collection process, including, among other things, open-ended surveys, online analytic tools, interviews and observational data collection. In this study, a questionnaire was used as a tool to collect the data. This research will make use of questionnaires to come up with a comprehensive study.

The questionnaire contained six sections; Section A will be demographic information. Sections B, C and D, had statements to be measured using a Likert scale of 1 to 5, from strongly disagree (1), disagree (2), Neutral (3), Agree (4) and strongly agree (5). Section A with demographic information to determine the sexual identity, age, home language and classification of area classification between urban and rural. Section B will contain statements to assess the impact of the North West province on the South African economy. Section C had statements to evaluate the challenges faced by electricity consumers in the North West province. Section E contained open-ended questions to identify measures taken to alleviate consumers’ unavailability of electricity supply. Lastly, Section F contained open-ended questions to discover the consumers’ alternative survival methods during the unavailability of electricity supply.

6.1 Data Analyses

Statistical analysis will be done through the SPSS Statistics 28 program to help ensure high-quality accuracy and quality decision-making. Open-ended (qualitative questions were analysed using thematic analysis, where applicable themes will be identified).

The data analysis for section A was descriptive, sections B, C and D contained quantitative statements measured with Likert scales, will apply a factor analysis, and sections E and F will be based on qualitative thematic analysis as indicated.

6.2 Reliability and Validity

The reliability of scales used in empirical research is assessed using a variety of methodologies. The techniques that are used are the most common among these are internal consistency tests, alternate forms, and test-retest reliability. There are three techniques to apply internal consistency tests (split-half, item-total correlations, and alpha reliability coefficient). The study results for Cronbach alpha coefficient values for the factors are tabled below in Table 3.2.

6.2.1 The reliability of the constructs

Construct	Number of Items	Cronbach Alpha
Factor 1	3	0,885
Factor 2	3	0,763
Factor 3	2	0,721
Factor 4	3	-0,320

Based on the results in Table factors 1,2 and 3 indicate good to adequate reliability scores. This means that the study conducted is repeatable should the need for further research arise.

7. Findings and Results

Data were collected through structured questionnaires. According to Hussey and Hussey (1997:162), a questionnaire is a cheaper method of collecting data as it is not time-consuming compared to other methods. An online questionnaire was created using google forms and distributed to two hundred and fifty (250) respondents. The questionnaires were sent through emails and circulation through social media platforms to the residents of Brits and Maboloka in the North West province. Respondents were requested to complete the questionnaires and submit them within a specified time. The questionnaire consisted of closed and open-ended questions.

7.1 Response Rate

The questionnaires were distributed to 250 participants; the researcher received responses from 132 completed online surveys. The study obtained a 52.8% of response rate.

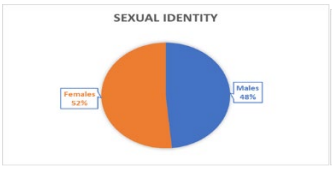
7.2 Analyses and Interpretation of Results

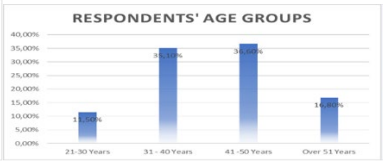
The researcher exported the responses to Microsoft Excel computer software for easy analysis.

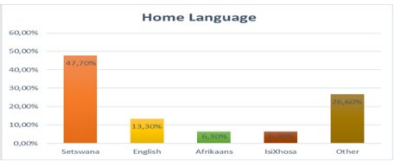
In the following section, analysed data will be presented and interpreted.

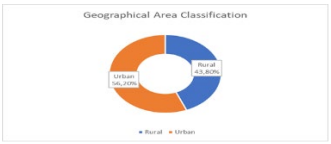
a. Demographic Profile

Figures reflect the "sexual identity" of respondents, as follows:









7.3.1 sexual identity

The survey participants comprised 52% females and 48% males.

7.3.2 Respondents' age groups

Participated respondents are representative off all indicated age groups. 11% of respondents between 21-30 years old. Between the age of 31-50 represented almost 72% of respondents. A relatively small group (17%) was older than 51 years.

7.3.3 Respondent's home language

The results show respondents with Setswana (48%) as their home language. English, Afrikaans and IsiXhosa cumulatively represent 25% of all respondents. Notably, almost 27% of respondents represent the "other" category.

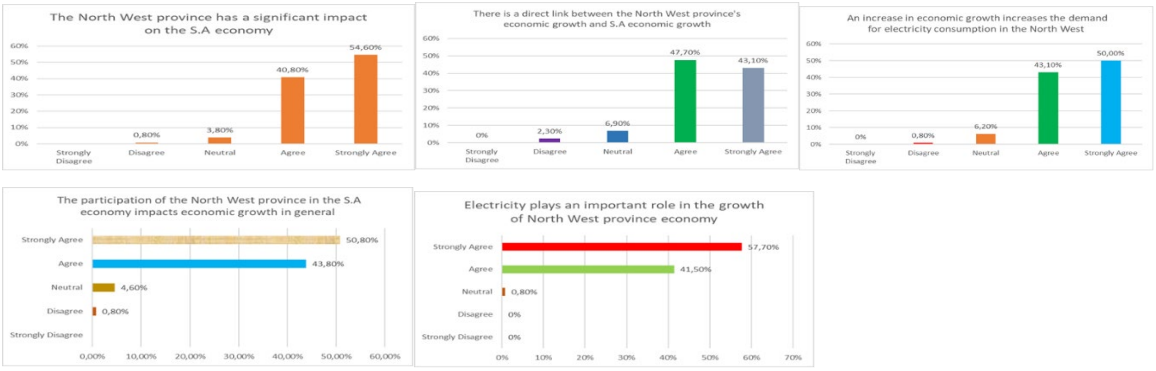
This finding resonates with the outcome of the pilot study, where pilot respondents indicate that it will be beneficial if the questionnaire is presented in Setswana as a communicating language.

7.3.4 Geographical area classification

In response to the posed question regarding their location – 56% indicated an urban location, while the rest (44%) confirmed the rural area.

8. Impact on the South African economy

In this section the impact on the SA economy will be discussed. Respondents were asked whether the North West province is seen to have a substantial contribution to the South African economy.



As reflected in the above Figure 95,40% of the respondents strongly agreed and agreed. In comparison, 3.8% were neutral to the statement that the North West province significantly impacts the South African economy. On the other hand, only 0.8% of the respondents disagreed with the proposed statement. Therefore, North West province has been deemed a significant contributor to the South African economy based on the outcome.

The responses to this question confirm the assertion mentioned. Findings agree that the North West province's participation positively impacts economic growth. Overall, 84.60% of respondents strongly agreed or agreed. Some 5% of respondents were neutral, whereas 0.80% disagreed. Therefore, North West province is believed to substantially impact the country's economic growth based on its performance.

As represented in below Figure, respondents agreed there was a direct correlation between the province's economic development and the nation.

The results represent 90,80% of the respondents strongly agree and agree that there is a direct link between the South African economy and North West province. However, 2.3% of the respondents disagree with the statement, and 6.9% remain neutral.

Based on the results represent, the respondents, 99,2%, strongly agree and agree that electricity plays an important role in the North West province's economic growth. Only 0.8% remained neutral about the statement.

Figure confirms that an increase in economic growth increases the demand for electricity consumption in the North West province.

Based on the results, 93.1% of the respondents strongly agree and agree that economic growth also increases the demand for electricity consumption. The rest of the respondents, 6.2%, remained neutral about the statement, while 0.8% disagreed. There is a direct relationship between the economic development of the province and that of the country. An increase in the nation's economic growth, therefore, also increases electricity consumption.

9. Exploratory factor analysis

Exploratory factor analysis is used to identify the structure of the relationship between the variable and the respondent.

Table 9.1: Rotation Component Matrix

	Factors			
	1	**2**	**3**	**4**
B2- The participation of the North West province in the South African economy impacts economic growth in general.	.913			
B3- There is a direct link between the North West province's economic growth and South African economic growth.	.853			
B1- The North West province has a significant impact on the South African economy.	.829			
D8- Intermittent supply causes losses and damages to our day-to-day livelihood.		.872		
D9- Intermittent supply imposes a threat on our jobs or small businesses.		.870		
D10- The unavailability of electricity supply promotes theft activities in society.		.594		
C5- An increase in economic growth increases the demand for electricity consumption in the North West province.			.777	
C4- Electricity plays an important role in the growth of the North West province's economy.			.755	
C6- The intermittent supply of electricity does not have a direct impact on the North West economy.				.729
D11- Lack of electricity affects skills development in rural and urban areas.				-.660
D7- Power failures do not have a negative impact on our day-to-day livelihood.				.488

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 7 iterations.

The rotated factor matrix extracted four factors from the data. This study used three methods to determine if four are the correct number of factors to retain for the rotation component matrix. Firstly, as per the Kaiser criterion, a factor's eigenvalue should exceed 1; secondly, the scree plot needs to show a point of inflexion; and thirdly, the Parallel Analysis engine. Patil *et al*.'s (2008) research indicates that factors can only be retained if both conditions are met. The conditions are:

1. the eigenvalue is greater than one, and
2. the eigenvalue is also greater than the randomised eigenvalue calculated by the Parallel Analysis software.

The results show that all four factors' eigenvalues are larger than one. These eigenvalues, as required, also exceed the PA eigenvalue. Lastly, the scree plot (Figure 4.4) indicates that either three or four factors can be retained (see the inflexion points in the figure). Given the evidence and the additional variance explained (11.82%) by the fourth factor, this study retains all four factors for interpretation.

Table 9.2: Variance explained and the Eigen Values

	Initial Eigenvalues			**Rotation Sums of Squared Loadings**		
Component	**Total**	**% of variance**	**Cumulative %**	**Total**	**% of variance**	**Cumulative %**
1	3.484	31.668	31.668	2.598	23.618	23.618
2	1.944	17.673	49.342	1.983	18.030	41.648
3	1.141	10.372	59.714	1.761	16.006	57.653
4	1.074	9.760	69.474	1.300	11.820	69.474

The results in Table 9.3 show that all four factors have eigenvalues higher than one. According to this measure, all four factors should be retained.

Table 9.3: The Parallel Analysis engine test

Component or Factor	**Mean PA Eigenvalue**	**Percentile Eigenvalue**
1	1.563068	2.598
2	1.393827	1.983
3	1.259675	1.761
4	1.154745	1.300

Table 9.3 indicates that the eigenvalues are larger than the randomised eigenvalues calculated by the Parallel Analysis engine. This test confirms that all four extracted factors should be retained for analysis.

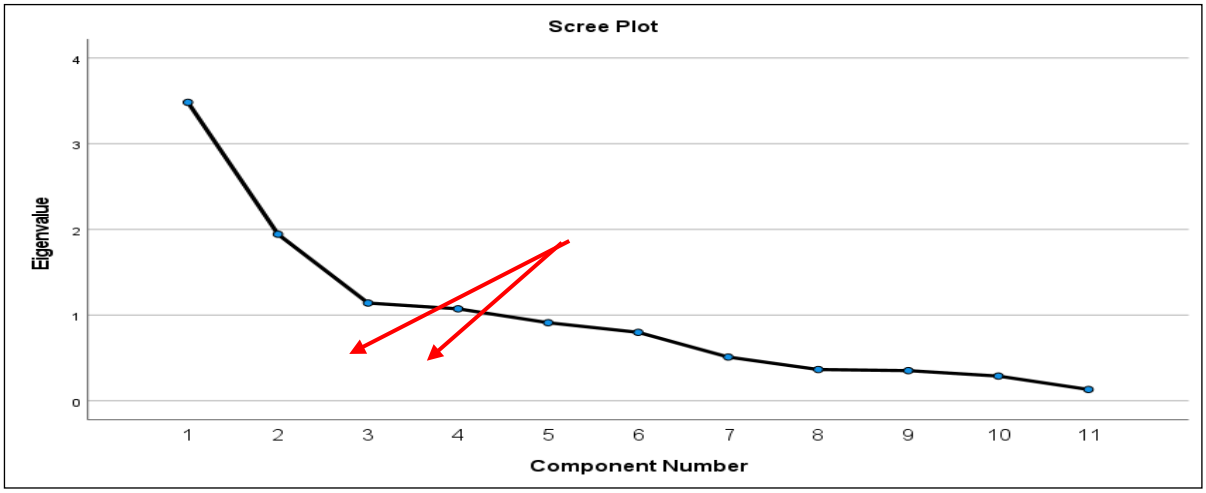


Figure 9.3.1: Point of inflexion

There are two points of inflexion on the above figure. They are at Factor 3 and Factor 4. This suggests that either three or four factors could be retained for analysis. Therefore, in support of the evidence of the eigenvalues larger than one and the Parallel Analysis engine, this study retains four factors for analysis.

Factor identification and description of the empirical study

The four factors explain a cumulative variance of 63.47%. This is very satisfactory because Field (2017) explains that a cumulative variance above 50% is satisfactory. Cumulative variance above 60% is regarded as very satisfactory, even excellent, because it provides "a good fit to the data". The individual factors are discussed next.

Factor 1: Economic factor

Three statements represent the economic factor one: B2, B3 and B1. All three statements represent a factor loading of above 0.80. The statements deal with the impact of the economic growth in the North West province and South Africa in general and how these connect. This factor explains 23.68% of the variance and is the most important factor. The factor explains 16.00% of the variance. The factor is reliable as per Cronbach alpha's coefficient (α=.885).

Stern *et al.* (2019:6) suggest that increases in energy availability and energy-enhancing technology have had a much greater impact on economic growth than they do today in developed economies. The author further states that energy is a crucial ingredient of production, and continual energy supplies are required to maintain current economic activity levels as well as grow and develop the economy. This suggests that the participants are in agreement with the statement that economic growth does make an impact on the South African economy.

Factor 2: Social factor

Statements D8, D9 and D10, are all loaded under factor two; statements D8 and D9 both resulted above 0,80, and D10 is above 0,50, representing how the intermittent electricity supply affects social livelihoods

in general. The negative impact associated may cause major damage to jobs and small businesses. The factor explains the 18.03% variance. The factor is reliable as per Cronbach alpha's coefficient (α=.763).

According to Umar & Kunda-Wamuwi, (2019:28), the unavailability of electricity has caused damage to the daily lives and operations of households and small companies, respectively. The results suggest that the intermittent electricity supply may threaten people's jobs and small businesses. During the eight-hour daily load shedding periods, residents have resorted to utilising charcoal, candles, and in some cases, portable diesel generators to supplement their energy needs. The author further states that this has increased the strain on women, who must transport water outside their homes when the water supply is disrupted by load shedding. Generally, load shedding is also related to interruptions in the water supply for houses having municipal piped water connections.

Factor 3: Electricity consumption demand

Only two statements were loaded on factor three: C5 and C4, and both statements recorded results above 0,70. These statements represent the economy's increase, which will subsequently affect the electricity consumption demand. The factor explains 16.00% of the variance. The factor is reliable as per Cronbach alpha's coefficient (α=.721).

According to Umar & Kunda-Wamuwi, (2019:20), every economy requires a reliable and uninterrupted supply of electrical energy. As economies grow, demand for electrical energy increases with populations, industrialisation, and affluence. Consequently, the rising demand for electrical energy exceeds the supply, resulting in power interruptions and rationing, a phenomenon widely known as load shedding (Umar & Kunda-Wamuwi, 2019:20).

Factor 4: Developmental factor

Three statements are loaded on factor four: C6, D7 and D11. The statements recorded a result of above 0,70 on C6, D7 was 0.488, and D11 recorded a negative outcome of -0.666, which is not significant for future study. However, all the statements represented how the unavailability of electricity may affect the development of human lives. The factor explains 11.82% of the variance. The factor is not reliable as per the Cronbach alpha coefficient. This unreliability can be ascribed to Statement D11's negative factor loading of -.660 (Field, 2017). In practice, this means that although the factor remains important to this study, future comparative studies may not identify the same factor again if Statement D11 is not inverted in future questionnaires.

9.4 Pearson correlation coefficient

Table 9.4.1: Factor correlations

		FACTOR1	FACTOR2	FACTOR3	FACTOR4
FACTOR1	Pearson Correlation	1	**.186***	**.452****	-.028
FACTOR2	Pearson Correlation	**.186***	1	**.298****	.023
FACTOR3	Pearson Correlation	**.452****	**.298****	1	.011
FACTOR4	Pearson Correlation	-.028	.023	.011	1

***. Correlation is significant at the 0.05 level (2-tailed).**

****. Correlation is significant at the 0.01 level (2-tailed).**

The correlational analysis showed that there is a significant weak positive relationship between Factors 2 and 3 ($r=0.298$; $p\leq0.10$) and a significant medium positive correlation between Factors 1 and 3 ($r=0.452$; $p\leq0.10$). However, there are no significant correlations between the factors and the demographic data or between the demographic variables and the other measuring criteria.

9.5 Thematic Analysis of Open-Ended Questions

Respondents were invited to suggest whether something could be done to alleviate the challenge of intermittent electricity, and 52% of the participants suggested that an alternative energy source was necessary. Specifically, respondents indicated the installation of solar systems. About 30% of the respondents suggested that significant infrastructural upgrades should be performed to alleviate the problem. However, some participants believed there could be an absence of skills which may be alleviated by providing relevant training. The issues of policing to minimise illegal connections and efficient collection of debts were also highlighted.

In this section, the open-ended questions were analysed and the themes for each question are briefly discussed.

Question: - Is there anything that can be done in the interim to alleviate the problem?

Emerged theme: Alternative energy

Alternative energy refers to sources other than fossil fuels (such as coal, petroleum, and diesel). It encompasses all forms of renewable and nuclear energy (Schlager & Weisblatt, 2006:5). The respondents are recommending alternative energy as a solution to alleviate the inconsistent supply of electricity.

Question: - What would you suggest should be the solution to alleviate the problem?

Emerged theme: Skilled Personnel

According to Iredale (1999:90), skilled or highly skilled workers are defined usually as having university degrees or extensive experience in a given field. It includes highly skilled specialists, independent executives and senior managers, specialised technicians or tradespeople, investors, physicians and sub-contract workers. The respondents suggested that the utility should employ skilled personnel to improve consistency in the electricity supply.

In the next open-ended question, respondents were asked how they survive without electricity. Please also indicate alternative methods for generating "power to which some indicated the following:

- Gas stoves for cooking.
- Generators for lighting and plugs.
- Coal stove for cooking.
- Paraffin stove for cooking.
- Inverters back up lighting and plugs.
- Solar backup for lighting and plugs.
- LED lights for lighting.
- Candles for lighting.
- Firewood/charcoal for cooking.

According to the discussion with responders, it is quite difficult for many households to live without electricity. While it is possible to seek out alternatives to the lack of electricity, some of these alternatives may be harmful or incapable of doing everything respondents could do with electricity.

9.6 Conclusion

Electricity is a crucial economic driver and facilitates human existence. This chapter highlighted the significance of electricity in the North West province and South Africa. The communities were affected by numerous elements, including economic factors, social factors, developmental factors, and electricity demand. These reflected the communities' perspectives on the difficulties posed by intermittent electricity. In light of these findings, it is necessary to investigate other energy sources to supplement electricity. The findings, recommendations, and conclusion are reported in the next chapter.

KEY FINDINGS FROM THE SECONDARY OBJECTIVES OF THE STUDY

Objective 1: To determine the importance of the North West province to the South African economy.

The study's first objective was to determine the importance of the North West province's participation in the South African economy. Figure 4.5 indicated that more than 95% of respondents agreed that the North West province's participation favourably impacted South Africa's economic progress.

Objective 2: To determine the importance of electricity supply to the economy of the North West province.

Over 95% of respondents stated that electricity plays a significant role in the economic development of the North West province; refer to Figure 4.8 for the demonstrated results. Objective 2 of the study has been achieved to determine the importance of electricity in the North West province.

Objective 3: To identify challenges that electricity consumers face in the North West province.

More than 92% of respondents disagreed that power outages have no negative influence on the health of communities, refer to Figure 4.11. As per Figure 4.12, 95% of respondents believed that inconsistent electricity supply causes losses and damages to social lives.

Objective 4: To identify measures that can be considered to alleviate the electricity problem.

More than 50% of respondents to a survey about the future of electricity in the North West believed that an alternate energy source is required. Furthermore, approximately 30% of respondents recommended that considerable infrastructure enhancements should be implemented to resolve the issue.

Objective 5: To identify alternative methods of consumer sourcing electricity supply.

Respondents were asked how they manage the inconsistent electrical supply, to which some responded as follows: Gas stoves used for cooking; Generators for electricity; Cooking stove fuelled by coal • Inverters provide backup power for lighting and outlets.

Key Findings from The Primary Study

The purpose of the study was to analyse the effect of intermittent electricity supply on consumers living in both urban and rural areas. The survey was conducted on 52% of females and 48% of males of age groups above 21 years. The survey was conducted in Brits in the North West province of South Africa.

Overall Study Conclusion

The purpose of the study was to analyse the effect of intermittent supply of electricity on the residents, the economy and livelihood. The electricity outages have had some negative impacts on the standards of living. The study established that national and provincial governments must explore alternative energy sources in light of ongoing and unsustainable situations that devastate economic growth and livelihood. The situation is terrible, and residents have been downgraded to using unhealthy alternative energy sources, such as coal

and paraffin, which may negatively impact human health. The study concluded that the national and provincial governments have a role in alleviating the challenge.

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