Mitigation of financial losses from small-scale embedded electricity generation in Drakenstein Municipality

By

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Declaration

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the authorship owner thereof (unless to the extent explicitly otherwise stated) and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

Date: December 2021

Abstract

South Africa has seen an increase in interest in alternative clean energy in recent years from higher-end electricity consumers, mainly due to environmental concerns, the load capacity of the country's electricity generator and also the decreasing cost of alternative electricity especially rooftop photovoltaic systems. Drakenstein Municipality implemented a mixed generation tariff in the 2015/2016 financial year that gave consumers the choice and opportunity to generate their own electricity and feed it into the municipal electricity grid for a consumption credit. This study attempts to find an alternative tariff structure to lessen the potential financial losses associated with the rapid uptake of Small-Scale Embedded Generation (SSEG) through roof Photovoltaic (PV) systems in Drakenstein Municipality.

The objective of the study is to determine: (1) the basis of the current mixed distribution tariff structure of the municipality, (2) determine the level of cross-subsidisation of lifeline electricity consumers and (3) ultimately devise and propose an alternative tariff structure that will lessen financial losses for the municipality. However, in order to fully understand the phenomenon of mixed electricity distribution, the relevant literature and legislation related to the topic will be explored as the non- empirical component of the study.

The secondary data sets of the municipality that is related to electricity purchases and sales were analysed to determine the core drivers and assumptions of the current electricity mixed distribution tariff of the municipality. The results of the analysed data were supplemented with interviews with relevant experts within Drakenstein municipality to enable the proper interpretation of analysed data. The results that were obtained from the analysed data were interpreted and used to determine if the municipality's tariffs are able to mitigate the future possibilities of revenue losses.

The conclusion made is that the municipality has with their tariff changes in the 2019/2020 financial year decreased the future financial losses that could have resulted from the introduction of Small-Scale Embedded Electricity Generation (SSEG).

Opsomming

Suid-Afrika het die afgelope paar jaar 'n toename in belangstelling in alternatiewe skoon energie gesien by hoërverbruikers van elektrisiteit, hoofsaaklik as gevolg van omgewingsprobleme, die laaivermoë van die land se elektrisiteitsopwekker en ook die dalende koste van alternatiewe elektrisiteit, veral dak fotovoltaïese stelsels . Drakenstein-munisipaliteit het 'n gemengde opwekkingstarief in die boekjaar 2015/2016 geïmplementeer, wat verbruikers die keuse en geleentheid gegee het om eie elektrisiteit op te wek en in die munisipale elektrisiteitsnet in te voer vir 'n verbruikskrediet. Hierdie studie poog om 'n alternatiewe tariefstruktuur te vind om die potensiële finansiële verliese wat verband hou met die vinnige opname van Kleinskaalse Ingebedde Opwekking (SSEG) deur dak Fotovoltaïese (PV) stelsels in die Drakenstein-munisipaliteit te vind.

Die doel van die studie is om (1) die basis van die huidige gemengde verspreidingstariefstruktuur van die munisipaliteit te bepaal, (2) die vlak van kruissubsidiëring van lewenslyn-elektrisiteitsverbruikers te bepaal en (3) uiteindelik 'n alternatiewe tariefstruktuur te ontwerp en voor te stel wat finansiële verliese vir die munisipaliteit sal verminder. Om die verskynsel van gemengde elektrisiteitsverspreiding ten volle te begryp, sal die relevante literatuur en wetgewing wat met die onderwerp verband hou, egter as die nie-empiriese komponent van die studie ondersoek word.

Die sekondêre datastelle van die munisipaliteit wat verband hou met die aankoop en verkope van elektrisiteit is ontleed om die kerndrywers en aannames van die huidige elektrisiteitsgemengde verspreidingstarief van die munisipaliteit te bepaal. Die resultate van die geontlede data is aangevul met onderhoude met relevante kundiges in die Drakenstein-munisipaliteit om die ontlede data behoorlik te interpreteer. Die resultate verkry uit die ontleding van data is geïnterpreteer en gebruik om vas te stel of die munisipaliteit se tariewe die toekomstige moontlikhede van inkomsteverlies kan versag.

Die gevolgtrekking gemaaak was dat die munisipaliteit met die tariefveranderings gemaak in die boekjaar 2019/2020 die toekomstige finansiële verliese as gevolg van die bekendstelling van Kleinskaalse Ingebedde Opwekking (SSEG) verminder het .

List of Abbreviations

AFS	-	Annual Financial Statements
Amp	-	Ampere
ERA	-	Electricity Regulation Act, No. 4 of 2006
kVA	-	Kilovolt-ampere
kWh	-	Kilowatt hour
MVA	-	Mega Volt Amp
NERSA	-	National Electricity Regulator of South Africa
NMD	-	Notified Maximum Demand
TOU	-	Time of Use
SSEG	-	Small-Scale Embedded Generation

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CHAPTER 1

1 STATEMENT OF RESEARCH PROBLEM

1.1 Background and rationale

1.1.1 Background

Drakenstein Municipality manages an operational budget of R 2.1 billion per financial year (Drakenstein AFS, 2018:8). The municipality receive most of its income from service charges (refuse removal, sanit0ation, water and electricity) and a small amount from the levying of property tax. The sale of electricity is the biggest income generator from the mentioned sources and the municipality relies heavily on this source of income to fund its other operational programs.

The municipality provides electricity to approximately 51,233 consumers in its municipal jurisdiction, where it supplies all the meters to the consumers in the municipal area through a standard fee structure. The electricity revenue component currently represents 51.4% of the total municipal revenue (Drakenstein AFS, 2020:80).

Due to the fact that electricity is becoming more expensive, the 2008-2009 load shedding crisis and growing environmental concerns regarding fossil fuel generated electricity, consumers are becoming more interested in the generation of green electricity. This interest in green energy has changed how people look at the electricity supply service. The supply of electricity around the world is also being re-shaped. (South African-German Partnership, 2017:8). The re-occurrence of the load shedding in 2020 due to capacity problems and the ongoing financial problems of Eskom, has further exasperated the need for an alternative to the traditional coal-fired energy. These domestic and international changes pose a huge challenge for South Africa whose electricity generation is predominantly coal-fired and centralised at Eskom. Currently South Africa has a PV capacity of 94 MW of which 18 MW is installed in the Western Cape (Solar PV, 2017:1).

In order to accommodate these changes, the municipality developed guidelines for embedded electricity generation and enabled consumers to install green energy generation systems in their businesses and households. The climatic conditions of the area have made the installation of rooftop PV systems the preferred option and this type of green installations have increased in the past few years (WWF, 2015:16).

The introduction of the guidelines for embedded electricity generation resulted in the implementation of an experimental “Co-generation tariff” in the 2015/2016 financial year. The experimental tariff was implemented so that consumers with the installed PV generation facilities could generate electricity for their own use and to feed the rest of the electricity back into the municipal grid. The basis of the tariff stemmed from the principle of compensating the consumer for the generated electricity. The introduction of this co-generation principle has an effect on the funding model of the municipal budget where the municipality no longer control a certain part of the income. At the start of the tariff in 2015/2016, the municipality adopted a feed-in tariff structure that was more favourable than the tariffs that the municipality paid to Eskom on the time-of-use principle.

1.1.2 **Rationale**

The researcher decided to do research since I am interested to find out what measures could be put into place to minimise loss of income associated with the installation of small-scale embedded electricity generation through rooftop photovoltaic (PV) systems. There is a visible gap that is related to the tariff structures of mixed electricity distribution networks and its possible impact on the financial positions of municipalities. This study aims to fill this gap by identifying possible tariff structures, cross-subsidisation or business models that can make renewable energy models, such as rooftop PV systems more favourable to municipalities. I chose Drakenstein Municipality because it is my current employer and is also my place of birth and residence.

1.2 Problem statement

The decreasing investment costs of PV systems, has resulted in a growing assumption and expectancy that electricity consumers on the high-end of the municipal grid will move towards small-scale embedded generation on a more rapid scale than previously anticipated (Janisch, Euston-Brown and Borchers, 2012:3). This is mostly expected in areas where the climatic conditions are favourable for PV systems.

Financial models of municipalities rely a lot on the income from the sale of electricity, and the expansion into the small-scale embedded generation of electricity through the installation of PV systems has an effect on this model. Janisch et al (2012:1), state that the income that is generated from the electricity service is closely linked to the financial sustainability of municipalities. Drakenstein Municipality has created the opportunity for consumers to generate their own electricity through PV systems and has devised a tariff structure and policy for SSEG in order to avoid the illegal generation of electricity.

This tariff structure is based on the business as usual approach for tariff structuring. The financial yields whether it being losses or gains that are related to the mixed distribution model has not been quantified to determine the further impact on the business model of the municipality if mixed electricity generation is expanded.

This gap is also evident in the literature where an extreme case approach relating to rapid expansion of SSEG has been used to determine the potential financial loss related to mixed distribution models (Korsten, 2016:56). Korsten also states that local municipalities need to move to sustainable models in order for mixed distribution models to be more feasible. The devising of alternative tariff structures for mixed electricity distribution becomes a key factor in the electricity domain.

1.3 Research question

How will the rapid uptake of Small-Scale Embedded Electricity Generation (SSEG) affect the income generation capacity and cross-subsidisation models of municipalities?

1.4 Research objectives

This study aims to achieve the following objectives:

1.4.1 Examine the distribution of electricity and tariff setting.

1.4.2 Determine the basis of the current co-generation tariff of the municipality and the current tariff modelling in Drakenstein Municipality.

1.4.3 Determine the legislative and policy rules that relates to electricity distribution in South Africa.

1.4.4 Propose a tariff or business model that will decrease the risks of income loss for the municipality and that will enable a cross-subsidisation model that will benefit the lifeline consumers of the municipality.

1.5 Theoretical framework

The theoretical groundwork that underlies this study is derived from the Financial Management principles of cost recovery in the setting of tariff models with specific reference to the electricity service. The Sustainable Development theories that relates to renewable energy has a potential effect on the municipal electricity service that can distort the current tariff modelling cost recovery principles.

The guidelines for electricity price-setting in South Africa is based on the principles captured in the Electricity Pricing Policy (EPP) of 2008 (Amra,2013:2). One of the main principles encouraged by the EPP is cost recovery in the setting of tariffs for electricity. The introduction of PV systems within the municipal grids has the potential of affecting these cost recovery principles.

The municipal financial planning and budgeting framework requires municipalities to prepare Medium Term Expenditure and Revenue Frameworks (MTREF) that are based on realistically anticipated sources that will enable the municipalities to reach their service delivery goals (Fourie & Opperman, 2015:140).

These realistically anticipated sources mainly relate to the capacities of the municipalities to generate income from the charges for refuse removal, sanitation, water and electricity provision and taxes such as property rates.

The majority of the municipal income comes from these service charges that can be broken down into metered services such as charges for water and electricity and unmetered services such as charges for refuse removal and sanitation. Fourie & Opperman (2015: 216) view the metered services as somewhat unstable since they depend on how much the consumers use, while the unmetered services are more stable since they are based on fixed monthly charges determined by the municipalities. The pricing of metered services is based on tariff structures which take the cost that are related to the services into account and translate that into unit prices for the amount of units that are used as well as basic charges that are derived from system maintenance costs and other input costs that are fixed.

In South Africa, Eskom has the sole mandate to generate and sell electricity and is the sole owner of the electricity transmission lines in the electricity grid. Eskom sells this electricity to municipalities licenced by NERSA in bulk for distribution to individual energy consumers (Mayr, Schmid, Trollip, Zeyringer, & Schmidt, 2015: 10).

In terms of the Constitution, municipalities have an executive authority and right to manage the electricity network in their respective areas (SALGA, 2014:2). Licenced municipalities have a dominant hold on the electricity business in most of the country and are thus able to generate a large amount of income from the electricity service. The introduction of Small-Scale Embedded Generation (SSEG) can be defined as a mode that can be compared to the generation of electricity from power plants but have small-scale generators with different sizes ranging from 5kW to 1,500kW which leads to a different distribution of electricity in South Africa (Wang, 2013:16). Therefore the South African municipal business models that rely on the generation of income from electricity can be seriously affected by the introduction of SSEG (South African-German Energy Partnership, 2017:4).

In looking at how small-scale electricity generation has changed the electricity distribution landscape, (Gonzalez-Langat & Fortoul:1) takes the definition of small-scale electricity generation further and states that embedded generation that is also known as distributed generation refers to any generation of electricity in a small scale, which brings the provision of electricity closer to its consumers.

The Energy Networks Association (2015:1) further explains that embedded generation is a unit that enables the consumer to generate electricity on his/her premises. These consumers can connect to the central electricity generation grid whilst they generate their own electricity. The consumers are viewed as generators and self-distributors of electricity and are defined as prosumers instead of consumers (Jacobs, 2017:521).

The own generation of electricity by consumers occurs through various systems such as wind, solar, geothermal, hydro and biomass amongst others. For the purpose of this study, the reference to small-scale embedded generation relates to the generation of electricity through photovoltaic systems, which are defined as systems that directly convert sunlight into electricity without the interference of any heat engine (Akarslan, 2012:22).

1.6 Research design

1.6.1 Introduction

The research design will determine the study that needs to be undertaken to provide suitable answers to the research problem and question (Mouton, 2007:55).

1.6.2 **Epistemology of the study**

The study will be an empirical study based on the analysis of both existing and secondary data by using Drakenstein Municipality as a case study. Although the basis of the study is empirical, non-empirical components are present especially where the literature relating to the introduction of PV systems in the municipal electricity distribution grids and its impact on the financial models of municipalities will be examined.

1.6.3 **Philosophies**

The philosophy that underlies the study has a practical nature where the focus is placed specifically on the real-life problem that was identified. The idea is to understand the problem and to formulate solutions. The study aims to emphasise the research problem and to use all of the available approaches to form an understanding with regards to the problem. Both quantitative and qualitative data will be used in the study to gather the necessary information.

An explanatory research design is used to analyse the secondary data of Drakenstein Municipality as a case study. A mixture of different research methods that involve quantitative and qualitative data will be used to collect and analyse the data. These types of research methods involve the combining of quantitative and qualitative research methods in order to strengthen the overall study (Creswell, 2009:30).

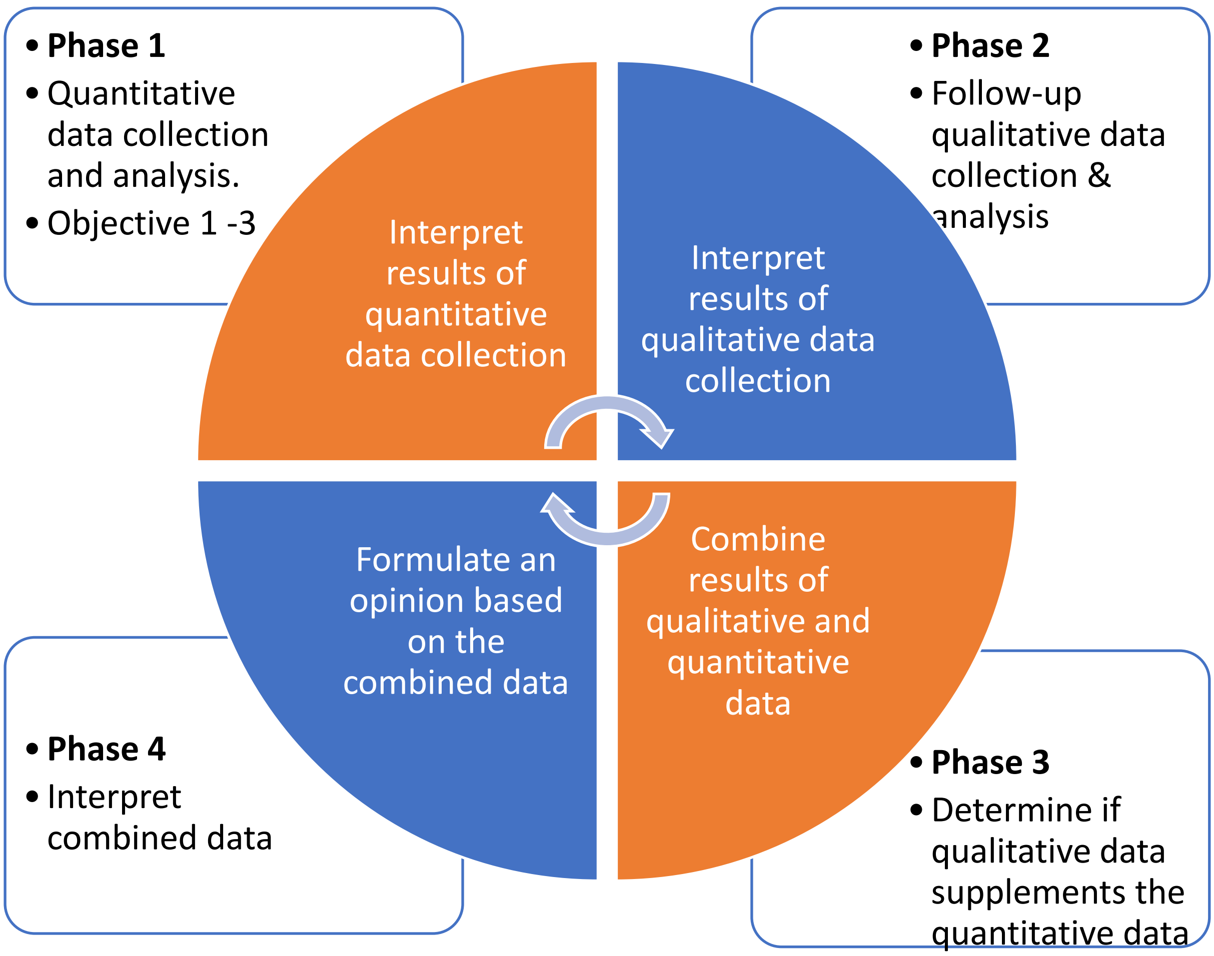
Though the research method involves different strategies, it is very important to know how the research strategy will be formulated. As stated in Creswell (2009:30), the timing, weight and the level of mixing needs to be outlined in order to determine the type of research strategy and how the strategy will flow. In this case the quantitative data that are available is more dominant and thus carries the most weight. The quantitative data analysis component will be the most dominant as a majority of the data will have a numerical nature (Korsten, 2016: 56).

1.6.4 **Strategies of inquiry**

Strategies of inquiry shows the different forms of research methods that can be used to provide the direction for the procedures that is used in the research design (Creswell, 2009:12).

Korsten (2016:57), uses an extreme case approach to show how the future share of small-scale embedded generation will look like in relation to the current electricity distribution model of municipalities. This approach shows that changes need to be made within the municipal electricity tariff modelling structures. In order to fulfil the objectives of the research the following sequential explanatory strategy will be followed. This strategy involves firstly the gathering and examination of quantitative data, followed by the gathering and examination of qualitative data that supplements the results of the quantitative examination (Creswell, 2009:15).

Figure 1-1: Sequential Explanatory Design



Source: Creswell (2009)

1.7 Research methodology

A research methodology is viewed as a manner in which to methodically solve a research problem (Kothari, 2004:8) and also as the choice to use certain approaches and procedures to conduct the research. It speaks to the logic behind the research methods that will be used.

Quantitative and qualitative data collection and analysis will be carried out through the collection and analysis of numerical information and non-numerical factors that will add to the holistic resolution of the research problem. The use of mixed methods aims to improve the authenticity of the study since qualitative techniques include the descriptive exactness of the study and the quantitative techniques ensures numerical accuracy (Kitchenham, 2010:2). Capitalisation is a priority that is given to either of the qualitative or quantitative data, the analysis of the data and the interpretation of the study (Creswell, 2009: 21). Since quantitative data is more dominant, it will take preference in terms of timing as well as the fact that more time will be spend on the analysis of the data.

1.7.1 **Population**

For the purpose of the research, the population represents the existing quantitative data sets of the Drakenstein Municipality relating to the purchase and distribution of electricity, secondary data that relates to the studies that were carried out on the distribution of electricity by the municipality in the recent years and that will be used to question the observations that were made from the quantitative data sets of the municipality.

1.7.2 **Data collection and analysis**

As explained above the research will follow a sequential explanatory study process, where existing quantitative data relating to electricity purchases and sales of electricity by the municipality as well as municipal electricity tariffs will be collected and analysed to determine the basis of the municipal tariff model and also to determine the municipal electricity cross-subsidisation principles used in the tariff modelling of Drakenstein Municipality.

The results of the analysis will be reviewed to determine their compatibility with the aim and objectives of the study. In order to fully analyse the spectrum of the research problem a follow-up analysis based on qualitative data will be conducted through a semi-structured interview with the Electrical Engineer to determine further assumptions used in their tariff modelling which are not evident from the quantitative data analysis. This qualitative information will be used to supplement the outcomes acquired from the scrutiny of the quantitative data. The sequential data collection and analysis process for this study will be broken down into the following stages.

1.7.2.1 **Stage 1 – Quantitative data collection**

The quantitative data that will be analysed as a first phase of the research process will be obtained from existing data sets from the municipal financial information systems for the following financial years of the municipality: 2017/2018, 2018/2019 and 2019/2020. Data collected during this phase relate to the achievement of objective one, two and three of the study. The data that will be collected and analysed as follows:

- The overall SSEG electricity distribution statistics of the municipality;
- The results from the Drakenstein Municipality case study that was conducted in 2015;
- The electricity tariff structure of the municipality for the years under review;
- Eskom electricity purchases reports over a period of 36 months from July 2017 till June 2020;
- The total municipal electricity sales statistics for the period under review;
- The electricity consumption patterns of the SSEG consumers.

1.7.2.2 **Stage 2 – Quantitative data analysis**

Data that were collected in stage one is analysed during this part of the study. The major analysis tools are computer-based data analysis tools such as Excel. The aim of the analysis is to try and achieve three of the study objectives by making use of the following:

- The use of Excel data analysis tools to determine the basis of the municipal co-generation tariff structure model that is linked to the first of objective of the study.
- The further use of Excel data analysis tools to compare the tariff structure of the municipality to the municipal electricity purchases and budget to determine possible gaps in the tariff modelling structure that is linked to the second objective of the study.

- Data analysis tools within Excel will be used to determine the sensitivity of the cross-subsidisation model of the municipality. This will be done by looking at the electricity sales and purchases of different consumer groups to determine their contribution to profits and how lower-end consumers are subsidised. This analysis will be linked to the achievement of the third objective of the study.
- Comparison of secondary data from the study that was carried out on Drakenstein Municipality by the WWF in 2016 to supplement the results from the analysis of existing data.

The results of the analysed data will enable the researcher to decide how the analysed data will influence stage 3 of the study that relates to qualitative data collection and analysis. These results will also allow the researcher to determine who will participate in the qualitative part of the study that will take place occurring in stage 3 of the data collection and analysis process.

1.7.2.3 **Stage 3 – Qualitative data collection and analysis**

The qualitative data collection process will start off with observations from the analysed quantitative data. The researcher will identify a small sample of municipal experts within the Drakenstein Municipality to which the observations of the analysed quantitative data will be presented to determine further tariff modelling assumptions. This data collection process will take place as follows:

- Semi-structured interviews will be conducted with the Chief Electrical Engineer to determine the technical aspects that are related to the municipal tariff structure and the uptake of PV systems within the area.

The researcher will draw up a standard set of questions for the participant and the interview will be done through face to face engagements, via the telephone or via Microsoft Teams where necessary.

The chosen participant is responsible for the quantitative data analysed in stage 1 of the data collection and analysis process and can provide further information in order to achieve the first three objectives of the study. The follow-up semi-structured interview with the responsible party will validate the results obtained from the quantitative analysis and ensure reliability of the data measurement instruments that were used.

1.7.2.4 **Stage 4 –Interpretation of results**

The results that are obtained from the combination of quantitative and qualitative data analysis will be used to obtain the following:

- Objective 4 of study, where a revised electricity tariff / business model will be proposed to the municipality that will ensure municipal financial viability.
- Objective 5 of the study where advice will be given to the municipality on an improved cross-subsidisation model.

1.7.3 **Merit of the research and proposed contribution to science**

The research shows the need to look at an alternative way to structure electricity tariffs as well as business models for municipalities. The tariff structure or business model would have the potential to mitigate potential risks related to the electricity distribution model.

1.8 Research Question

This study will be spread over seven (7) chapters and the outline of these chapters is as follows:

Chapter 1: Introduction and statement of research problem

This chapter provides an introduction of the study. This chapter provides the background, the research problem and the objectives of the study. The research design and the methodology are also introduced in this chapter and gives an idea of how the research report should be structured.

Chapter 2: Literature Review

This chapter will cover the following: (1) reviewing the literature and theories that relates to the electricity distribution model in South Africa, (2) renewable energy generation through photovoltaic systems, (3) the municipal financial models and tariff structuring and (4) the possible impacts that a mixed electricity distribution model can have on the financial position of municipalities and their cross-subsidisation models.

Chapter 3: Legislative Framework

The legislative framework deals with the authority that a municipality has in providing basic services to its communities of which the distribution of electricity is one. This authority is given through different pieces of legislation like the Constitution, the

Municipal Structures Act, the Municipal Finance Management Act, the Electricity Regulation Act and other pieces of legislation which relates to electricity distribution and municipal tariff structuring.

Chapter 4: Context of electricity as a revenue source at Drakenstein Municipality

This chapter provides the context of the Drakenstein Municipality as an electricity service provider. A brief discussion on the demographic profile of Drakenstein Municipality is carried out in the chapter where the municipal electricity distribution model is discussed. A further discussion on the structuring of the municipal revenue budget and its performance versus planned targets in the previous years is also carried out in the chapter. A snapshot of the how the electricity tariffs of the municipality are currently structured is also provided in the chapter to provide an idea of how the municipality prices its electricity service. A brief overview of mixed electricity distribution is provided in conclusion of this chapter.

Chapter 5: Research design and methodology

This chapter will focus on the design of the study and the methodology that was used to collect and analyse data in order to reach the objectives of the study.

Chapter 6: Study methods, analysis and results

This chapter will set out the study methods used to analyse the data and their results. These results will be analysed to determine if the objectives of the study can be aligned to the observed results.

Chapter 7: Summary of findings and conclusion of study

This chapter will provide a summary of the analysed findings and how these findings answer the research problem at hand and achieve the objectives of the study.

CHAPTER 2

2 LITERATURE REVIEW ON ELECRICITY DISTRIBUTION AND MUNICIPAL FINANCIAL MANAGEMENT

2.1 Introduction

This chapter looks at the following: (1) the literature that forms the basis of municipal financial management, (2) the electricity services as a source of municipal revenue, and (3) the installation of rooftop PV's within communities. It also looks at how these private installations of electricity have an effect on the way in which the municipalities can generate income. The chapter will look at the research conducted on this topic and current gaps in the literature relating to the topic. The researched literature will be used as a basis to conceptualise the results of this study.

In order to sequence the concepts which, have a bearing on the distribution of electricity by municipalities and how the introduction of embedded electricity generation has an effect on the financing models of municipalities the literature has to be linked to the current model of electricity distribution in the South African context, and then to how the renewable and small-scale embedded generation electricity landscape and trends currently look like in the country. Since there is a direct relationship between electricity distribution and municipal financing models, it is very important to look at what the current situation is and how possible changes in the future could influence this relationship.

2.2 The South African electricity generation and distribution model

Eskom is responsible for the generation of bulk electricity in South Africa. The municipalities buy electricity from Eskom on a time-of-use tariff and sell it to its consumers (Kotzen, Raw and Atkins, 2014:51). The energy generation of South Africa relies heavily on coal, and in 2016 74% of the energy generated by the country was coal-based. (ERC, CSIR & IFPRI, 2017:13).

Approximately 234 municipalities (metros and local) and 44 district municipalities purchased electricity in bulk from Eskom during 2016. In order for the municipalities to fund the distribution of electricity and other services, they put a profit margin on the cost price of the electricity that Eskom provides. (Korsten, 2016:47).

The traditional power systems architecture historically works on the basis that on the electricity generation side of the power structure generators are found at a maximum voltage level, whereas the loads on the consumption side of the power structure can be found on all voltage levels (Bischof-Niemz 2015:5). Due to the traditional power structure where generators are only found on the maximum voltage level, energy supply only moves in one direction. In this model there is no power generation on the consumption side of the power structure.

Figure 2-1: Traditional (Vertical) Electricity Distribution Model

Source: Energy Information Administration

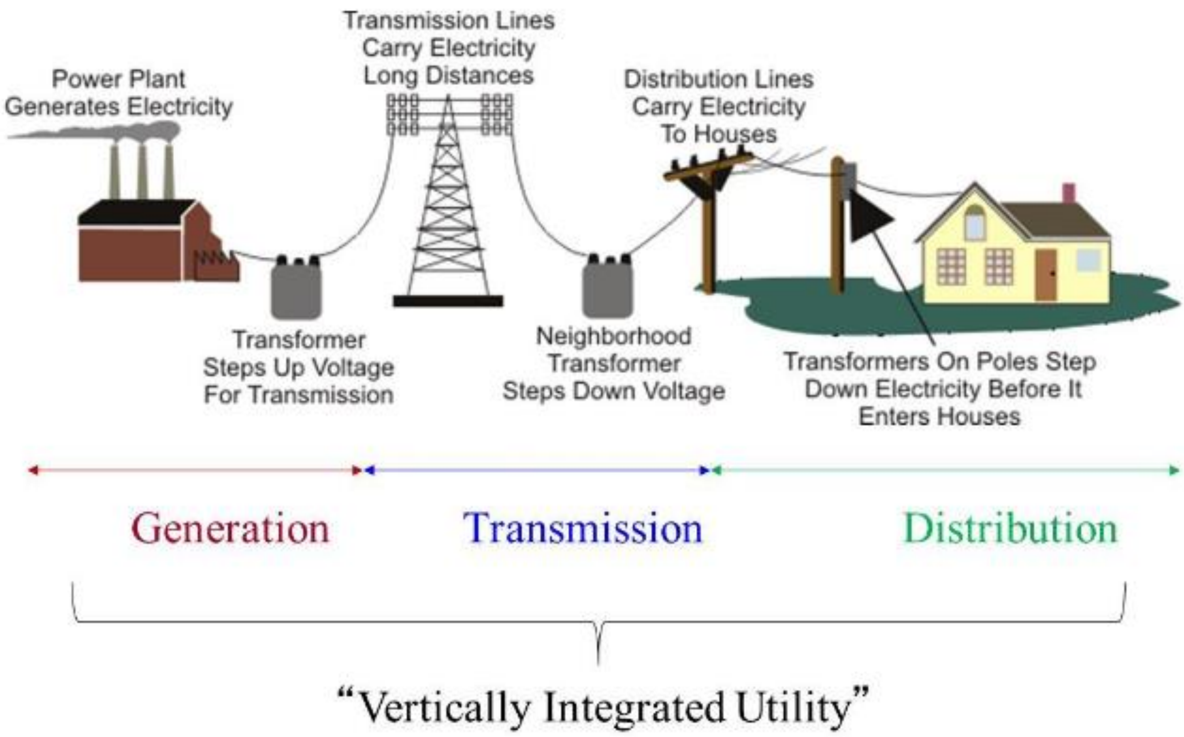
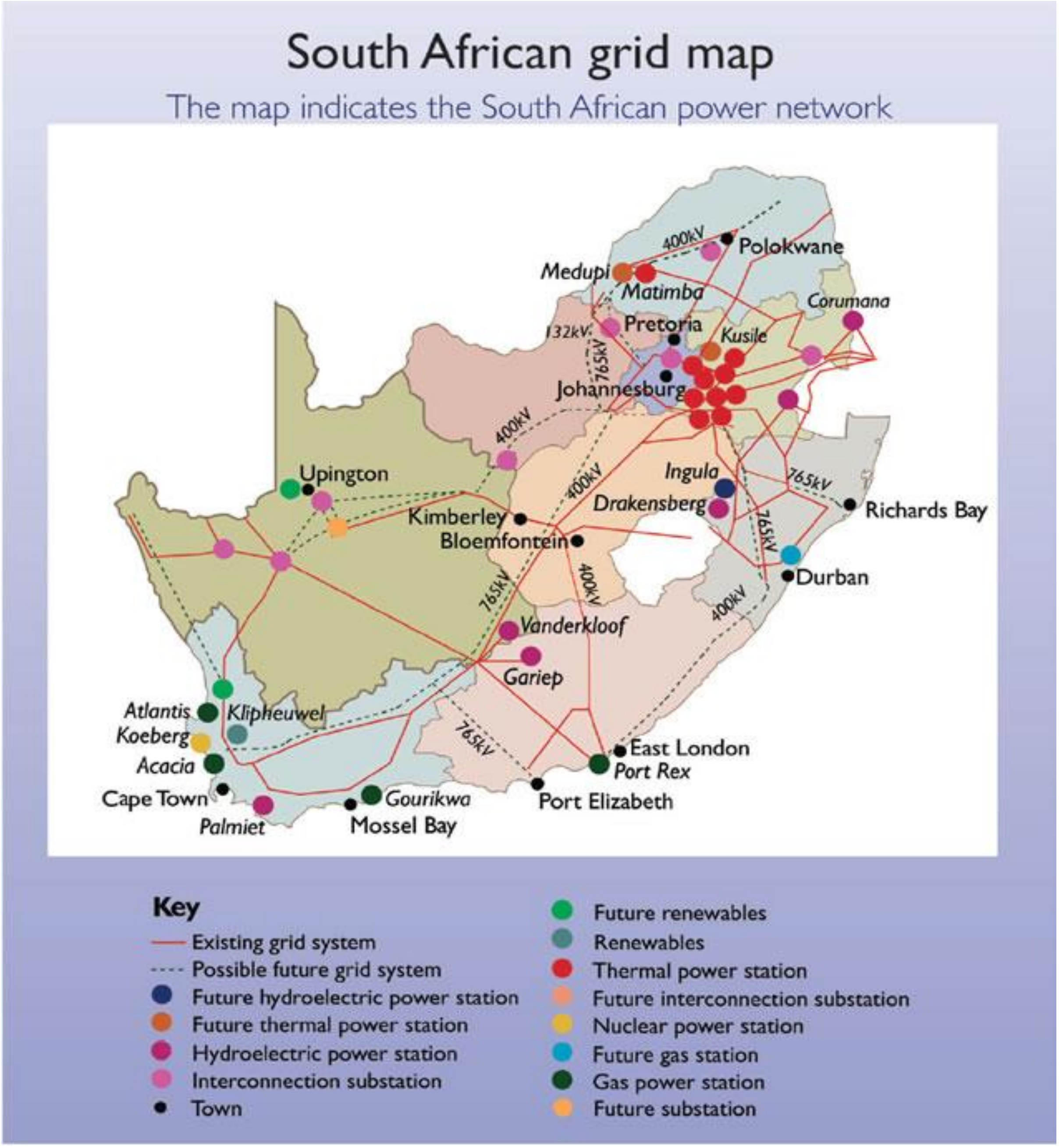


Figure 2.1 above illustrates the traditional model, where the flow and load of electricity runs in one direction from the power stations to the consumers who cannot generate, store or manage the electricity loads. (Bischof-Niemz, 2015:5).

In the South African context, Eskom is the main generator, distributor and transmitter of electricity. This generation, distribution and transmission occurs through various power stations, which are mainly coal-based, and who generate electricity for the country while also exporting electricity to some parts of Africa (ERC, CSIR & IFPRI, and 2017:13).

Figure 2-2: South African Power station network



The various power stations that are responsible for the generation of electricity in South Africa are illustrated in Figure 2.2 above. The conventional coal-based power stations form the backbone of the power network of the country. The electricity generation capacity of all of the Eskom power stations is currently approximately 44.5 GW, of which 85% of the electricity generation is coal-based (ERC,CSIR & IFPRI, 2017:13).

In South Africa the flow of electricity is mainly one directional or vertical. This means that the electricity is dominantly generated by the power utility, who then distribute and transmit the electricity to reach the various consumers. In the case of Eskom, these consumers are generally municipalities and a minority of private consumers and areas.

The emergence of photovoltaic systems and other external systems of generating electricity has changed this traditional electricity generation and distribution framework. These alternative sources including photovoltaic systems, have become role players in the energy market due to the decline in the cost of technologies that relates to alternative electricity.

The life cycle of photovoltaic systems has increased in recent years from 20 to 25 years and this created the opportunity for their use to grow significantly in the future (Mehmet, 2015: 1). This longer lifespan of PV's and the newer technologies has resulted in a lower capital investment in recent years and a greater demand for these systems from consumers. PV systems give individual installers the ability to convert solar radiation from the sun into electricity (Eskom, 2015:1).

This remarkable decline in prices of alternative energy generation has occurred internationally and there has been a significant decrease in the cost related to photovoltaic systems and their storage devices (Energy Research Centre, 2017: 9). This decrease in cost together with the insecurity of consumers in Eskom due to load shedding as well as the on-going sustainable development concerns provides incentives to consumers who wish to secure their electricity capacity.

The International Renewable Energy Agency in its IRENA 2019 report stated that the cost of renewable energy is becoming cheaper every year. The report also states that the global weighted average of energy that is generated from the rooftop photovoltaic systems has fallen since 2014 and has landed in the same cost range to that of coal generated energy. (IRENA 2019, 2019: 11) This decrease in the cost of solar photovoltaic systems provides a good incentive for the installation of a Solar PV system by consumers who see the value in generating their own electricity. This decline in cost is expected to continue until the year 2050 with projections estimating all time low costs by the year 2050.

The highly anticipated growth in the renewable energy market is becoming a reality because of the continued decline in the cost of producing renewable energy. Consumers are starting to realise that they have energy choices that are proposing major future changes to the traditional electricity generation model (Electricity beyond the grid: Accelerating access to sustainable power for all, 2016:4).

According to the Integrated Resource Plan (IRP, 2010) that was updated in December 2012, 9770 MW of PV Solar capacity should be installed by the year 2030. The plan also estimates that both residential and commercial embedded generation could reach 22.5GW by 2030 (NERSA, 2015: 15). Solar energy through PV generation is becoming a major player in the electricity generation space.

According to Bischof – Niemz all the technical solutions that is needed to integrate embedded generators into existing systems are available (Bischof-Niemz 2015:7). The challenge at hand now however relates to the commercial aspects of a mixed electricity distribution system that is presented through the introduction of embedded electricity generation.

The greater penetration of small-scale embedded generation into traditional electricity networks has the potential of resulting in a gradual but inevitable distribution network change towards a more active electricity network (Alberts and de Kock, 2014:59).

The requirement for power regulation is increasing, due to the fact that a larger proportion of the electricity supply consists of variable and unpredictable SSEG (CSIRO, 2015:24). This changed electricity distribution models affects the revenue generating capacities of municipalities and can have major effects on the capability of municipalities to run their business and deliver the required services to its communities.

The above ties in with the sentiments shared by the South African-German Energy Partnership which states:

> "Generally municipal utilities face the challenge of declining revenue from conventional sales of electricity, due to competition from external suppliers and due to increase of distributed renewable energy systems which convert power consumers into power prosumers (South African-German Energy Partnership, 2017:8)."

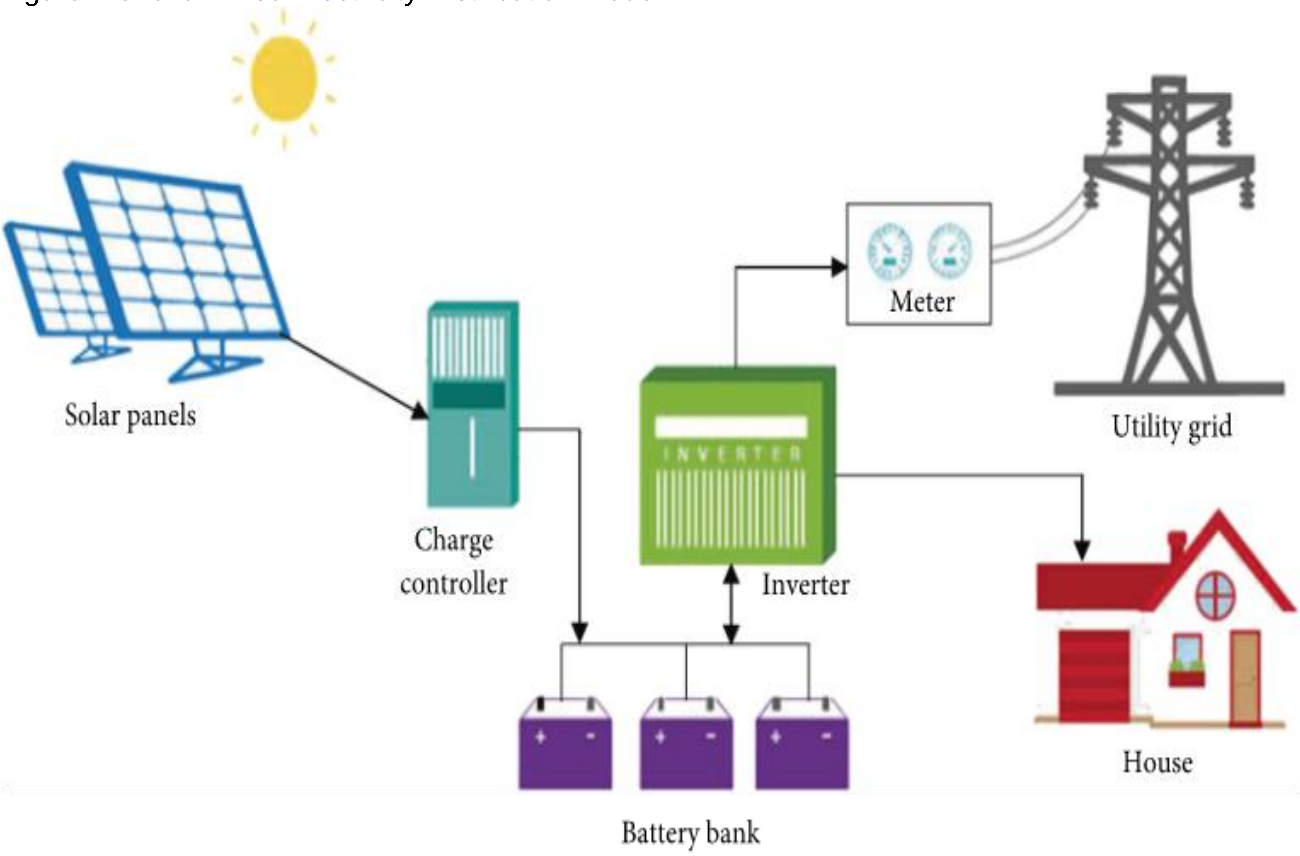
Since embedded generators are normally installed behind the meter of the consumer and the same entity that sells the electricity operates the distribution grid, any electricity consumed from an embedded generator decreases the sales volumes of the electricity distributor (Bischof-Niemz 2015:7). The reduced sales mean less profit for the distributor and thus less money to enhance and maintain the distribution grid.

If one looks at the current composition of municipal revenue where electricity revenue is used to cross-subside other services, one has to look at how this change in the traditional electricity distribution model will affect the municipal revenue (Sustainable Energy Africa, 2013: 4).

The introduction of embedded electricity generation brings a change in the flow and load of electricity. The flow is no longer one directional and the consumers of electricity also become small-scale generators of electricity which turns them into prosumers.

The proposed mixed electricity model can look like the illustration in figure 2.3 below.

Figure 2-3: of a Mixed Electricity Distribution Model

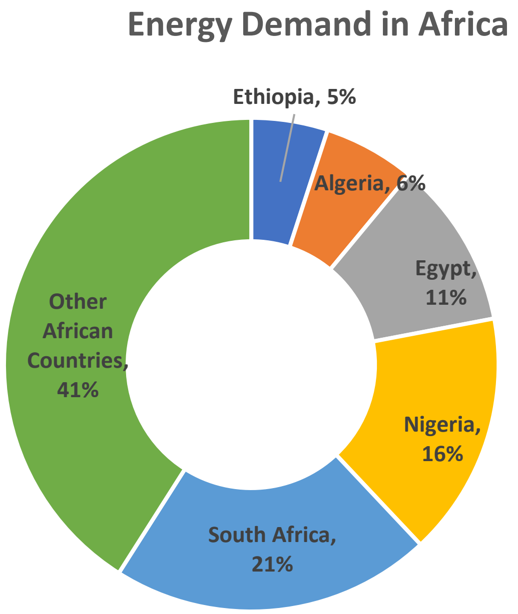


2.3 The PV potential in Drakenstein Municipality

South Africa is regarded as the sixth (6th) biggest manufacturer of coal and the fifth (5th) biggest exporter of coal globally and therefore over 77% of the electricity needs of the country are coal-based (Eberhard, 2011:2). During the energy crisis of 2007 the coal-fired plants struggled to meet the supply of electricity needed by the country which led to an unreliable power system and load shedding throughout the country. This energy crisis and factors such as the rural areas that have no access to electricity and other sustainable future concepts that are related to the environment urged the South African government to start looking for alternative energy sources (Eberhard, 2011:4).

If one looks at the South African energy consumption in relation to other African countries, the country stands out in terms of energy consumption both on the supply side of coal-fired energy and on the demand side of energy. Based on graph 2.1 below that was sourced from a study conducted on renewable energy in South Africa, Egypt and Nigeria shows the significant role that the South African energy market plays in Africa. Any major changes in the energy supply demand models in South Africa will have a major effect on the country and also has the potential of affecting the energy landscape of the African continent.

Graph 2.-1: Energy Consumption in Africa per country



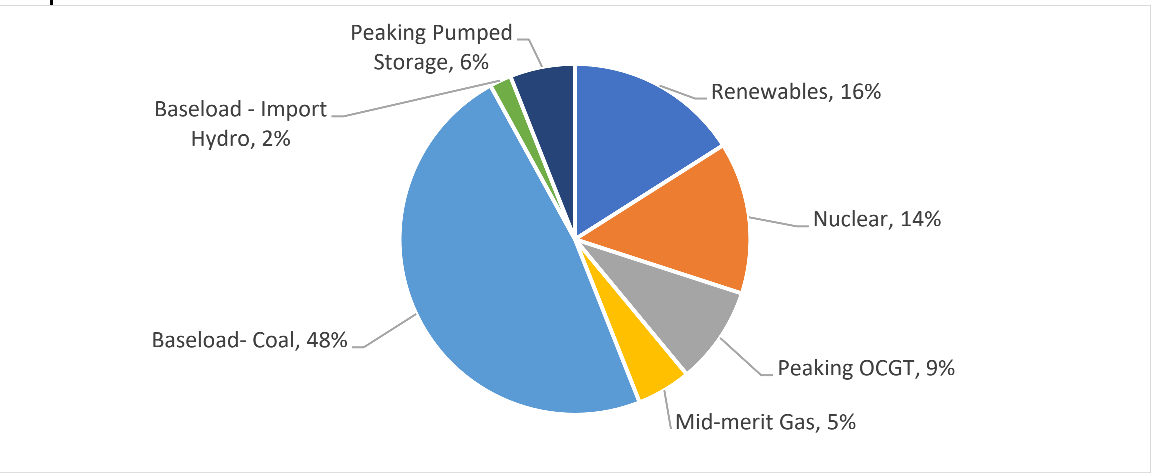
The graph above shows the 5 most dominant countries out of the 54 countries in Africa that demand 58% of the energy versus the rest of the continent. The remaining 49 countries combined demands 41% of the generated electricity. South Africa dominates the electricity demand in Africa with a whopping 21% which further emphasise the dominance of the country in Africa's energy space.

With the status quo of dominance in energy demand in Africa in mind and the changes required as a result of the Brundtland report and all the related sustainable development considerations which highlighted threats in the current energy model of the world, South Africa had to act to ensure a continued and reliable energy supply to its consumers.

In 2003, the South African Government, adopted the White Paper on Renewable Policy which had the aim of decreasing the reliance on the generation of coal-fired energy and encouraging the use of different types of renewable energy. This white paper set the scene for alternative energy generation policies and guidelines in the country. The Integrated Resource Plan 2010 (IRP) explained and followed set targets for the different alternative energy types that South Africa could invest in, in order to meet the optimal energy mix by the year 2030 (WWF, 2017:19). The Integrated Resource Plan (2010), which was circulated in March of 2011, followed a specific process where the estimated capacity requirements of the country were determined after various consultations with the relevant stakeholders. The end result of these consultations determined that the estimated capacity and capacity mix would be as showed in graph 2.2.

The main aim of the IRP in 2010 was to give an idea of how much the supply of electricity needs in South Africa would cost and how this electricity would be supplied over the next 20 years (IRP Summary, 2010:4). A balanced scenario approach was followed where the information that was obtained from workshops with government departments as well as the results of all the developmental scenarios were used to come up with a balanced scenario that allows for greater diversity in the estimated electricity mix of the country by the year 2030 (IRP Summary, 2010: 22). The revised targets set in the IRP 2010 are stipulated in graph 2. 2 below.

Graph 2.2: Revised Balance Scenario



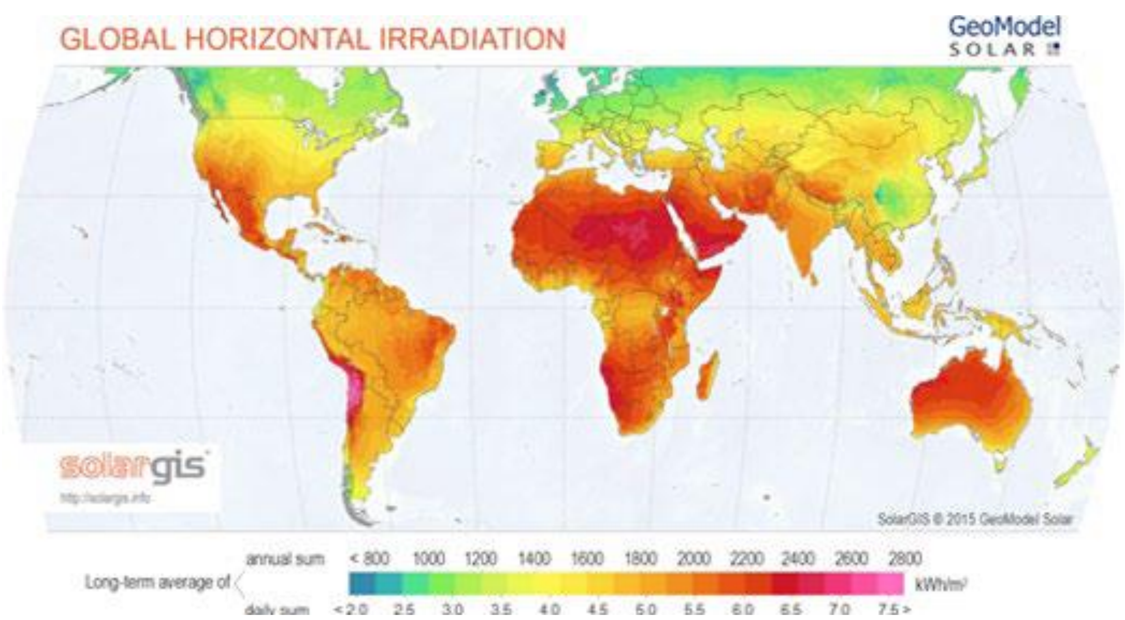
Something that is evident in graph 2.2 above is the intentional and open-minded shift from coal-fired electricity generation to a more diverse energy mix where renewables play a bigger role. (IRP Summary, 2010: 24). The IRP was further revised in 2019, because it is regarded as a living document.

In addition to the various targets that have been set in the different versions of the Integrated Resource Plan, South Africa is viewed as having a good potential for solar and wind energy due to the favourable climatic conditions found in in the country (WWF 2017:10). This has been illustrated in various studies where the country has been quoted amongst those countries that have the most conducive conditions for solar and wind energy.

Figure 2.4 below illustrate the potential of the African continent and South Africa in the solar energy space. The continent and South Africa's solar potential is more than that of countries such as the United States of America, United Kingdom as well as the European continent. (WWF,2017:9). This shows that there is potential for rapid growth in the installation of solar energy in South Africa and on the African continent, especially because of the decreasing cost of solar PV equipment and the instabilities of the main electricity distributor in the country.

Figure 2-4 : Global Horizontal Irradiation

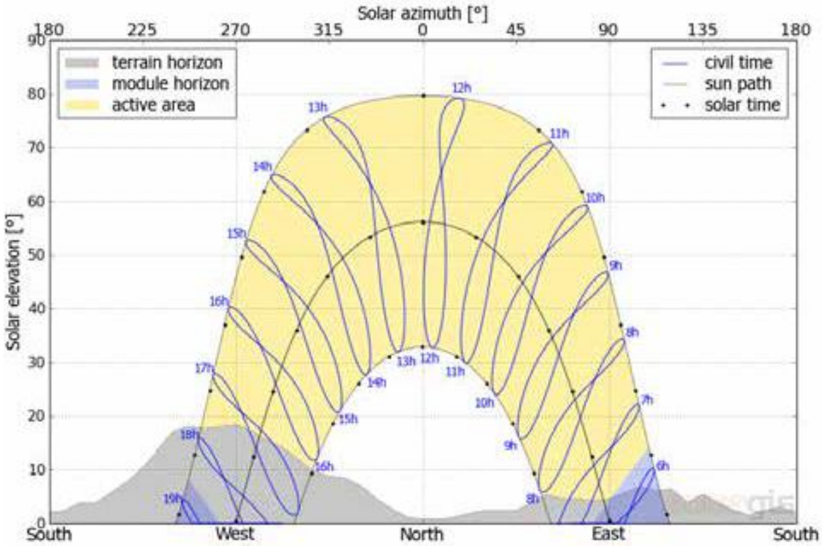
Global Horizontal Irradiation



According to the IRENA RE-map case, PV would take up 13% of the electricity generation by 2030 that will increase to a 25% share in the world's electricity generation by the year 2050 (IRENA, 2019:34). South Africa and Japan at 26%, are the countries that have the biggest share in solar energy in the respective energy mixes, followed by countries such as the United States at 18% and India and China at an estimated 15% of their respective energy mixes (IRENA, 2019:34).

According to a study conducted by the WWF on Drakenstein Municipality in 2015, the town of Paarl situated within the municipality has a reasonable solar resource in comparison to other locations in South Africa (WWF, 2015: 16). Figure 2.5 below illustrates the times when solar electricity generation will be at the most optimal point and when it will be at its lowest.

Figure 2-5: Drakenstein Municipality PV generation potential times



According to the study, approximately 24 Megawatt of embedded solar PV could be installed in the municipality while the electricity generation from the installed PV would complement the load profiles within the required substation levels (WWF, 2015: 35). The electricity purchases that were analysed during the study showed that the municipalities bought the most units of electricity during the summer months of February and March while the least amount of electricity units was bought during April and September. This shows that the most electricity is used during the summer months followed by the winter months and is the lowest during the time of autumn and spring. (WWF,2015:34).

Should the complete uptake of SSEG through rooftop PV happen, the municipality could lose potential income which can be minimised through the devising of a proper cost reflective tariff structure (WWF, 2015: 41). The study concluded that Drakenstein

Municipality had a probable PV installation capacity of 24 000 KWp, that would result in a 3% impact on the municipality's revenue (WWF,2015: ANNEXURE 3). If these results could be inferred to a more extreme case, the effects to the municipal revenue could be more extensive.

There is a potential for more PV installations in the area that can change the current electricity distribution model of the municipality and its cross-subsidisation models.

2.4 Municipal revenue models, tariff structuring & cross-subsidisation: Municipal Revenue Models

Municipalities in South Africa generate their income from three major sources, which are classified as property rates, service charges and grants and subsidies (Korsten, 2016:51). The income from these sources comes from the delivery of goods and services where the consumer gets a direct benefit. These municipal goods and services are regarded as specific and need to be replaced in order to be available to the next consumer. Municipalities also deliver services that are seen as a collective service. These services are non-exhaustible and do not have to be replaced if it is used by another consumer (Gildenhuys, 1997:15). Lastly municipalities also deliver quasi-collective services which have elements of both particular and collective services (Gildenhuys, 1997:15). The difference in services that are delivered by municipalities has an impact on the type of charges that municipalities can levy and also on how these charges are determined by the municipality.

Table 2.1 below shows the various characteristics of the different services that are delivered by municipalities and other government departments.

Table 2.1: Characteristics of Particular, Collective and Quasi-Collective Services

Characteristic	***Particular***	***Collective***	***Quasi-Collective***
1. Apportionable	Yes – consumption quantities can be defined	No - cannot be supplied per unit	Yes & No– Partial distribution
2. Exclusiveness	Yes – only those paying for the service benefit	No – Other consumers cannot be excluded from consumption	Yes & No – Partial exclusiveness
3. Exhaustible	Yes – Services needs to be replenished after consumption	No – Services do not become depleted when others consume the service.	Yes & No – Partial exhaustibility

4. Pricing per unit	Yes – a price per unit can be determined	No – there is no price per unit	Yes & No – A portion can be priced per unit and a portion cannot
5. Monopoly	No – other service providers can provide the service	Yes – Service providers are kept out of the market by the government	Yes & No – A portion of the service can be provided by a private service provider and a part can only be provided by the government

Source: Adapted from Moeti, 2014

Table 2.1 above provides a brief explanation of the characteristics of the different services that are delivered by municipalities. In practise these characteristics determine whether a user charge or a tariff will be charged for the services rendered. It is very important to distinguish between a municipal user charge and consumption tariff.

2.4.1 **Municipal user charges**

Municipal user charges are the amounts of money that a municipality or government entity charges in order for consumers to use a specific public service. In the context of the government or municipality this means that services could be used without having to replace it (Gildenhuys, 1997:115). This means that the specific service will always be available to other consumers. A service can only be used by the consumer until he or she is satisfied with the rate that is defined by the government entity. User charges are linked to services which have both elements of particular and collective services and should be charged on quasi-collective goods. In the case of municipalities user charges are normally charged for services such as fire services, law enforcement and clinics (Moeti, 2014: 28). User charges can recover the costs of providing services and also encourage the efficient consumption of services if properly structured (Bahl & Smoke, 2003:77).

Based on the explanation and discussion on user charges one can see that user charges can be directly linked to quasi-collective services (Gildenhuys, 1997:115). Elements of fixed costs are always present in determining the user charge for quasi-collective services.. These costs are financed by making use of taxes while an adjustable portion is directly linked to the operational and direct costs associated with the delivery of the quasi-collective service (Gildenhuys, 1997:116). When looking at municipalities, services can be viewed as quasi-collective if they have both elements of fixed and variable costs.

2.4.2 Municipal consumption tariffs

The difference between municipal consumption tariffs and municipal user charges is that user charges are tariffs that are paid for particular services (Gildenhuys, 1997: 117). Thus, cost recovery principles become applicable to these services. The cost recovery principle implies the recovery of all or a majority of the cost that relates to the provision of a particular service (McDonald & Page, 2003: 18). In the case of municipalities, the recovery of cost can occur wholly or in part for services such as electricity and water. In the case of these services, consumers are charged with the full production marginal cost of the services consumed plus a percentage of the long-term operating and maintenance cost (McDonald & Page, 2003: 18).

The economics theory of demand and supply plays a crucial role in the setting of municipal consumption tariffs. This is because the demand side of the electricity market refers to the need of electricity that is derived from consumers and the supply side which refers to the availability of electricity from the seller. The consumer demand for electricity is normally linked to long- and short-term decisions that consumers have taken which create a specific demand for electricity (Biggar & Hesamzadeh, 2014:7). The supply side of electricity is mostly informed by the production models of entities and the type and range of input costs that these production models lead to (Biggar & Hesamzadeh, 2014:10). Thus, in a mathematical equation of Price (P) multiplied by Quantity (P×Q), the consumers inform the amount of goods required (Q) and the seller determines the price (P).

In terms of services such as refuse collection and sanitation, it becomes difficult to apply the cost recovery principles in full. Municipalities usually determine flat rates that must cover the average static and adaptable costs that are related to the service (McDonald & Page, 2003: 18).

All of the above user charges and tariffs must adhere to certain principles in order for it to fulfil its purpose. The definition of a good municipal tariff or user charge is regarded as one which is adequate, flexible, fair, administratively feasible and politically acceptable (Bahl, Smoke et al, 2003: 72).

Municipal user charges and tariffs are normally charged on the municipal services which have an exchange nature. These are the services where there is a *quid pro quo* between the municipality and the consumer and which resemble the characteristics of particular and quasi-collective services.

Exchange related services can be classified into economic services and trading services, where the economic services represent the provision of refuse removal and sanitation and the trading services represents the sale of water and electricity. Both the economic and trading services represent the quasi-collective goods where the municipality sells these services in volumetric fashion to each consumer with fixed charges so that the capital and maintenance cost that are required to bring the services to the consumers can be recovered (Mossel Bay Municipality, 2019:22). The economic and trading services are required to either break even or to make a profit. These profits help the municipality to fund other services which do not generate an income.

According to Burger (2018) basic domestic services are all quasi- collective as a result of the free basic services component which is granted to certain households (Burger, 2018:1). This means that some consumers (poor consumers) receive a certain portion of these services without having to pay for them. This revised definition of quasi-collective goods and services brings another angle to the provision of these goods by the municipality. The tariff model of quasi-collective services is altered because the free basic services provided to indigent consumers has to be subsidised by other consumers of the municipality (Burger, 2018: 5). Although these goods and services conform to the characteristics of quasi-collective services, their prices cannot be determined by the market (Burger,2018:6).

It also suggests that where natural resources become scarce as a result of environmental degradation, that municipalities are forced to protect these services and ensure longevity by decreasing the current demand trends. Thus, to decrease demand, the prices of goods have to be altered, which leads to a more punitive set of tariffs for consumers who fall outside the free basic services threshold. (Burger,2018:7). This argument has some truth especially when it comes to the water and electricity services provided by municipalities. As a result of the scarcity of natural resources, the over-consumers are heavily penalised and as a result they start looking at alternative services (Burger, 2018:7).

The introduction of alternative generation of water and electricity distorts the picture painted above of user charges and tariffs in the municipal context. This requires municipalities to adopt an " business unusual" perspective in trying to minimise losses that comes from this distortion. The picture above poses problems for larger municipalities because they rely heavily on the electricity service revenue stream to fund their operations whilst smaller municipalities are more prone to grant dependency (Korsten, 2016:51).

According to the results of the Financial Survey on Municipalities published by StatsSA on 28 June 2017, electricity sales represented 28.3% of the total revenue generated by municipalities. (StatsSa Statistical Release P9114, 2017:3). This makes electricity revenue the second largest generator of municipal revenue after grants and subsidies.

2.4.3 **Price Elasticity in electricity demand**

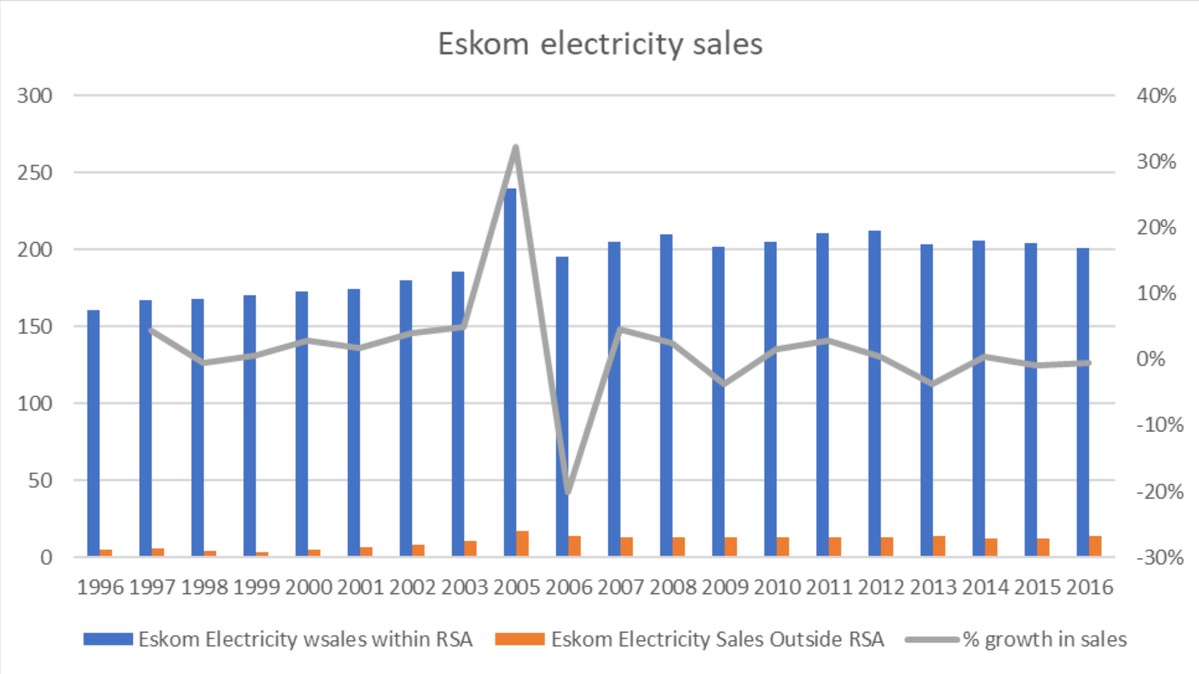
The concept of price elasticity becomes a very important consideration, where one needs to look at the consumer response to prices both in the long-run and in the short-run. Dutta & Mitra distinguish elasticity in the short-run as the response of prices to the current status quo in terms of delivery of the service and long-run elasticity as the consideration of other ventures that can be explored by consumers, as a response to higher prices (Dutta & Mitra,2016:5).

In the South African context Eskom generates 95% of the electricity that is used in the country which means that the entity's sales can be used to determine the electricity sales of the country as a whole (Deloitte, 2017:25). If one examines the historical electricity sales trends in South Africa over a period of 20 years a steady sales trend can be observed.

There was a continuous increase in sales between 1996 and 2008 as seen in graph 2.3 below (Deloitte, 2017: 27). During 2008, South Africa experienced its first taste of load shedding due to Eskom's inability to generate the electricity that was needed by the country. Shortly thereafter the global financial disaster reached a peak and the international market went into recession. The combination of the above resulted in the contraction of Eskom sales by 4% in the 2009 financial year.

Eskom sales only returned to its pre-recession norm in 2011 but experienced another decline in the 2013 financial year due to a big decline in the global demand for commodities that were manufactured in the country's energy intensive sector. The slowed economic growth, decreases in the supply of goods and the reintroduction of load shedding in 2015, also affected the sales of electricity by Eskom even more.

Graph 2-3 Historical Eskom Sales data per financial year from 2006



In order to understand how and why the supply trends of Eskom affects the price elasticity of electricity demand one has to look at the Eskom tariff trends, how these tariff trends compare to inflation and how the reaction of the consumers has affected the demand for electricity.

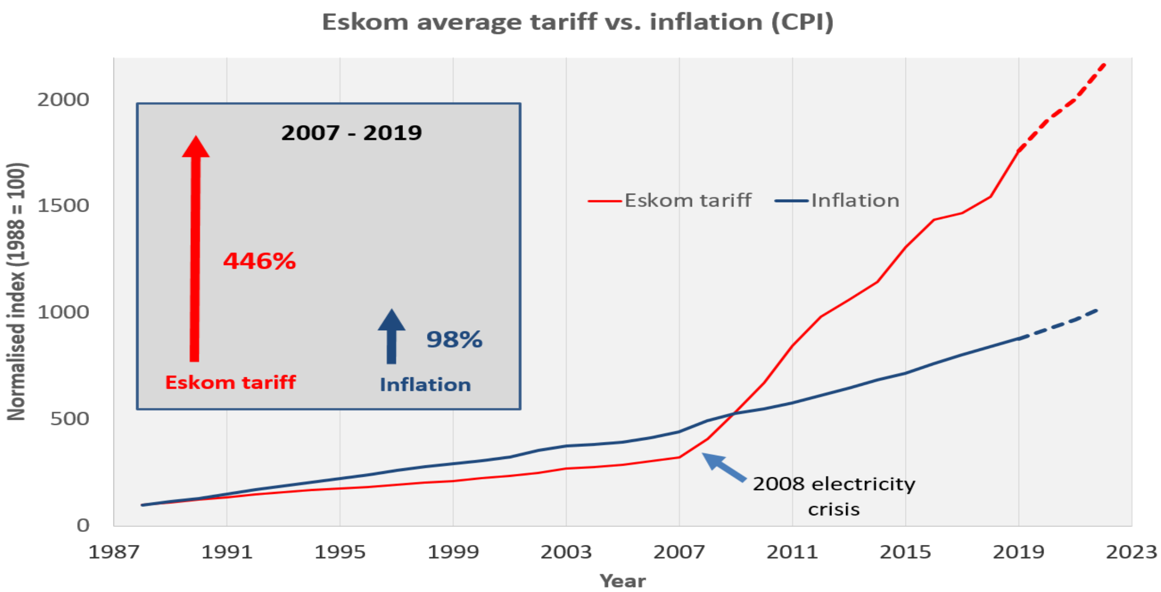
The following conclusions can be drawn by looking at graph 2.4 below which represent the increases in tariffs by Eskom versus the inflation rate for the period from 1988 – 2019:

- 1988 – 2008 : Electricity tariff increases were on par with inflation. During this period the combined inflation rate increase was slightly more than the combined electricity tariff increases.
- 2009 – 2019 : Electricity tariff increases were above the increases in the inflation rate. During this period the combined electricity tariff increases were four times more than the combined increase in the inflation rate.

Inglesi-Lotz & Blignaut (2011) saw that the price elasticity of electricity differed from sector to sector during these periods. This observation was made after looking at the price variance per sector (Inglesi-Lotz & Blignaut, 2011: 459). The industrial sectors' elasticity was the only sector that showed a substantial price elasticity. All of the other sectors including the residential consumers electricity price elasticity recorded insignificant elasticities (Inglesi-Lotz & Blignaut, 2011: 459).

Based on the above information, the conclusion can be made that the price elasticity of the electricity demand remained consistent during the period from 1988 – 2000. This picture changed in 2008 due to the global recession and the introduction of load shedding by Eskom. Since this turning point in 2008, we have seen an increase in electricity prices followed by the corresponding decrease in electricity consumption as consumers started looking for alternative sources of energy. During that period the price elasticity of electricity demand decreased.

Graph 2.4 Eskom Electricity Tariff increases vs inflation increase

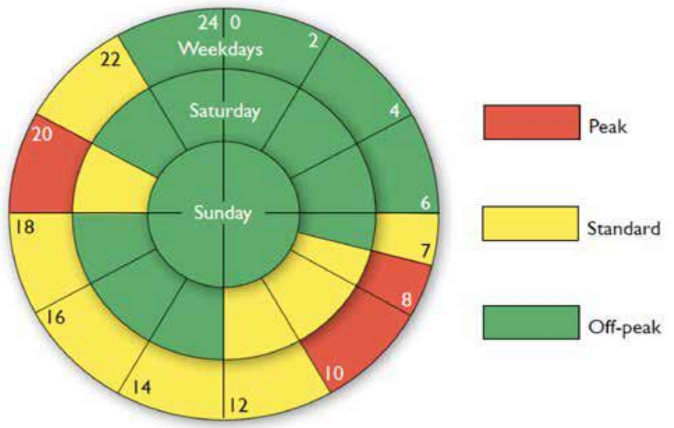


When you consider the financial crisis that Eskom currently has and the ongoing capacity problems that Eskom is experiencing, the assumption can be made that the electricity prices will continue to rise as shown in the graph above. The continued rise in prices will lead to an elastic electricity demand in the long-run that will give consumers the chance to look at alternative ways to generate electricity.

2.4.4 **Electricity purchases**

Municipalities purchase electricity on a time-of-use tariff, where the municipalities pay for electricity based on the demand in a particular time slot of the day and the year. Nicolson, Huebner and Shipworth, (2016:82), says that the electricity time-of-use tariff (TOU) applies different charges per kilowatt hour during different times of the day or year, depending on the electricity usage at that particular time of day and period of the year. The daily time periods of Eskom are illustrated figure 2.6 below.

Figure 2-6: Eskom Defined Time Periods



Since municipalities buy electricity on the time-of-use tariff, electricity is sold at fluctuating levels throughout the day and sales made in high demand peak times leads to losses of income (Kotzen et al, 2014: 52).

The embedded generation model throws a spanner in the works in this model, where the electricity that was previously purchased from Eskom is now individually generated by the prosumers. Solar PV systems produce a considerable amount of their energy during the day and not in peak periods. During these times the purchase costs for bulk energy are usually at standard rates, with the loss in income taking place between the time that the power is generated and when the electricity is used during peak times (Janisch et al, 2012:4).

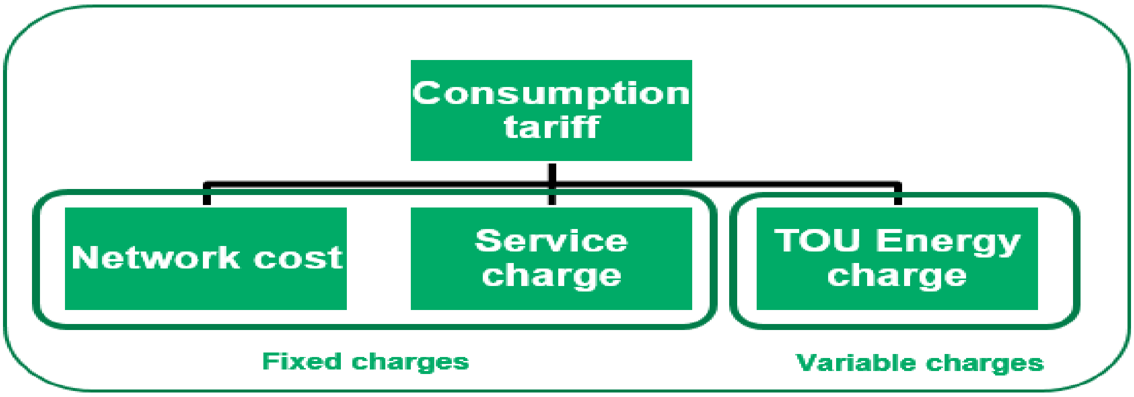
The question that should be asked is whether municipal policies and tariff models cater for these time fluctuations between when the time electricity was generated and when the generated electricity is used by the prosumers.

2.4.5 **Municipal tariff modelling**

The Western Cape Governments' guide to transparent tariffs prescribes that good municipal tariffs must be efficient in terms of the following: revenue generation, provide a stable revenue base and must accurately reflect the cost incurred to provide the particular services (Western Cape Government,2012:6). Municipalities devise tariffs for all of their respective services to be in line with the abovementioned characteristics.

Municipal tariff structures for electricity are based on cost accounting principles which comprises of a fixed portion that is associated with the operation, maintenance and expansion of the distribution grid and which is factored into the unit price charged per kWh of electricity (Bischof-Niemz, 2015; 12). The tariff structures of municipalities are structured to make high-end consumers of electricity pay more for the electricity than consumers who consume less. GreenCape illustrates this traditional electricity tariff structure as follows:

Figure 2-7: Green Cape Traditional Electricity Tariff Model

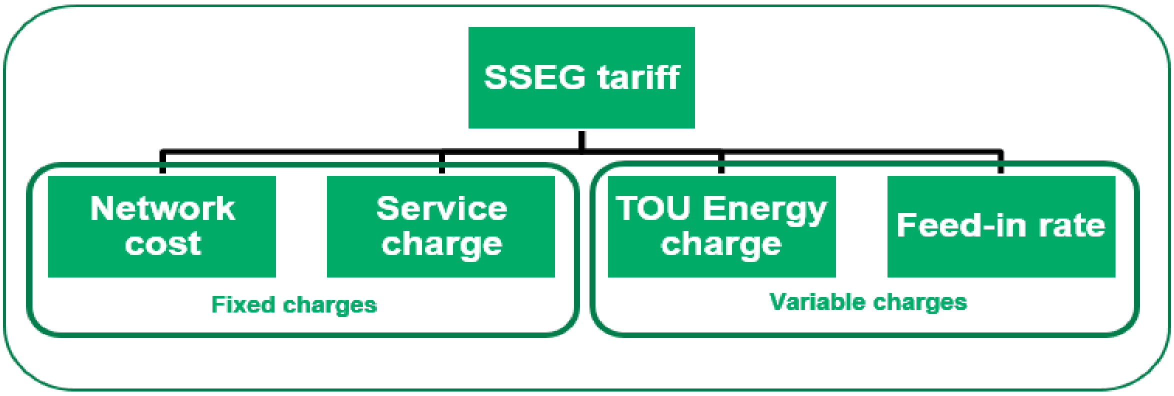


The tariff structure illustrated in figure 2.7 above is based on the traditional one directional electricity distribution model where the utility or the municipality uses cost accounting principles to recover the fixed charges that are related to bringing the electricity to its consumers combined with the charges linked to the consumption of electricity.

According to NERSA (2015) SSEG consumers will always need to be connected to the main grid as backup due to variable energy resources even though they generate their own electricity. The associated grid connection usage cost of SSEG consumers when using the main electricity grid as a backup is not recovered if the electricity distributor does not charge the consumers a fixed charge which is cost reflective and in conjunction with a net-metering / billing scheme or a net-FIT tariff structure.

GreenCape further validates the consultation Paper of NERSA by suggesting the following possible tariff structure for SSEG consumers who feeds electricity into the municipal or Eskom grid (GreenCape, 2016:3).

Figure 2-8: GreenCape SSEG Tariff Structure



This suggested tariff of GreenCape illustrated in figure 2.8 above consist of a fixed charge for network and service charges and a variable tariff component that caters for time-of-use as well as a feed-in-tariff for SSEG consumers (GreenCape, 2016:3). The addition to the traditional electricity tariff structure is the Feed-in tariff which represent the payment per kWh offered to the prosumer for electricity exported back into the municipal grid (GreenCape,2016:2). Thus, there is a need to decouple the fixed charges for electricity from the variable unit charge that depend on the time electricity is consumed and when it is fed back into the electricity grid.

According to Korsten (2016:33) the best sales tariff would include an access charge that reflects when electricity is needed and that would account for a customer's input to peak hours, meaning that a Time-Of-Use rate that is designed by utilities and electricity distributing municipalities should be used to mitigate the anticipated losses from SSEG (Korsten, 2016:33).

However, Bischof-Niemz (2015) feels that a decoupled tariff is not enough to mitigate the anticipated losses, and is of the opinion that a Net Feed-in Tariff (NETFIT) concept is the appropriate approach. This concept proposes the creation of a Central Power Purchasing Agency (CPPA) that would be a legal entity either owned by the state or fully regulated and that would act as the official sole national off-taker of all SSEG that is fed into the grid (Bischof-Niemz, 2015:21). Hermanus (2017) further supports this concept where she argues that in order for increased municipal control to occur in decentralized electricity distribution, a shift is required in the current national policy frameworks (Hermanus,2017:24). Thus, a national policy changeover is required similar to those in countries like Germany, where South Africa as country can take lessons in making bold policy changes that transfer power from national government to other spheres of government.

2.4.6 **Cross-subsidisation model**

The current South African municipal revenue models caters for cross-subsidisation from high-end electricity consumers to low-end consumers. The electricity supply tariff structures of municipalities are mostly structured as residential flat / inclining block tariffs where consumers pay unit tariffs that depends on how much electricity they consume (Kotzen et al, 2014:51).

The inclining block tariff structures are regarded as progressive tariff structures where consumers that are wealthy and better-off support low-end consumers. This progressive tariff structure leads to incentives for high-end consumers to migrate from the traditional grid and seek alternative electricity through self-generation (Mayr, Schmid, Trollip, Zeyringer, & Schmidt, 2015:10).

The increasing interest of these high-end consumers in solar generated energy due to the high cost of fossil fuel energy, could affect the profits and surpluses of municipalities negatively as well as the subsequent cross-subsidisation of the low-end consumers (Janisch et al, 2012:7).

The difference between a surplus and profit is that a surplus enhances the income that is needed elsewhere in the municipality after it is redistributed while profits are used as earnings for shareholders. (Korsten, 2016:47).

Thus, in the municipal context the surpluses that are generated from the sale of electricity are important to fund the other non-income generating activities of the local government. The migration of high-end consumers from the main electricity distribution grid to small-scale embedded generation puts strain on the traditional cross- subsidisation model.

2.4.7 **Municipal business model**

The short and long-term municipal forecasting models require modification when looking at how the conventional supply and demand model of municipalities have been altered as a result of alternative sources of electricity, water and other services.

According to Louis Fourie, Senior Business Consultant for Aurecon the introduction of a mixed electricity distribution framework has the potential of disrupting the business model of municipalities that will have a negative effect on the municipal finances. The CSIR (2015) argued that there is a business case that can be developed through a Net-Feed-in Tariff (NETFIT) that can make municipalities financially unresponsive to distributed electricity models (Bischof-Niemz, 2015: 21).

Careful planning is required to determine what the future energy supply and demand of electricity will be in a municipal area, and the potential impact it will have on municipal income with the introduction of renewable solar energy. The energy mix in terms of supply and demand needs to be studied to enable the proper forecasting of actions that are required to maximise the potential revenue generating capacity of a municipality or to determine the revenue generation incapacity of the municipality due to the introduction of renewable energy.

A smart pro-active and balanced planning approach to energy would include numerous characteristics that show the demands of low-income electricity users and evidence-based usage to understand the consumption patterns and preferences of such consumers (Abrahams et al, 2013:41).

Municipalities need to look at their current electricity tariff structure models to be able to prevent the risk of crippling municipal revenue losses and decreased cross-subsidisation of low-end electricity consumers. The municipalities need to start looking at breaking down the operational cost related to the electricity service from the actual consumption of electricity (Sustainable Energy Africa, 2013:11).

Municipalities also still need to make sure those high-end consumers do not pay unreasonably high tariffs that will cause them to look for other alternatives (Janisch et al, 2012: 8).

Municipalities need to find the right balance that will facilitate the cross-subsidisation of low-end consumers, and encourage consumers to move towards green energy and finding the right pricing structures that will ensure financial viability for the municipality (Sustainable Energy Africa, 2013:7).

In the discussion paper compiled by the South African-German Partnership in 2017, a review was carried out on possible changes in the business models of municipalities that are related to the distribution of electricity.

In order to determine how this balance can be achieved the existing data on small-scale embedded generation through rooftop photovoltaic systems (SSEG PV) needs to be analysed. The following questions needs to be looked at: (1) what happens after the data is analysed? (2) Can the municipalities still carry on as usual?

2.5 Summary and conclusion

The literature discussed above gives an indication of the existence of the research problem. There is a possible revenue threat that municipalities need to guard against in being able to have continued financial viability and that is presented by the introduction of mixed electricity distribution networks.

In the case of Drakenstein Municipality the secondary data that were taken from a study conducted earlier sets the tone in terms of possible revenue losses that may occur if PV installations occur on an extremely rapid scale. The municipality’s cross-subsidisation model is at risk as a result of the prevalence of PV installation at higher-end consumers. It becomes important for municipalities to prepare for such possibilities by ensuring that their tariff structuring models are cost reflective and to also consider the dynamics that are linked to PV generation and the feed in of electricity into the municipal electricity grid.

The business as usual approach is thus no longer appropriate and municipal decision makers need to think further than the methods that are currently being used.

CHAPTER 3

3 LEGISLATIVE FRAMEWORK ON ELECTRICITY DISTRIBUTION AND MUNICIPAL FINANCIAL PLANNING

3.1 Introduction

The South African electricity generation and financial framework is regulated through certain pieces of legislation. These documents starting with the Constitution of the Republic of South Africa gives the legislative guidance in terms of who has the right to distribute electricity in South Africa and through what means this distribution can occur. It also provides the funding model of municipal revenue as well as guidance on the cross- subsidisation of the cost of electricity.

This chapter reviews the national legislation that relates to electricity generation and general financial management. Various pieces of legislation which directly affects how electricity is generated and distributed are discussed and how these pieces of legislation tie into municipal budgeting and financial management models. Later on in the chapter there will be a discussion on the municipal legislation which only have an impact on certain municipal areas pertaining to the distribution and supply of electricity as well as the tariff setting and general guidelines that are approved by municipalities to facilitate the environments for small-scale embedded electricity generation.

3.2 Review of national legislation relating to electricity generation and financial management.

In this context National legislation refers to legislation promulgated and signed off by the President of the Republic of South African wherein guidelines and stipulations are given which have to be adhered to by the country as whole. The legislation having an impact on this study is discussed below.

3.2.1 The Constitution of the Republic of South Africa

Section 151 (3) of the Constitution of South Africa provides municipalities with the right to manage its own initiatives for the local affairs of its community that is subject to national and provincial legislation as provided in the Constitution. Section 151 (4) of the Constitution states that national or provincial governments may not compromise a municipality’s ability or right to exercise its powers or functions.

The Constitution speaks to the objects of local government in section 152 (1) and of particular relevance in this case is section 152(1) (b) which states that the municipalities has the responsibility to ensure that their communities are provided with services in a sustainable manner and that the municipality must ensure the promotion of social and economic development. The services that are referred to in section 152 (b) are summarized in schedules 4B and 5B of the Constitution.

Section 153 of the Constitution also places the accountability on municipalities' planning, administrative and budgetary procedures to be of such a nature that it ensures that priority is given to the basic service needs of their communities. Electricity is an important funding source for local government, particularly for larger urban municipalities.

Section 156 (1) of the Constitution further gives municipalities the executive authority and the right to manage the local government matters that are listed in Part B of Schedule 4 and Part B of Schedule 5. In the context of embedded generators, Schedule 4B of the Constitution gives the municipalities the responsibility to reticulate gas and electricity (where reticulation includes the distribution of electricity and all other related services). These actions make local government a very important player in the electricity industry in South Africa.

Section 156 (2) give municipalities the authority and right to make and manage by-laws in order to enable the effective management of the matters which it has the right to administer.

Section 156 (3) state that a by-law that is conflicting with provincial or national legislation is null and void which is subject to section 151 (4). In the case of a conflict between a by-law and provincial or national legislation that is inoperative as a result of a conflict mentioned in section 149, the by-law must be regarded as valid for as long as that legislation is inoperative.

Section 156 (5) allows a municipality the right to exercise any power concerning a matter reasonably necessary for, or incidental to, the effective performance of its functions.

3.2.2 The Municipal Structures Act No. 117 of 1998

The Municipal Structures Act allows for the national Minister of local government to authorize a local municipality "to perform a function or exercise a power", including the electricity power and function, "in its area or any aspect of such function or power" as defined above.

In Section 84 (1) the act states: "A district municipality has the following functions and powers: [...] (c) Bulk supply of electricity that affects a significant proportion of municipalities in the district."

The Association of Municipal Electricity Utilities (AMEU) states that bulk supply of electricity means transmission, distribution and where applicable, generation of electricity and that this is contradictory with the reticulation of electricity set out in the Constitution of South Africa 1996 Section 156 (1).

Embedded generation has only emerged in the last few years and was not anticipated by these laws. Municipalities must purchase electricity in order to reticulate it. In the past electricity was exclusively bought from Eskom. In the view of their customers, municipalities are responsible for electricity supply. In a situation of limited supply by Eskom, municipalities should be able to access other sources such as SSEG or own generation.

3.2.3 The Municipal Systems Act No. 32 of 2000

Section 74 (1) of the Municipal Systems Act (MSA) requires municipal councils to adopt tariff policies on the levying of municipal service fees for services that are either provided by the municipality itself or by other entities through a service agreement.

Section 74 (2) (b) of the MSA specifically stipulates that the amount that consumers pay for a service should generally be in proportion to the use of that service and must be cost reflective.

Section 74(2) (c) of the MSA states that poor households must at least have access to basic services through tariffs that only cover the operating and maintenance costs; special or lifeline tariffs for low levels of consumption or basic levels of services and any indirect method of subsidisation of tariffs for poor households.

Section 95 (c) of the MSA also states that municipalities must take sufficient steps to ensure that consumers of municipal services are notified of the cost involved in the provision of the municipal services.

Section 96 (b) of the MSA requires municipalities to adopt and implement debt collection and credit control policies that are coherent with the municipalities tariff and rates policies and section 97(1)(c) of the MSA require these policies to provide for the subsidies to be granted to indigent consumers.

3.2.4 **The Municipal Finance Management Act No. 56 of 2003**

Section 17 (1) of the Municipal Finance Management Act (MFMA) requires that the municipal budget should be a schedule in a prescribed format that allows for the planning of realistically anticipated revenue.

Section 17 (2) state that an annual budget must set the tariffs for the budget year from each of the budget sources.

Section 24 (1) of the Municipal Finance Management Act (MFMA) requires the municipal council to approve the annual budget of the municipality at least 30 days prior to the start of the budget year.

3.2.5 **The National Energy Regulator Act No. 40 of 2004**

The National Energy Regulator Act established the regulator to regulate electricity, piped gas and petroleum pipe line industries. Section 4 (1) (c) of this act gives the National Energy regulator the function of undertaking the functions as set out in section 4 of the Electricity Act.

3.2.6 **The Electricity Regulation Act No.4 of 2006**

The Electricity Regulation Act 4 of 2006 as amended in 2007 (ERA) outlines the policy for the electricity supply industry. The act details the legislative requirements with regards to the generation, transmission, distribution, dispatch, reticulation, import, export and trading of electricity.

The object of the act as stipulated in section 2 speaks to amongst other things the promotion of the use of diverse energy sources and energy efficiency. This section is particularly relevant to the concept of SSEG because in the current South African electricity distribution model, SSEG brings about diversity that changes the model to a mixed electricity distribution model.

Section 4 (a) (i) of the ERA provides powers and duties to the National Energy Regulator of South Africa (NERSA) to consider and approve license applications for the operation of generation, transmission and distribution facilities, the export and import of electricity and the trading thereof.

Section 4 (a) (ii) to (vii) of the ERA further gives NERSA the power to regulate prices and tariffs, to register persons who are required to register with the Regulator in cases where they are not required to hold licenses, to issue rules to implement the national electricity framework and to enforce performance and compliance to these rules.

Section 10 of the ERA gives detail of the information that is required for the licensing of a generation plant and section 11 provides for all details that is required in the processing of a generation plant license application. NERSA determined in the Standard Conditions of Embedded Generation within Municipal Boundaries that due to the envisaged high uptake of solar rooftop installation that licensing of these PV distribution models would not be necessary and that a registration process must be conducted within municipal boundaries.

Section 16 of the ERA specifically speaks to how the tariff structuring of the electricity industry in South Africa must be structured and gives the authority to electricity distribution license holders to recover the full cost of its licensed activities, including a reasonable margin of a return. Section 16 (e) of the ERA also allows for the tariff set by the license holder to permit for cross-subsidisation amongst certain groups of consumers.

3.2.7 Electricity Pricing Policy

The Electricity Pricing Policy was promulgated in 2008 to provide national guidelines on the pricing, tariff structuring and the cross-subsidisation principle that needed to be summarised in the electricity service. Paragraph 2 of this policy document summarises the overall tariff principle as directed by section 16 of the ERA.

This paragraph further stipulates the importance of the revenue requirement for all entities that have a licence to distribute electricity in the country.

In paragraph 2.3 of the policy the principle of cost-reflectivity is discussed where utilities and municipalities were given a guideline of 5 years to ensure that all tariffs reflect the true cost of providing the service.

Paragraph 9 of the policy speaks to the cross-subsidisation principles that should be transparent and that should ensure that low income users enjoy subsidies pertaining to the electricity service.

3.2.8 Standard conditions for embedded generation within municipal boundaries 2011

NERSA approved the Standard Conditions for Embedded Generation within Municipal Boundaries in 2011. These guidelines made provision for embedded generators with up to 100 kW to register with the municipality and also to sell electricity back to the municipality.

The only problem experienced with this document is that it was approved without NERSA following the required public consultation and is thus not clear to stakeholders.

There is a view by participants that the cut-off point of 100 kilowatts is too insignificant for a majority of the anticipated small-scale embedded generators. The existing renewable energy procurement programmes also do not accommodate projects that are less than 1 megawatt. The small-scale renewable energy projects between 1 megawatt to 5 megawatts will be bought by the Department of Energy through the Small-Scale Renewable Energy Programme while the DoE will secure the large-scale projects that are bigger than 5 megawatts under the Renewable Energy Bidding Programme (REBID). There is thus no legal implementation framework for a project between 100kW and 1MW.

As a result of the above there is a general proposal that the 2011 Standard Conditions for Embedded Generation within Municipal Boundaries should be replaced by these additional guiding principles from NERSA.

3.2.9 The Integrated Resource Plan 2010

The Integrated Resource Plan 2010 was compiled and approved with the primary objective of determining the long-term electricity demand of the country and detailing how this demand should be met in terms of generation capacity, the type of the capacity, its timing and its cost.

The Integrated Resource Plan (IRP) of 2010 does not have any consideration for SSEG systems. The proposed revisions to the IRP explicitly include the consideration of SSEGs, due to the fact that the money for such systems comes in its entirety from private sources. There is significance in the scenario pertaining to the rolling out of the 10 000 megawatts that was predicted by 2010. The SSEG power should thus be purchased by a principal purchaser in order to 'render the municipalities indifferent between their Eskom supply and embedded generators that will support small-scale distributed generation' (IRP Update Report, 2013:52).

3.2.10 Renewable Energy Feed-In Tariff (REFIT)

The Renewable Energy Feed-In Tariff was introduced and announced in the year 2009. NERSA announced further changes to these tariffs in 2011. In the same year the REFIT was abolished and replaced by another strategy called the Renewable Energy Independent Power Producer Procurement Program (REIPPP).

3.2.11 National Environmental Management Act, no. 107 of 1998

The National Environmental Management Act, No.107 of 1998 (NEMA), prescribes co-operative governance in terms of the protection and the promotion of the social and environmental rights of the inhabitants of the Republic of South Africa.

Section 2(4)(a)(v) of the NEMA, urges all spheres of government to consider sustainable development by ensuring that the use and abuse of non-renewable natural resources takes into the account the exhaustion of such resources and the resultant consequences.

Section 23(2) of the NEMA sets out the general objectives of an integrated approach to environmental management to ensure that all the activities that are related to the environment and their impacts are dealt with in harmony by all three spheres of government.

Section 24(5) and (6) of the NEMA thus gives the Minister the obligation and duty to publish procedures and guidelines to enable the implementation of any actions related to environmental management and to have this procedures and guidelines gazetted through published regulations.

3.2.12 Regulations on the Establishment of Renewable Energy Development Zones (REDZs).

In February 2016 the Cabinet of South Africa approved the establishment of 8 REDZs and 5 Power Corridors also referred to as Strategic Transmission Corridors. The idea behind the establishment of these zones was essentially to create power centres that would act as anchor points for possible grid expansions in the identified areas.

The identified 8 REDZs boundaries and locations were gazetted in February 2018 as a first phase, with a further additional 3 zones gazetted in February 2021 as a second phase. These REDZs are spread across 5 provinces whilst the Strategic Transmission Corridors are classified in Central to Western corridors spreading across the entire country.

3.2.13 South African National Standards: The application of the National Building Regulations: Part X and Part XA (SANS10400-XA:2011).

The SANS standards were published in 2011 in terms of the National Building Regulations and Building Standards Act, No 103 of 1977 to guide the building and planning industry in terms of environmental sustainability (SANS 10400 part X) and energy usage in buildings (SANS 10400 part XA).

These standards provide the required guidelines to municipalities on how to enforce energy efficiency and identify the property envelopes where energy efficiency is to be implemented and also provide for the roll out of renewable sources of energy on different types of buildings.

3.2.14 Summary

The introduction of small-scale embedded electricity generation and the rights that is afforded to municipalities in terms of the Constitution may provide municipalities with alternative business models related to the electricity services. Since Schedule 4 of the

Constitution explicitly lists the reticulation of electricity and gas as a competency of local government, opportunities for municipalities may be presented to explore alternative trade and business models related to the generation of electricity by prosumers (Montmasson-Clair, Kritzinger, Scholtz & Gulati, 2017:38).

The other pieces of legislation presented above may be viewed as possible impairments to some of the business models that are related to generated electricity. If one looks at the nature of business projects that are related to generated electricity such as the building of power systems, it requires long- term agreements, which would require that municipalities must follow certain difficult processes regulated by the MFMA. In other projects such as the buying of electricity from Independent Power Producers (IPPs), the approval from NERSA is one of the biggest impairments especially since none of the legislation pieces that are related to electricity distribution and procurement cater explicitly for municipalities. (Montmasson-Clair at al, 2017: 43).

The identification of the Renewable Energy Development Zones (REDz) and Strategic Transmission Corridors provide a glimmer of hope in terms of the renewable energy forward planning for the country, especially in terms of solar energy, because the country has a very good amount of solar radiation in different regions (Akinbami, Oke & Bodunrin; 2021; 5086). However, barriers such as the non-existence of a favorable investment climate, are still hindering the success of the South African renewable energy roll out program (Akinbami et al; 2021; 5089).

3.3 Municipal financial and electricity by-laws, guidelines and policies

This section deals with the by-laws and policies which are specific to a particular municipality. The relevant by-laws and policies having a direct relation on this study are discussed below.

3.3.1 **Electricity by-law**

Municipalities are required in terms of the Electricity Regulation Act to pass by-laws that will provide the guidelines for electricity generation within that municipal jurisdiction.

The by-laws provide for the general supply conditions of the municipality, the application process for the electricity service, the tariff conditions of the municipality and the standards that are required for the proper distribution of electricity.

The by-laws also speak to the responsibilities of the municipality and its consumers as the distributors and consumers of electricity.

3.3.2 **Tariff by-law**

Municipalities are required in terms of section 74 (2) of the Municipal Systems Act to pass Tariff by-laws that influence the Tariff Policies of municipalities.

The Tariff by-law of a municipality specifies the basis that the municipality have used to differentiate between categories of its consumers. The categories of consumers can be differentiated in terms of categories of users, debtors, service providers, geographical areas and service standards as long as such differentiation does not lead to the unfair discrimination against one of these categories.

3.3.3 **Municipal guidelines for application of SSEG**

These municipal guidelines make provision for the information that is required from potential SSEG consumers when they want to install embedded generation networks at their properties. Consumers are required to conform to a set of rules related to the quality of the network and safety and will only then be allowed to feed electricity back into the municipal grid.

The guidelines also stipulate the metering requirements and the tariff principles that need to be applied, how licencing of embedded generation is to operate and also how the load profile should be managed. .

3.3.4 **Summary**

The by-laws and guidelines that the municipality has put into place have provided for an internal legislative framework that the municipality can use to regulate the generation of electricity in its jurisdiction. With these documents the municipality is able to plan how the generation of small-scale embedded electricity should be rolled out in the municipality and how the pricing of the small-scale embedded electricity should be structured.

3.4 Summary and deductions

Although South Africa has the required legislative environment geared towards the increased use of greener energy, there is a need to be more thorough in terms of the promotion of small-scale embedded generation. As a result, municipalities are becoming more and more pro-active in devising and approving policies and by-laws which provide guidelines to their consumers about how the respective municipalities are dealing with small-scale embedded generation (SSEG) within their respective jurisdictions.

A more structured and comparative approach needs to be followed on a national level to ensure that all consumers will be treated equally should SSEG be introduced on a rapid scale as assumed in this study. Even though NERSA would not undertake the licencing, there should still be national laws and guidelines that will enable uniformity in SSEG across the country. A considerable amount of alignment between national legislation and municipal policies and by-laws are required to enable such an approach.

The identification of the catalyst REDZs, and Strategic Transmission Corridors creates an enabling policy environment for renewable energy expansion, especially the expansion in SSEG. Though this would be a big move towards the protection of the environment and decrease in the carbon footprint of the country, this might not be such good news for municipal financial models. This together with the SANS 10400 XA regulations if expanded to enforce renewable energy as a standard for new building developments would further exacerbate the challenge for municipal business models pertaining to electricity distribution.

CHAPTER 4

4 ELECTRICITY AS A REVENUE SOURCE AT DRAKENSTEIN MUNICIPALITY

4.1 Introduction

This chapter gives the reader an overview of Drakenstein Municipality as an electricity service provider in its jurisdiction while also providing electricity to a small group of consumers outside its jurisdiction. The chapter starts of by giving a brief overview of the municipality followed by an in depth discussion on how the electricity distribution in the municipality is conducted. Key to the discussion will be the climatic conditions of the Drakenstein area which makes it lucrative for consumers to opt for alternative electricity generation. The importance of the electricity revenue stream in the municipality will be illustrated by a discussion relating to the revenue budget electricity tariffs of the municipality as well as the performance of actual revenue target versus the budgeted revenue. The chapter concludes with a brief discussion of how the Drakenstein Municipality's current mixed electricity distribution is structured and how it is currently been administered.

4.2 Overview of Drakenstein Municipality

Drakenstein Municipality with municipal code WC023 is located within the Cape Winelands District Municipality. From Figure 4.1, it can be noted that the municipality consists of the towns of Paarl, Wellington, Simondium, Hermon, Gouda and Saron that cover an area of 1,538 km². (Drakenstein, 2017: 123).

According to the community survey of 2016, the Drakenstein Municipality's population was 280,195 (IDP, 2018:46). The town of Paarl is regarded as the hub of the municipality where the main businesses and major attractions are situated. The town is near the N1 national road giving its residents and businesses quick access to the City of Cape Town. The area is famous for its wines, grapes and its tourist attractions.

Figure 4-1: Drakenstein Municipality Map (Source: IDP, 2017: 123)

The area also boasts a number of prestigious low-density estates along the R 301 road to Franschhoek where golf and polo estates like Val de Vie, Pearl Valley and Boschenmeer are situated. On the other side of Paarl away from the main CBD are the areas of Paarl East, Groenheuwel, Fairyland, Smartie Town and Mbekweni, which are predominantly high-density areas where the black and coloured community of the area reside.

Wellington is the second biggest town in the Drakenstein Municipality and is situated on the Northern side of municipality approximately 13km from Paarl. The town of Wellington have a mixture of both higher-end and lower-end consumers, farms and industries as well as commercial consumers of municipal services.

The last portion of Drakenstein Municipality is made up of the towns of Saron, Hermon and Gouda, situated approximately 73 km from Paarl. Saron was classified in terms of the Transformation of Certain Rural Areas Act, No. 94 of 1998 (TRANCAA) as one of the 23 rural areas where the land is held by residents on a communal basis. This community was incorporated into the Drakenstein municipal area during the amalgamation and restructuring of municipalities in 2000 and the Drakenstein Municipality currently has the responsibility to provide the required services to the area. The electricity of Saron, Gouda and Hermon is provided by Eskom. Drakenstein Municipality also provides electricity to Pniel, Hollandse Molen and Dwarsrivier which is part of the Stellenbosch Municipality municipal area.

4.3 Electricity distribution in Drakenstein Municipality

In South Africa, the electricity supply industry is organised in three elements, namely the generation of electricity, the transmission of electricity and lastly the distribution and sale of electricity which also includes the importing and exporting of electricity (Eskom Integrated Report, 2017:4). Eskom is the main generator of electricity in the country and take on the transmission and distribution of electricity in bulk to its redistributors.

The National Electricity Regulator of South Africa (NERSA) regulates the licencing of redistributors of electricity in terms of the Electricity Regulations Act, No.4 of 2006. NERSA also manages the revenue requirements of Eskom as the national distributor of electricity through the multi-year price determinations (MYPD) applications that has to be submitted by Eskom on an annual basis to NERSA (Eskom Integrated Report, 2017:4).

In terms of the South African Constitution municipalities have the executive and legislative authority within their respective jurisdictions, and also have the right to govern its affairs subject to legislation. Schedules 4B and 5B of the Constitution stipulates the services which municipalities must deliver in their respective jurisdictions with the provision of electricity being one of them. Even though these municipalities have the right to act as redistributors of services, they have to be licenced in terms of national legislation in order to conduct the delivery of services. Drakenstein Municipality is licenced by the government through section 6 of the Electricity Regulation Act, No. 4 of 2006 (ERA) to redistribute electricity within its municipal jurisdiction. This redistribution licence provides the municipality with the following: (1) power to reticulate electricity within its area; (2) having the responsibility of managing and maintaining the infrastructure associated with the distribution of electricity; (3) the setting of tariffs and (4) the responsibility to manage all other services related to the electricity service. The municipality is required to use the most appropriate voltage level as a distributor of electricity in its jurisdiction to ensure that electricity is carried to its furthest consumers in the area.

Drakenstein Municipality distributes electricity to 68,426 consumers and has an estimated monthly notified electricity demand of 175 Mega Volt Amp (MVA). The electricity is supplied by Eskom to the municipality on a monthly basis. (Draft Annual report, 75, 2018). This monthly notified demand from Eskom secures the 175MVA of electricity for Drakenstein Municipality from the Eskom national grid. This means that the municipality purchases electricity on a time-of-use basis from Eskom. The purchased energy is metered into the municipality through 5 metered points of connection called substations. These 5 substations are Dalweiding, Parys, Dwarsrivier, Kliprug and Slot van die Paarl. Eskom applies the Megaflex time- of-use tariff to each of the distribution points that the municipality uses as energy entry points in its jurisdiction. Eskom defines the time-of-use periods as blocks of time linked to the size of electricity demand which reflect the times when electricity demand is at a low, medium and high demand. These blocks of time are normally called peak (high electricity demand), off-peak (low system demand) and standard (medium system demand) periods and differ between the different electricity demand seasons (Eskom, 2016:9).

According to the Eskom tariff booklet, there are four urban tariffs for non-local authorities and local authorities., These tariffs are : Nightsave Urban Large, Nightsave Urban Small, Megaflex and Miniflex (Eskom, 2016: 2). The Nightsave Urban Large and Small tariffs are appropriate for urban consumers with load factors that have a Notified Maximum Demand (NMD) that is greater than 1 MVA or Nightsave urban large consumers and that have a NMD that is between 25 Kilovolt-ampere (kVA) and 1 MVA.

The Miniflex tariff is applied to urban consumers that has a NMD that is between 25 kVA and 5 MVA while the Megaflex tariff is applied to consumers with an NMD that is larger 1MVA and has the capability to change the energy demand of their consumers between the three different time of use periods (peak, off-peak and standard periods) (Eskom, 2016: 15).

Drakenstein Municipality with its reported NMD of 175 MVA fits the profile of a local authority that is charged by Eskom on the Megaflex tariff. The distribution network of Drakenstein Municipality from the time electricity is purchased to the time that electricity is distributed to the different consumers is described below.

The 175 MVA of electricity that the municipality require on a monthly basis is purchased at a high voltage of 66kV and 132kV respectively. Once the electricity is within the municipal distribution area it is transformed down to 11,5kV (11,500V) low voltage electricity so that it can be distributed via the municipal ring main unit. The 11.5kV electricity moves through the switchgear unit of the municipality where it is further transformed down from 11.5kV to 400 V through various mini substations. The various mini substations within the municipal ring main unit supply the different domestic and commercial consumers with electricity through what is called service connections that enables the transmission of electricity directly to small domestic and commercial consumers.

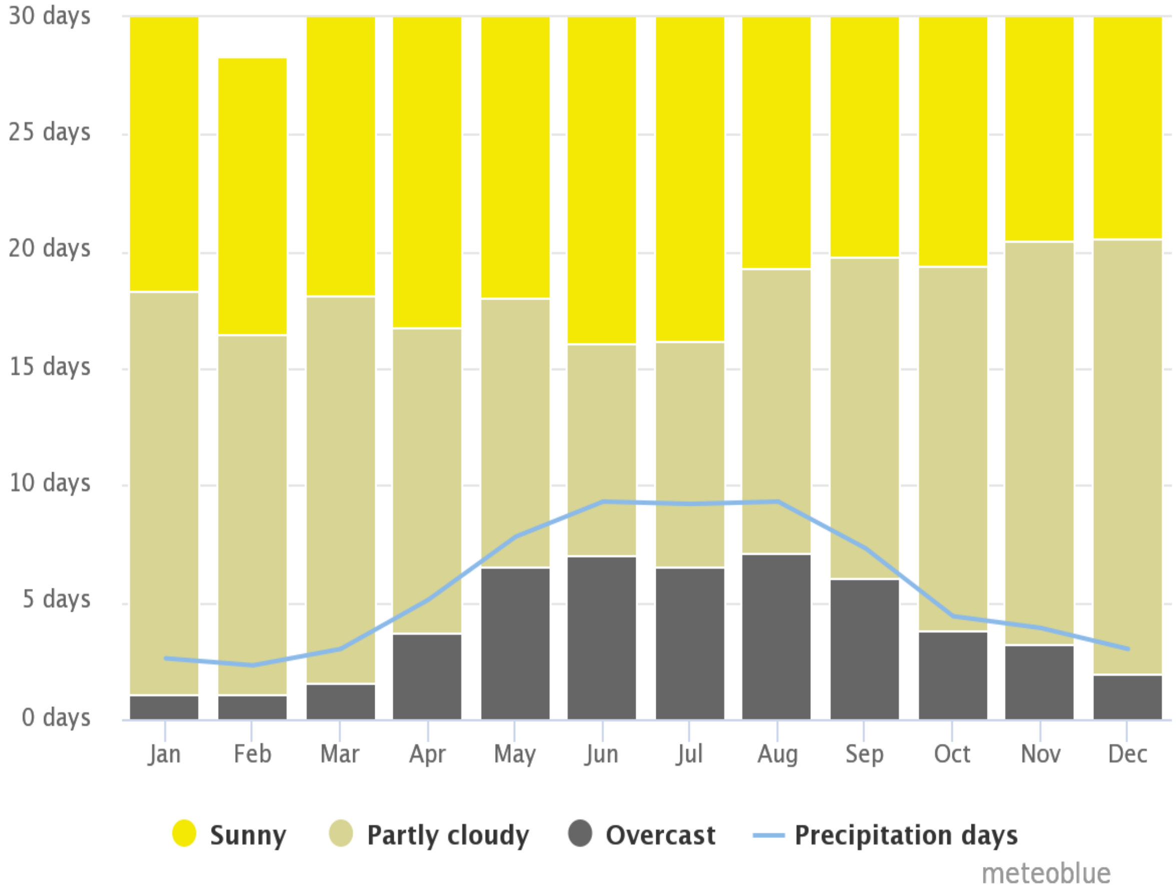
Within the municipal ring main unit, the transmission of bulk electricity is directly possible from the 11,5kV line where big industries like factories are directly provided with bulk electricity from the municipal electricity grid.

4.4 Climatic conditions in Drakenstein and solar potential

4.4.1 Paarl Climate

The climate diagram in figure 4.2 below is extracted from the meteoblue website which bases its information on a weather simulation model that observes weather patterns for a period of 30 years. This diagram illustrates the amount of days the Paarl area experiences sunshine in a 12-month period versus days that are partly cloudy and overcast.

Figure 4-2: Number of sunny days versus partly cloudy & overcast days in Paarl

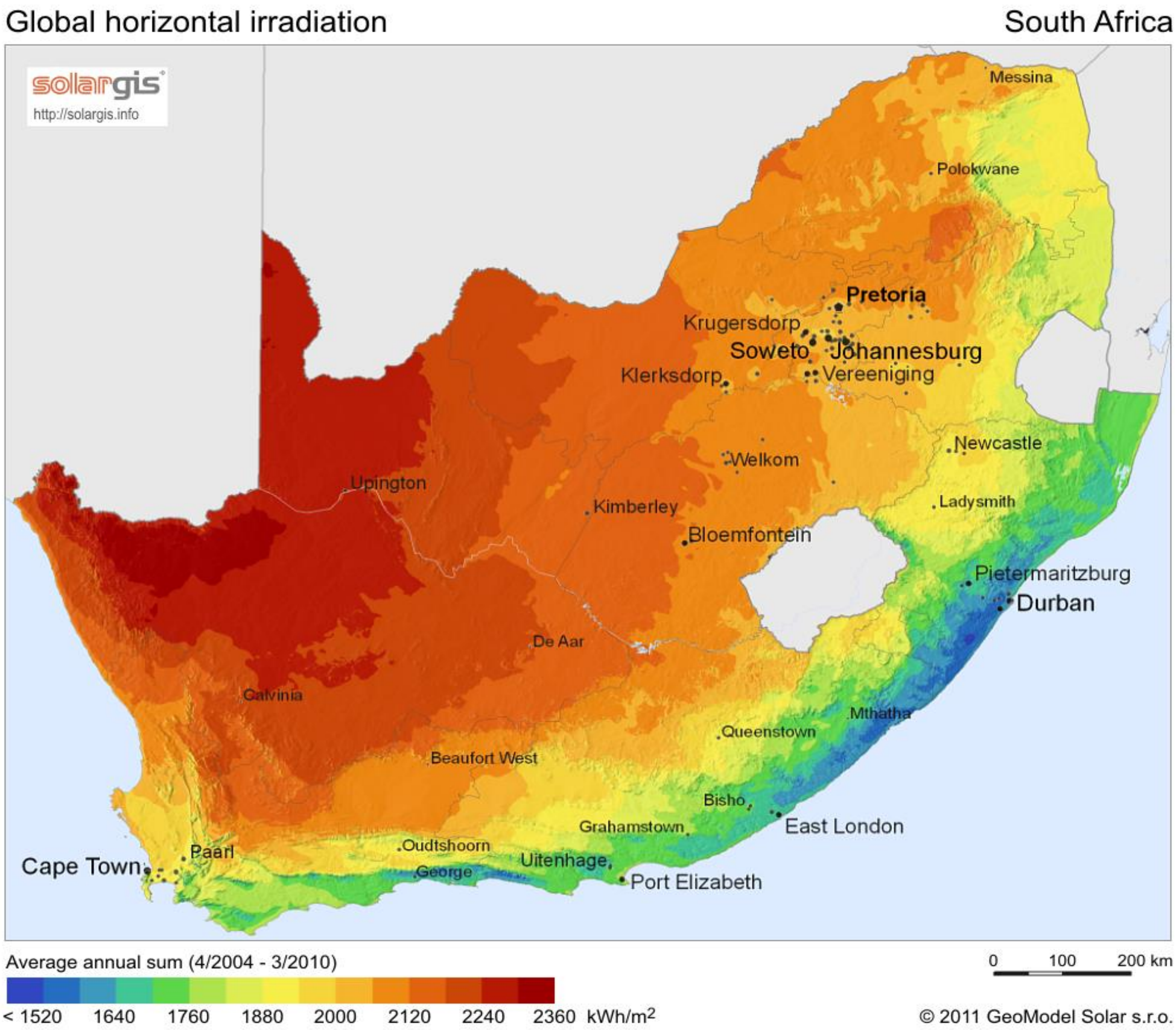


According to the figure the sun shines for a maximum of 12 hours a day during summer and a maximum of 7 hours in winter in the Paarl area. The Department of Energy further confirms that South Africa can be regarded as a potential contender in the generation of solar energy because the sun shines on average for than 2500 hours a year. This sunshine pattern is more than that of most European countries which has successfully implemented solar PV.

4.4.2 **Paarl Solar PV Potential**

The generation of electricity through solar PV has enormous potential in South Africa due to the high solar radiation that South Africa has compared to other countries. The Western Cape government has identified electricity generation though solar PV as one of the main short-term interventions that can be rolled out in the province. Figure 4.3 below illustrate the reported solar output capacity for different cities in South Africa. The solar output potential on this map is measured as the quantity of kilowatt hour (kWh) of electricity that can be produced during a specific year.

Figure 4-3: Solar Output Map South Africa: Source Solar GIS



The potential solar output capacity of Paarl falls between 1640 and 1760 kWh as shown on the map above. In the study that was conducted by the WWF in 2015, the approximated PV potential of Paarl was identified and could become 1,632kWh/kWp, if it was optimally utilised (WWF, 2015:15). Although the shading caused by the shading of Paarl Mountain effects the time that the sun is shining in Paarl it still does not reduce the capacity of the area to produce electricity through solar PV.

4.5 Drakenstein Municipality revenue budget and performance

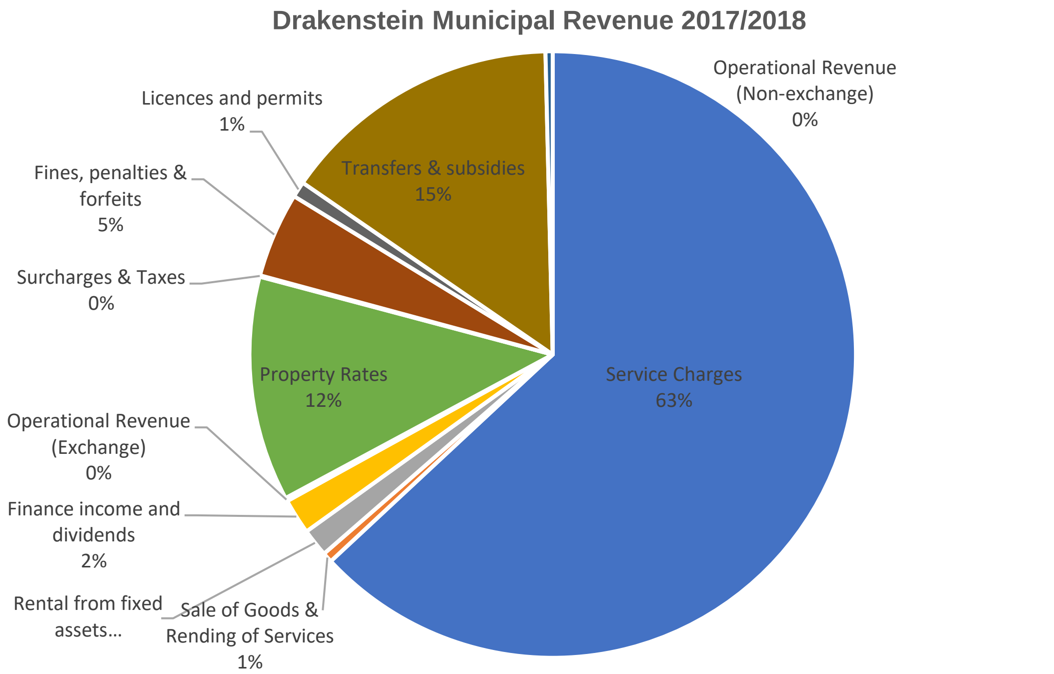
Drakenstein Municipality's revenue budget for the 2016/2017 financial year amounted to R1.8 billion. The funding model of the Drakenstein municipal budget is represented by two revenue types. The first one is revenue that is generated from exchange transactions which consist of services charges (representing revenue from the sales of electricity and water and also from the provision of refuse removal and sanitation services), the sale of goods and services, rental of fixed assets, finance income and dividends and operational revenue from exchange transactions.

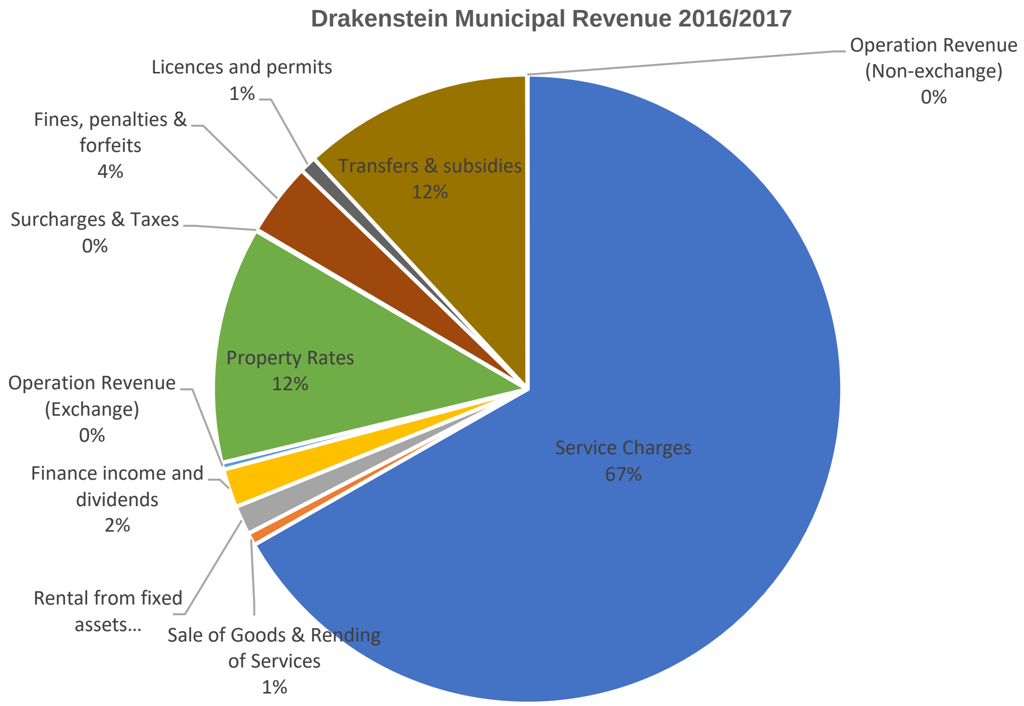
The second revenue type is revenue from non-exchange transactions which consist of revenue that is generated from Property rates, Surcharges and Taxes, Fines, Penalties and forfeits, Licences and permits, revenue from Grants and subsidies and operational revenue from non-exchange transactions.

Figure 4-4 below shows that the municipality's major funding source comes from the revenue generated from services charges which accounted for 67% of the revenue generated by the municipality in 2016/2017. This percentage decreased to 63% in the 2017/2018 financial year. This service charge component represents revenue that is generated from electricity sales, water sales, refuse removal and sanitation services. This picture tells us that the municipality is highly dependent on the revenue that is generated from service charges in order to survive. Any drastic changes in the delivery model of these services has the potential of providing problems for the municipality in funding its operations. In addition to the above the municipality must ensure that the assets, which are directly linked to the provision of these services, are maintained properly to enable and ensure a longer lifespan and revenue generating capacity of these assets.

It is also the responsibility of the municipality to ensure that the pricing structures of these services are up-to-date with proper data and pricing studies in order so that the municipality is able to plan properly for its activities. If the municipality makes errors in this regard it could have a negative effect on service delivery.

Graph 4..1: Municipal Revenue Breakdown as per Audited Annual Financial Statements (AFS) 2016/2017 and 2017/2018





When this service charges component is further broken down it is clear that the sale of electricity represents the largest revenue category in this revenue stream. Table 4.1 below provides a breakdown of the service charges component for the 2016/2017 and 2017/2018 financial years. According to table 4.1 it is clear that the municipality relies heavily on the sale of electricity as a funding source for its operations. Something else which can be noted from table 4.1 is the decrease of the electricity component from 53% in 2016/2017 to 48% in the 2017/2018 financial year. The electricity service is a major source of revenue for the municipality and any changes must therefore be closely monitored. This change from 53% to 48% is a sign that the municipality must pay closer attention to this revenue stream.

Table 4.1: Services Charges Breakdown as per 2017-2018 Audited AFS

Service	Amount 2017-2018	%of Total Revenue	Amount 2016-2017	%of Total Revenue	Increase / Decrease in Revenue	% of Revenue Growth
Electricity	R 988,802,269	48%	R 982,657,031	53%	R 6,145,238	3%
Water	R 204,535,986	10%	R 165,573,102	9%	R 38,962,884	19%
Refuse Removal	R 120,931,290	6%	R 106,335,063	6%	R 14,596,227	7%
Sanitation	R 101,204,564	5%	R 84,576,640	5%	R 16,627,924	8%
Other	R42,670	0%	R 38,743	0%	R 3,927	0%
Total	**R 1,415,516,779**	69%	**R 1,339,180,579**	73%	**R 76,336,200**	**38%**
Less: Income Foregone	R 123,216,298	-6%	R 106,240,000	-6%	R 16,976,298	-8%
Total Service Charges	**R 1,292,300,481**	**63%**	**R 1,232,940,579**	**67%**	**R 59,359,902**	**29%**
Total Revenue	**R 2,049,181,217**		**R 1,846,926,150**		**R 202,255,067**	

4.6 Mixed electricity distribution in Drakenstein Municipality

4.6.1 **General guidelines for small-scale embedded generation installations**

Drakenstein Municipality has devised guidelines for Small-Scale Embedded Generation in its jurisdictional area, where the municipality provides the criteria and steps that residential and commercial consumers should follow to install these grids with the connected devices on their premises.

Consumers who want to make use of mixed generation grids for other uses are required to obtain generation licences and exemptions from NERSA (Drakenstein SSEG guidelines, 2018: 9). In the Drakenstein context, the municipality does not require proof of licences and exemptions from consumers who are registering for SSEG for their own consumption and who have grid connections of below 1MVA. This occurs with a provision that the electricity that is fed into the municipal grid by the consumers over a period of 12 months, may not exceed the electricity used by those consumers.

The guidelines of the municipality further require consumers to be “net consumers” which means that they on average buy more electricity from the municipality over a period of 12 months than what they feed back into the municipal network. The municipality does not allow SSEG consumers who are “net generators”, i.e. those who purchase less electricity from the municipality than what they feed back into the municipal network (Drakenstein SSEG Guidelines, 2018: 12). Although the municipality does not require generation licences from the consumers, the municipality still has a reporting obligation to NERSA where they have to report on the number of consumers on SSEG and also their generation consumption patterns.

These guidelines also prescribe the sizes of the SSEG service connections from a minimum of 2.3 kVA and a maximum of 17.3kVA for residential consumers and to a maximum of 1 MVA for commercial and industrial consumers.

4.6.2 **Metering requirements**

The metering requirements are linked to the specific needs of the consumers where residential, commercial and industrial consumers who want to connect to SSEG are required to install devices on their meters preventing the reverse energy flow back into the municipal grid. These consumers do not receive any compensation for returning the power flow back into the municipal grid. Consumers wishing to push energy back into the municipal grid are required to install bi-directional smart meters that enable power to be pushed back into the municipal grid. Another requirement for consumers with a single and three-phase supply is the installation of a meter box on the property of the consumer. The municipality’s electrical services department ensures the electronic reading of these bi-directional meters on a monthly basis to determine the amount of electricity used from the municipal grid and the amount of electricity that has been pushed back into the grid by the Co-generation consumers.

4.6.3 **Tariff structuring**

Since the municipality approved the first guidelines in 2015, 81 domestic applications and 15 commercial applications has been approved where consumers currently generate their own electricity and feed it back into the municipal grid for own consumption. Thus, in a space of three financial years there has been a sign of growth in own generation of electricity within the municipality.

The municipality devised a tariff structure which they call the ‘co-generation” tariff to facilitate the above. This tariff structure provides the electricity pricing principles to the consumers where they generate electricity and push it back into the municipal grid. It also provides the tariffs in the case when the consumers consume electricity straight from the municipal grid which comprises of: (1) a basic service charge; (2) a kWh unit charge for electricity consumption and (3) a rate per kWh that is applied to the electricity that is fed back into the municipal grid.

Although there is a separate tariff structure for the co-generation consumers, all the rules that are applicable to the normal domestic, commercial and bulk time-of-use consumers will still be applicable to the co-generation consumers. The general electricity safety requirements comply with the municipality’s Electricity Supply By-Laws, the NRS 097, the Occupational Health and Safety Act (OHASA) and the Electricity Regulations Act (ERA).

In order to accommodate the above tariff structure, the municipality had to devise special billing system specifications to enable this mixed distribution of electricity. The municipality uses the Business Connection system (Solar) for all of its financial transactions and had to be programmed to properly account for credits, where electricity is pushed back into the municipal grid and also for the debits where consumption from the municipal network occurs. The program has also been programmed to enable the equalising of both of the debits and credits as well as the clearing of the credits after a 12 month period.

4.7 Conclusion and deductions

The aim of this chapter was to give a brief outline of the electricity distribution functions of the Drakenstein Municipality and also how the electricity service is linked to the financial model of the municipality. The tariff structures used by the municipality to levy electricity services to its consumers was also explained in this chapter and gives an indication of what informs the municipal revenue budget. The solar generation potential of Paarl was also discussed which illustrated that a rapid uptake of solar PV on a large scale could be possible in this area given the sunshine patterns which are far better than that of European Countries who are currently at the forefront of solar electricity generation.

The conclusion that can be made is that the municipality has embraced the potential for solar PV in the Drakenstein Municipality. The question however remains how this interest in solar PV uptake will take off in the municipality and if the current tariff structures are sufficient to curb any possible negative impact that may arise from a rapid uptake of solar PV in Drakenstein Municipality.

CHAPTER 5

5 RESEARCH DESIGN AND METHODOLOGY

5.1 Introduction

In chapter 1, it was stated that the researcher will follow a sequential explanatory research design and that Drakenstein Municipality will be used as a case where the study will be based on a combination of empirical information that uses existing secondary data from the municipality. The study objectives are aimed at understanding the current electricity tariff model for small-scale embedded electricity generation of the municipality, and also at suggesting alternatives and thus it seems best that both quantitative and qualitative data is collected and analysed.

This chapter looks at the following: (1)the aim and rational of the study; (2) the design of the study; (3) the methodology to be followed and (4) the research instruments that will be utilised in the study. It also looks at the manner in which data is to be collected and the relevant stakeholders in the data collection process as well as the analysis of the collected data.

Lastly the identified or imagined limitations to the study are discussed to conclude the chapter.

5.1.1 **Aim of the study**

The overarching aim of the research is to fulfil the objectives of the study that is to (1) examine the literature on the distribution of electricity and tariff setting. (2) determine the legislative and policy imperatives related to electricity distribution in South Africa, (3) determine the basis of the current co-generation tariff of the municipality and the current tariff modelling in Drakenstein Municipality. (4) determine how the cross-subsidisation of lifeline consumers will potentially be affected by an expansion in small-scale embedded generation and the possible impact on the indigent consumers of the municipality. (5) propose a tariff model that can minimise the risks of revenue loss to the municipality and enable a cross-subsidisation model that will benefit the lifeline consumers of the municipality. In order to achieve these objectives, it becomes important to structure the research in phases in order to properly assess the literature, legislation and secondary data sets of Drakenstein Municipality in to in the end formulate objective 5 of the study. As discussed in chapter 1, phase one of the study will be used to address objectives 1, 2 and 3, and phase two of the study will address objectives 4 and 5.

5.2 Rationale of the study

In order to answer the research question and fulfil the required objectives, the researcher used a mixed methods research model. This model enables the collection and analysis of both quantitative and qualitative data sets in order to reach the objectives of the study. The use of the mixed methods approach will also enable the researcher to establish the causal relation between the independent and dependent variables of the study.

5.3 Research design

The research design can be described as a proposal that stipulates the kinds of information that are pertinent to a particular research problem, and which also provides specifications of the methods that will be used to collect and analyse data (Kothari, 2004: 32).

The design of the study is of an explanatory nature and a case study format will be followed in order to address the objectives of the research. A case study is regarded as a useful tool in explanatory design, because it gives the researcher the ability to understand prevailing phenomena and to use it to study the effects of adjustments and improvements (Martin & Harrington, 2012:28). This occurs through the gaining of intensive information about the particular instance. The explanatory design also assists the researcher in identifying connections between the variables in the study and actions and events that can affect these variables (Babbie & Mouton, 2001:81).

Drakenstein Municipality is used as a case study wherein the explanatory sequential design is followed through the collection and analysis of both quantitative and qualitative data. The results of the study will incorporate both inputs from the quantitative and qualitative data analysis to ensure that the study objectives are addressed.

A quantitative method to research is described as research which aims to produce data in a measurable form that can be analysed by making use of quantitative analysis in various forms. This form of research is also classified into simulation, experimental and inferential research approaches (Kothari, 2004: 5). For the purpose of this study the researcher has opted to use the simulation method for the quantitative part of the data collection and analysis. Kothari defines simulation as the building of an imitated setting wherein the data that are relevant to the study can be produced. This model openly includes uncertainty in one of the study variables to allow the input variable to take on different forms, in order to assess the impact on the dependent variable (Albright, Winston & Zappe, 2011:918). The aim of the researcher is to discover if the independent variable will have an impact on the dependent variable through the manipulation of the independent variable, which will justify the use of a simulation approach for the quantitative part of the study (Cooper & Schindler, 141: 2006).

The source of the quantitative data to be used for the first part of the data collection process will be the secondary data sets of Drakenstein Municipality, from both internal and external sources. The results of the analysed secondary data will form the basis of the qualitative data collection and analysis that is needed to complete the study.

A qualitative method to research relates to the independent assessment of outlooks, conduct and views in order to discover underlying motives (Kothari, 2004:20). Thus, in terms of qualitative methods, the insights of the researcher are captured in a form that is not subjected to difficult quantitative analysis.

The qualitative portion of the study will entail an unstructured interview with an expert in the Electrical Engineering department of the municipality. Unstructured interviews are defined as interviews that do not have a pre-determined system of questioning and recording (Kothari, 2004: 98). This manner of interviews gives the researcher the flexibility to ask additional questions if the need arises.

The interviews occurred via face-to-face contact which each participant who received the interview questions before the date of the interview.

Mixed method to research relates to assessments based on the assumption that the gathering of diverse forms of data provides a more comprehensive understanding of the research problem that is being investigated (Creswell, 2014: 19).

The explanatory sequential mixed method is an approach where the researcher first conducts quantitative research, examines these results and then builds on the outcomes to clarify these results in more detail with qualitative data (Creswell, 2014: 15). This is the approach that has been used in this study where the results of the quantitative part of the study have been used as a basis for the qualitative portion of the study. This has assisted the researcher in validating the results that was obtained from the analysis of the quantitative data.

5.4 Research methodology

The research methodology is generally regarded as a general research plan that illustrates how the research assignment should be carried out. It also identifies the approaches that must be used in the research project (Ugwuowo, 2016:4). The main aim of the research methodology is the following: (1) to clarify the nature and the procedure of the research and (2) to allow those reading the research to be in a position to conduct their own investigations and find their own solutions to research problems (Welman, Kruger & Mitchell, 2005: ix). The research methodology also provides the manner in which the research problem can be solved in a systematic way (Kothari,2004: 25).

Welman et al (2005) distinguish between research methodology and research techniques and methods and states that it has a wider scope than research methodology (Welman et al, 2005:2).

The independent variable of the study refers to the item which can be manipulated to determine its effects of the dependent variable (Cooper & Schindler, 40: 2006). In the case of this study the independent variable is the uptake of PV to create distributed electricity. On the other hand, the dependent variable of a study refers to those items that are measured through the study and which are influenced by the independent variable (Cooper & Schindler, 40: 2006). In the case of this study the dependent variable is the electricity revenue that is generated by Drakenstein Municipality.

5.4.1 Research instruments

5.4.1.1 Populations and sampling

The population in a research represents the complete set of cases from which a sample can be extracted. Thus, a research problem normally relates to a particular population and that population includes all the units to be analysed for research purposes (Welman et al, 2005: 52). In the case of this study the unit of analysis is the uptake of SSEG in the Drakenstein Municipality and how this uptake will affect the electricity revenue generation capacity of the municipality. The population in question in this study represents all of the revenue that is generated from the sale and the distribution of electricity. The main focus in terms of sampling will be those consumers who has moved away from using only electricity sold to them by the municipality , to the generation of a portion of electricity by themselves through the uptake of PV Solar panels.

The sampling technique that has been used entails a non-probability sample where some participants in the population were not selected for the sample. The population was further analysed in conjunction with the analysed sample for SSEG to determine the level of cross-subsidisation and how this level of cross- subsidisation is influenced by the sampled information.

5.4.2 **Data collection instruments**

In research there are various types of data collection techniques that can be used to collect data that is relevant to the research problem and the solving thereof. In order to ensure that the researcher gets to the root of the research problem, the correct data must be collected in the correct form. To ensure proper data collection, the researcher is required to guarantee that the type of data collection method or technique chosen complement the type, range and object of enquiry of the study (Kothari, 2004:112).

In the case of this study, the data will be collected from secondary data for the quantitative portion of the research and via unstructured interviews with two professionals at Drakenstein Municipality for the qualitative portion of the study. The two data collection techniques that are used by the researcher are discussed below.

5.4.2.1 **Secondary data**

Secondary data refers to data that has already been collected by other persons or organisations and that has already been approved through a statistical process (Kothari, 2004:95). The secondary data related to the research problem is mainly electricity sales statistics for normal municipal consumption and the electricity statistics of consumers who use both the municipal grid and alternative sources of energy to supplement their electricity consumption need.

NERSA also requires from municipalities through the Electricity Regulations Act to develop cost of supply studies to ensure that the tariffs that are set for electricity are based on the actual cost of providing the service to the consumers. These cost of supply studies are important documents for both municipalities and external parties and clearly outlines how the cross-subsidisation models of municipalities are structured. The latest cost of supply study of Drakenstein Municipality was not used because the municipality disagreed with the results of the study and never implemented it. Other statistical documentation that is also related to the electricity services will also be examined.

5.4.2.2 **Interviews**

Kothari describes the interview method of data collection as a spoken question and answer session which can be conducted via face to face or the telephone (Kothari, 2004: 97). These interviews can be conducted in either a structured manner where questions are pre-set and there is a high standard of coding techniques that are used by the researcher or in an unstructured manner, where questions and structure of the interviews are flexible and dependent on the outcomes of the particular interview setting.

For this study the researcher chose to use the unstructured interview method, where one professional from the municipality who works with electricity was interviewed. The results that were obtained from the secondary data analysis were used to formulate the basis of the interview questions. The interview questions posed to the participant is annexed as Appendix A.

5.4.3 **Data collection and analysis process**

The data collection and analysis process will be structured in four phases where phases one and two will deal with the collection of quantitative data in phase one, and the difficult analysis of the collected data in phase two. Phases three and four will deal with the collection and analysis of the qualitative data.

5.4.3.1 Data analysis instruments

To formulate the results of the study the researcher used the Data Analysis Toolpack on Excel to determine a trend and growth forecast from the electricity revenue data from the municipality, which was followed up with an unstructured interview with the Senior Manager of Electro Electrical Engineering.

5.5 Research limitations

The unstructured interview that was conducted whilst doing the qualitative portion of the research might lead to comparability problems between the professional that was interviewed and other industry experts. Due to the flexibility in this type of questioning, it can be that the recorded answers might have different perspectives that cannot be easily compared to the collected data.

CHAPTER 6

6 STUDY ANALYSIS AND DEMONSTRATION OF RESULTS

6.1 Introduction

This chapter is divided into four sections and involves a discussion of each of the phases that are outlined in the research methodology. Since the study is sequential and involved the collection of both quantitative and qualitative data, the researcher started off with the collection of the quantitative data(collection of the electricity sales database of the municipality for the 2017/2018, 2018/2019 and 2019/2020 financial years, Eskom electricity purchases data for 36 months, the municipal cost of the supply study, SSEG consumer patterns over 36 months and other secondary data that are available to the researcher relating to tariff setting and modelling of the municipality). The main source of the information is the Solar Financial System that the municipality uses and the electricity pre-paid vending system where pre-paid electricity sales are managed from. This data collection and presentation process represents the first phase of the research methodology.

The second phase of the research methodology deals with the analysis of the collected quantitative data.

6.2 Phase one – Quantitative data collection

The quantitative data collection phase of the study entails the following: (1) the collection of base data from various sources within the municipality to determine what the municipal electricity sales revenue is made of; (2) the amount of energy that the municipality purchases from Eskom;(3) the consumer patterns of municipal consumers especially the SSEG consumers, and (4) the current cross-subsidisation model of the municipality in terms of electricity through patterns that was identified in the municipal Cost of Supply Study. The collected data is discussed below.

6.2.1 **Electricity sales data**

The financial system of the municipality provides for an extraction of the electricity sales data for each consumer group which forms the first part of the quantitative data collection portion of the study. A summary of the information that was received from the municipality is depicted below per consumer group for the 2017/2018, 2018/2019 and 2019/2020 financial years.

Table 6.1 Electricity Sales Statistics Summary 2017/2018 - 2019/2020

ELECTRICITY BASIC CHARGES, CONSUMPTION & UNITS			
	2017/2018	**2018/2020**	**2019/2020**
Basic Rand Value	**119,861,144.77**	**124,426,792.70**	**149,526,089.31**
Agriculture	14,702,093.27	14,987,130.83	16,176,600.18
Business	11,388,503.54	12,165,776.30	13,779,196.18
Domestic	79,671,433.75	82,028,715.16	103,233,993.82
High Tension	-	-	2,581,368.26
Low Tension	7,693,133.90	8,339,175.38	4,021,549.17
Low Tension - KVA	-	-	3,440,031.81
Municipal	6,405,980.31	6,905,995.03	6,293,349.89
Consumption Rand Value	**654,190,209.85**	**705,336,114.08**	**825,895,821.23**
Agriculture	39,676,156.50	41,585,555.57	43,189,895.84
Business	49,853,745.11	55,604,826.33	61,570,995.42
Domestic	92,157,791.51	95,833,810.49	103,261,520.86
High Tension	275,759,152.61	258,872,421.06	299,178,516.51
High Tension - KVA	1,621,258.13	29,900,057.31	96,506,902.02
Low Tension	154,147,059.77	141,923,251.47	111,643,637.73
Low Tension - KVA	1,015,549.88	25,585,549.93	45,238,199.79
Municipal	7,110,907.76	9,320,857.70	5,117,909.11
Municipal	2,910,752.01	4,290,925.32	6,409,426.47
Municipal Low and High Tension	15,053,330.01	17,635,261.13	15,826,454.57
Municipal Low and High Tension - KVA	215,272.32	2,799,434.22	7,270,321.36
Municipal Street Lights	14,669,234.24	21,984,163.55	30,682,041.55
Units	**618,001,258.10**	**638,700,759.60**	**587,080,524.50**
Agriculture	34,245,018.00	33,640,932.00	30,725,096.00
Business	32,279,596.00	33,804,574.00	33,548,640.90
Domestic	64,349,992.00	62,732,407.90	59,976,438.00
High Tension	231,297,984.70	238,554,719.00	263,862,768.80
High Tension - KVA	64,963,717.00	66,829,060.40	42,544,632.70
Low Tension	114,645,840.81	116,141,490.10	87,029,650.00
Low Tension - KVA	40,683,597.48	42,419,832.50	28,505,399.10
Municipal	4,713,773.67	4,856,708.70	2,605,913.60
Municipal	1,983,615.00	2,772,370.00	3,643,348.00
Municipal Low and High Tension	10,624,457.44	14,418,494.50	13,380,501.80
Municipal Low and High Tension - KVA	8,627,307.00	8,917,505.50	4,620,143.60
Municipal Street Lights	9,586,359.00	13,612,665.00	16,637,992.00

The municipality sells electricity to its consumers through both conventional credit meters and pre-paid electricity meters. The municipality manages the sales on these meter types from different systems where the conventional credit meters are read in a six weeks cycle every month by meter readers. The readings that are obtained by the meter readers through portable devices are uploaded in the financial system, Solar where the approved tariffs of the municipality are applied in order to create the electricity bill of each consumer. The municipality also uses pre-paid electricity meters which work differently from the credit meters explained above. In the instance of pre-paid meters, the consumers buy the electricity from the municipality upfront. Thus, no readings are required. At the point of purchase the consumer obtains an electricity token with the electricity kilowatt hours equivalent to the amount tendered for the electricity units. These sales are also based on the approved annual tariff structures of the municipality. Table 6.1 above illustrates the electricity sales summary for the financial years 2017/2018 until 2019/2020 for electricity sold through conventional credit and pre-paid meters. The detailed sales statistics are attached as **Appendix B**.

6.2.2 SSEG consumption patterns

In addition to the above an extract was done on the amount of electricity generated by prosumers and fed into the municipal grid. A summary of this extract is presented in Table 6-2 below for the three financial years in question.

Table 6.2: Summary of SSEG feed-in units and rand value from 2017/2018 - 2019/2020

Debtor Type	Tariff	2017/2018		2018/2019		2019/2020	
		Units	Amount	Units	Amount	Units	Amount
Bulk Time of Use	Bulk Time of Use	(1,071,956.00)	(816,065.71)	(1,524,620.00)	(1,125,582.61)	(827,707.00)	(434,212.07)
Commercial	Commercial 1x80	-	-			(2,592.00)	(1,258.16)
Commercial	Commercial 3x40	-	-	(15,997.00)	(23,067.57)	(14,167.00)	(9,377.72)
Commercial	Commercial 3x60	-	-	(313.00)	(413.67)	(6,815.00)	(10,675.79)
Commercial	Commercial 3x80	-	-	(2,643.00)	(3,490.52)	(15,491.00)	(7,649.80)
Commercial	Commercial 3x100	-	-	(1,364.00)	(1,956.41)	(26,631.00)	(14,739.61)
Commercial	Commercial 3x150	-	-	(34,848.00)	(53,033.35)	(52,455.00)	(28,758.00)
Domestic	Domestic 1x40	(21,548.00)	(29,506.81)	(24,537.00)	(34,404.40)	(28,362.00)	(30,025.78)
Domestic	Domestic 1x50	-	-	-	-	(3,187.00)	(1,546.98)
Domestic	Domestic 1x60	(12,890.00)	(16,243.96)	(118,480.00)	(158,156.28)	(145,863.00)	(96,132.67)
Domestic	Domestic 1x80	(1,924.00)	(2,380.01)	(4,162.00)	(5,498.78)	(3,148.00)	(1,596.60)
Domestic	Domestic 3x30	-	-	(1,382.00)	(2,123.34)	(1,891.00)	(1,200.72)
Domestic	Domestic 3x40	-	-	(20,050.00)	(28,514.75)	(33,612.00)	(20,492.84)
Domestic	Domestic 3x60	(4,007.00)	(4,953.30)	(124,928.00)	(172,965.47)	(163,040.00)	(98,679.97)
Domestic	Domestic 3x80	-	-	(10,381.00)	(14,273.01)	(13,251.00)	(13,314.03)
Domestic	Domestic 3x100	-	-	(13,396.00)	(20,309.34)	(10,641.00)	(5,508.82)
Bulk Consumers	Small Bulk 40KVA	-	-	-	-	(90,216.00)	(43,790.85)
Bulk Consumers	Large Bulk 100KVA	-	-	-	-	(229,278.00)	(111,291.58)
Rural Consumers	Rural 1x80	-	-	-	-	(15,134.00)	(7,346.03)
Rural Consumers	Rural 1x150	-	-	-	-	(77,698.00)	(37,714.61)
TOTAL		**(1,112,325.00)**	**(869,149.79)**	**(1,897,101.00)**	**(1,643,789.50)**	**(1,761,179.00)**	**(975,312.63)**

From the above table one can see that the municipality has allowed consumers to push back over 3 million units of electricity over the three financial years in question into the municipal grid. In total these units have cost the municipality just over R3.4 million in electricity sales revenue. The table further illustrates the distribution over the various debtor types from bulk time-of-use, domestic, commercial and large and small bulk users not on the time-of-use tariff. The table above was further broken down to show the number of consumers pushing electricity back over the three financial years and also which consumer type had contributed the most to the 3 million units pushed back over the three financial years in question.

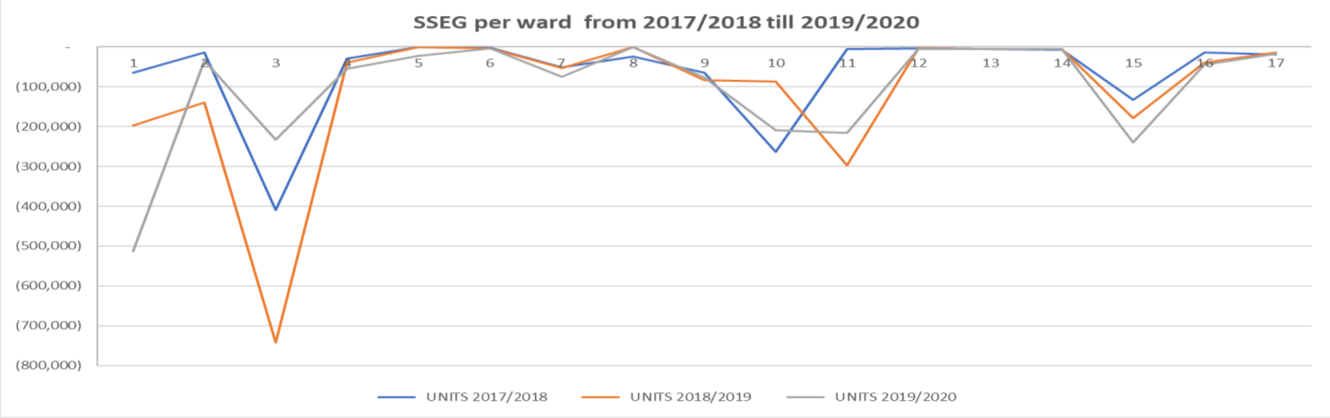
Table 6.3: Summary of SSEG feed-in units per consumer, units and rand value

CONSUMER TYPE	CONSUMERS			UNITS			AMOUNT		
	2017/2018	2018/2019	2019/2020	2017/2018	2018/2019	2019/2020	2017/2018	2018/2019	2019/2020
Bulk Time of use Consumers	89	17	8	(1,071,956)	(1,524,620)	(794,473)	(816,066)	(1,125,582.61)	(407,251.07)
Commercial Consumers	0	10	13	-	(55,165)	(113,902)	-	(81,961.52)	(70,396.62)
Domestic Consumers	8	103	124	(40,369)	(317,316)	(402,995)	(53,084)	(436,245.37)	(268,498.41)
Large Bulk Consumers	0	0	5	0	0	(254,214)	0	0	(130,215.97)
Rural Consumers	0	0	2	0	0	(90,367)	0	0	(43,864.12)
Small Bulk Consumers	0	0	5	0	0	(105,228)	0	0	(55,086.44)
TOTAL	97	130	157	(1,112,325)	(1,897,101)	(1,761,179)	(869,149.79)	(1,643,789.50)	(975,312.63)

Table 6.3 above show how the number of consumers has grown from 97 consumers in 2017/2018 to 157 consumers in the 2019/2020 financial year. In the above table one can also see how the units that were generated have increased over the three financial years and also illustrate the consumer type that dominated the generation of electricity outside the municipal grid.

The SSEG information was also extracted per ward and showed the number of SSEG consumers in each of the 33 wards in the Drakenstein Municipality. Table 6.4 below illustrates the wards where the installation of PVs is prevalent and also shows how the generation of electricity in units have increased or decreased over the extracted three financial years.

Table 6.4: Summary of SSEG feed-in units per consumer, units and rand value



From the information above the researcher concluded that the municipality sold 1.8 billion units of electricity nett the 3.4 million units that were generated by consumers off the municipal grid.

6.2.3 Drakenstein electricity tariff structure

The electricity tariff structure of Drakenstein Municipality reflects a two-part tariff consisting of a basic fixed charge per amperage and a unit charge per kilowatt hour for domestic, commercial and rural consumers. The municipality has a two-step inclining tariff for life-line domestic consumers that are connected to the municipal grid via a 20Amp connection. The normal domestic consumers that have a connection larger that 20Amp are charged on two flat rates of which one is for the domestic single-phase and the other for the domestic three-phase with no inclining structure.

The charges for the energy that are described above and that do not include VAT are as follows for the 2017/2018, 2018/2019 and 2019 financial years:

6.2.3.1 Domestic Tariffs

Table 6.5: Domestic Electricity tariffs 2017/2018 - 2019/2020

Row Number	Basic, Demand and Energy Tariffs	2017/2018 (VAT Excluded)	2018/2019 (VAT Excluded	2019/2020 (VAT Excluded
1.	**Domestic: Single-Phase: Life-line Tariffs**			
1.1	Domestic Lifeline 20 Amp: ≤400 kWh per kWh	R1.0090	R1.0780	R1.2282
1.2	Domestic Lifeline 20 Amp: ≥400 kWh per kWh	R1.4500	R1.5492	R1.7650
2.	**Domestic: Single-Phase: 30 Amp Connections**			
2.1	Basic Charge per Ampere	R4.92	R5.25	R5.89
2.2	Energy Charge (R/kWh)	R1.4500	R1.5492	R1.8076
3.	**Domestic: All Other Single-Phase Connections**			
3.1	Basic Charge per Ampere	R6.28	R6.71	R7.52

Row Number	Basic, Demand and Energy Tariffs	2017/2018 (VAT Excluded)	2018/2019 (VAT Excluded	2019/2020 (VAT Excluded
3.2	Energy Charge (R/kWh)	R1.4500	R1.5492	R1.8076
4.	**Domestic: All Three-Phase Connections**			
4.1	Basic Charge per Ampere per Three-Phase	R5.31	R5.67	R6.46
4.2	Energy Charge (R/kWh)	R1.4500	R1.5492	R1.7650
5.	**Domestic Co-generation (1 & 3 Phase)**			
5.1	Feed – in tariff			R0.4854

***Note 1: Supply Rules:**
Reduction in capacity: No charge, only allowed once (1) per year. Increase in capacity: Pay as per quote.
First 100 kWh free for 1x20 Amp consumers on indigent register and pre-payment
All new connections by pre-payment or smart meter
Maximum capacity: Prepaid (60 Amp: 1or 3-phase) and Credit (150Amp: 3-phase)
Domestic tariffs are only applicable to church buildings(place of worship) and residential dwellings occupied by the office bearers
***Note 1: Co-Generation Rules**
All rules applicable to Domestic Metering will apply
The conditions and safety standards of generation will apply as per Eskom Supply By-Law, NRS 079, the Electricity Regulation Act and the Occupational Health and Safety Act as well as any other relevant legislation.
The co-generated unit will be credited against the units consumed, but not against the basic charges.
The total co-generated units will expire on 30 June each year.

The domestic sales tariff structure is represented above with a two-step tariff for lifeline consumers, when their consumption reaches 400kWh per month. The other domestic consumers are charged a flat tariff irrespective of the consumption, with the tariff varying between single-phase domestic consumers and three-phase domestic consumers. As part of the domestic tariff, the municipality also instituted an electricity co-generation tariff where consumers could install PVs on their rooftop to generate their own electricity for consumption. These tariffs of the municipality have enabled qualifying consumers to push electricity back into the municipal grid and to receive compensation.

The domestic tariffs also have a second component which is basic charges which are charged per Amp connection every month.. These basic charges represent the recovery of cost that the municipality has invested in the electricity infrastructure and the maintenance thereof. The basic charges are connected to amperages because of the load that individual consumers apply on the municipal network as a result of the amperage connection. Consequently, the higher the amperage connection, the higher the fixed basic charge.

In table 6.6 below is the domestic co-generation tariff that was implemented by the municipality in the 2017/2018 and 2018/2019 financial years. The municipality changed this tariff model in the 2019/2020 financial year where consumers were only allowed a flat feed-in tariff that corresponded to Eskom's low season off-peak tariff that Eskom charged the municipality with. The co-generation feed-in tariff for the 2019/2020 financial year is shown in table 6.5 above.

Table 6.6: Domestic co-generation tariffs pre 2019/2020 financial year

Row Number	Basic, Demand and Energy Tariffs	2017/2018 (VAT Excluded)	2018/2019 (VAT Excluded	2019/2020 (VAT Excluded
19.	**Domestic 1-phase**			
19.1	**Basic charges**			
19.2	Basic Charge 40 Amp	R366.80	R391.88	N/A
19.3	Basic Charge 60 Amp	R550.20	R587.82	N/A
20.	Basic Charge 80 Amp	R733.60	R783.76	N/A
20.1	**Energy Charges**			
20.2	Energy Charge (R/kWh) up to 500kWh (buying & feed-in)	R1.2370	R1.3216	R0.4854
20.3	Energy Charge (R/kWh) above 500kWh (buying & feed-in)	R1.5450	R1.6507	R0.4854
21.	**Domestic 3-phase**			
21.1	**Basic Charges**			
21.2	Basic Charge 40 Amp	R614.04	R656.04	
21.3	Basic Charge 60 Amp	R921.04	R984.06	
21.4	Basic Charge 80 Amp	R1,228.08	R1,312.08	
21.5	Basic Charge 100 Amp	R1,535.10	R1,640.10	
22.	**Energy Charges**			
22.1	Energy Charge (R/kWh) up to 500kWh (buying & feed-in)	R1.2370	R1.3216	
22.2	Energy Charge (R/kWh) above 500kWh (buying)	R1.5450	R1.6507	
22.3	Energy Charge (R/kWh) up to 500kWh (feed-in)	R1.2370	R1.3216	

6.2.3.2 **Commercial tariffs**

Table 6.7: Commercial Electricity tariffs 2017/2018 till 2019/2020

Row Number	Basic, Demand and Energy Tariffs	2017/2018 (VAT Excluded)	2018/2019 (VAT Excluded	2019/2020 (VAT Excluded
6.	**Commercial: Single-Phase: Lifeline 20 Ampere Customers**			
6.1	Commercial Lifeline per kWh	R1.9120	R2.0076	R2.2873
7.	**Commercial: All Other Single-Phase Connections**			

Row Number	Basic, Demand and Energy Tariffs	2017/2018 (VAT Excluded)	2018/2019 (VAT Excluded	2019/2020 (VAT Excluded
7.1	Basic Charge per Ampere	R6.17	R6.59	R7.51
7.2	Energy Charge (R/kWh)	R1.5430	R1.8781	R1.6485
8.	**Three-Phase: All Commercial Three-Phase Connections**			
8.1	Basic Charge per Ampere per Three-Phase	R4.87	R5.20	R5.82
8.2	Energy Charge (R/kWh)	R1.5430	R1.6231	R1.8492
9.	**Commercial Co-Generation (1 & 3 phase)**			
9.1	Feed – in tariff			R0.4854

***Note 1: Supply Rules:**
Reduction in capacity: No charge, only allowed once (1) per year. Increase in capacity: Pay as per quote.
All new connections by pre-payment or smart meter
Maximum capacity: Prepaid (60 Amp: 1or 3-phase) and Credit (150Amp: 3-phase)
All requests for supplies above the network design must refer to 2.9.5

The tariff structure of commercial consumers is represented in the same format as the tariff structure of domestic consumers. The only exception with commercial consumers is that they do not have a step tariff for the commercial lifeline tariff, these consumers have higher kilowatt charges than the rest of the consumers that are on higher ampere. The three-phase and single-phase commercial consumers purchase electricity at the same rate, but their basic fixed charges differ based on their different amperage connections. This is illustrated in table 6-7 above.

Table 6-8 below illustrates the commercial co-generation kWh charges for purchasing electricity from the municipality and the tariff that is used to credit electricity that has been generated by consumers and pushed back into the municipal grid. The municipality structured this tariff as a step tariff for both the 2017/2018, and 2018/2019 financial years where the prosumer would be remunerated at different rates once a maximum of 500 and 1000khW respectively for different amperage connections has been pushed back into the municipal grid.

This table also gives an indication of the fixed basic charges per amperage connection that must be paid by prosumers. This co-generation tariff also changed in the 2019/2020 financial year to a flat feed-in rate, equivalent to the rate that the municipality charges in low season during off-peak times.

6.2.3.3 **Commercial co-generation tariffs**

Table 6.8: Commercial co-generation tariffs pre 2019/2020 financial year

Row Number	Basic, Demand and Energy Tariffs	2017/2018 (VAT Excluded)	2018/2019 (VAT Excluded	2019/2020 (VAT Excluded
23.	**Commercial 1-phase**			
23.1	**Basic charges**			
23.1.1	Basic Charge (R.c)/Amp	R8.95	R9.56	
23.1.2	Energy Charge (R/kWh) up to 1000kWh (buying & feed-in)	R1.2370	R1.3216	R0.4854
23.1.3	Energy Charge (R/kWh) above 1000kWh (buying & feed-in)	R1.5450	R1.6507	R0.4854
23.2	**Commercial 3-phase**			
23.2.1	Basic Charge (R.c)/Amp	R20.45	R21.85	
23.2.2	Energy Charge (R/kWh) up to 500kWh (buying & feed-in)	R1.2370	R1.3216	
23.2.3	Energy Charge (R/kWh) above 500kWh (buying)	R1.5450	R1.6507	
23.2.4	Energy Charge (R/kWh) up to 500kWh (feed-in)	R1.2370	R1.3216	

6.2.3.4 **Rural tariffs**

Rural consumers are those municipal consumers that are mainly situated outside the urban edge and who have the option to connect directly to the municipal grid or receive their electricity directly from Eskom. Table 6.9 below provide an illustration of how the electricity tariffs of these consumers are charged.

Table 6.9: Rural Electricity tariffs 2017/2018 - 2019/2020

Row Number	Basic, Demand and Energy Tariffs	2017/2018 (VAT Excluded)	2018/2019 (VAT Excluded	2019/2020 (VAT Excluded
10.	**Rural Customers: 12.5 kVA and less**			
10.1	Basic Charge	R943.49	R1,008.02	R1,148.44
10.2	Energy Charge (R/kWh)	R1.1450	R1.2233	R1.3937
11.	**Rural Customers: >12.5 kVA up to 25 KVA**			
11.1	Basic Charge	R1,079.57	R1,153.41	R1,314.08
11.2	Energy Charge (R/kWh)	R1.1630	R1.2425	R1.4156
12.	**Rural Customers: >25 kVA up to 50 kVA**			
12.1	Basic Charge	R1,524.10	R1,628.34	R1,855.17
12.2	Energy Charge (R/kWh)	R1.1630	R1.2425	R1.4156
13	**Rural Customers: >50 kVA up to 100 kVA**			
13.1	Basic Charge	R2,007.18	R2,144.47	R2,443.19

13.2	Energy Charge (R/kWh)	R1.1630	R1.2425	R1.4156
14.	**Rural Co-Generation (1 & 3-phase)**			R0.4854
14.1	Feed –in tariff			

In terms of table 6.9, rural consumers have to pay both a basic charge and a kWh charge depending on the amount of kVA they pull from the municipal grid.

Note 3: Supply Rules:
Consumers directly supplied from rural 11kV lines or from line through transformer and meter box, LT distribution involved.
Where more consumers require a LT Distribution System to be installed, it will be regarded as an Urban Area on approval of the Senior Manager: Electro Technical Services.
All requests for supplies above the network design must refer to 2.9.5.
***Note 3: Co-Generation Rules**
All rules applicable to Rural Supply Metering will apply.
The conditions and safety standards of generation will apply as per the Electricity Supply By-Law, NRS 097, the Electricity Regulation Act and the Occupational Health and Safety Act as well as any other relevant legislation
The co-generated units will be credited against the unit consumed, but not against the basic charges.
The total co-generated units will expire on 30 June each year

6.2.3.5 **Bulk time-of-use tariffs**

The municipality also have bulk time-of-use (TOU), tariffs for larger consumers. These are mostly industries and here the municipality reserves a certain amount of capacity on a monthly basis. The time-of-use tariff consists of basic fixed charges for medium and low voltage consumers, demand charges per kVA, access charges for different categories of consumers with different seasonal demand preferences and TOU user charges which are classified into Medium and Low Voltage Standard, Peak and Off-peak per kWh rates. The tariffs are structured into a high season which occurs during the months of June to August each year and a low season which occur during the months of May to September each year. The consumers whom are on the seasonal tariffs have a preference of a 2, 4 and 6 monthly seasonal demand. These bulk consumers are required to apply for this demand as and when changes in their demand occurs and can only be loaded on the seasonal tariffs once they have been approved by the Electrical Infrastructure Department of the municipality.

The bulk consumers that are linked to TOU are consumers that have requested a supply of electricity that is between 400 Volt (expected demand between 100 Kva & 500 Kva) and 11 Kilovolts (expected demand exceeding 500 Kva). The TOU times are categorised into two seasons, the low season which is 9 months long and which run from September – May each year and the high season which is 3 months long from

June to August each year. The respective bulk time-of-use tariffs of Drakenstein Municipality are illustrated below for the 2017/2018, 2018/2019 and 2019/2020 financial years.

Table 6-10: Bulk Time-of-Use Electricity tariffs 2017/2018 - 2019/2020

Row Number	Basic, Demand and Energy Tariffs	2017/2018 (VAT Excluded)	2018/2019 (VAT Excluded	2019/2020 (VAT Excluded
17.	**Bulk TOU (Urban): Medium Voltage (MV) Customers: Fixed Charges**			
17.1	Fixed Charge per Month	R1,614.09	R1,724.49	R1,964.71
17.2	**Bulk TOU (Urban): Medium Voltage (MV) Customers: Access Charges**			
17.2.1	Access Charge (NMD) (R/kVA): 12 Months Season	R45.94	R49.08	R56.75
17.2.2	Access Charge (NMD) (R/kVA): 6 Months Season	R22.35	R23.88	R27.61
17.2.3	Access Charge (NMD) (R/kVA): 4 Months Season	R14.90	R15.92	R18.41
17.2.4	Access Charge (NMD) (R/kVA): 2 Months Season	R7.45	R9.20	R7.96
17.2.5	Access Charge (NMD) (R/kVA): Boland Cricket	R0.00	R0.00	R0.00
17.3.	**Bulk TOU (Urban): Medium Voltage (MV) Customers: Demand Charges**			
17.3.1	Demand Charge (R/kVA)	R54.80	R58.55	R67.70
17.4	**Bulk TOU (Urban): Medium Voltage (MV) Customers: Energy Charges: High Season**			
17.4.1	Peak (R/kWh)	R2.7900	R2.9808	R3.4875
17.4.2	Standard (R/kWh)	R0.9660	R1.0321	R1.1876
17.4.3	Off-Peak (R/kWh)	R0.5540	R0.6629	R0.5919
17.5	**Bulk TOU (Urban): Medium Voltage (MV) Customers: Energy Charges: Low Season**			
17.5.1	Peak (R/kWh)	R1.4120	R1.5086	R1.7651
17.5.2	Standard (R/kWh)	R0.7890	R0.8430	R0.9612
17.5.3	Off-Peak (R/kWh)	R0.4900	R0.5235	R0.5968
17.6	**Bulk TOU (Urban): Medium Voltage (MV) Customers: Other Charges**			
17.6.1	RE / kVA rh	R0.0250	R0.0267	R0.0305
17.6.2	Bulk Co-Generation (Feed – in Tariff)	R0.0000	R0.0000	R0.4854
18	**Bulk TOU (Urban): Low Voltage (LV) Customers: Fixed Charges**			
18.1	Fixed Charge per Month	R1,614.09	R1,724.49	R1,964.71
18.2	**Bulk TOU (Urban): Low Voltage (LV) Customers: Access Charges**			
18.2.1	Access Charge (NMD) (R/kVA): 12 Months Season	R50.90	R54.38	R62.00
18.2.2	Access Charge (NMD) (R/kVA): 6 Months Season	R24.83	R26.53	R30.25
18.2.3	Access Charge (NMD) (R/kVA): 4 Months Season	R17.38	R18.57	R21.17
18.2.4	Access Charge (NMD) (R/kVA): 2 Months Season	R8.69	R9.28	R10.59
18.2.5	Access Charge (NMD) (R/kVA): Boland Rugby/Rusoord	R0.00	R0.00	R0.00
18.3	**Bulk TOU (Urban): Low Voltage (LV) Customers: Demand Charges**			
18.3.1	Demand Charge (R/kVA)	R58.54	R62.55	R71.31
18.4	**Bulk TOU (Urban): Low Voltage (LV) Customers: Energy Charges: High Season**			
18.4.1	Peak (R/kWh)	R2.7900	R2.9808	R3.4875

Row Number	Basic, Demand and Energy Tariffs	2017/2018 (VAT Excluded)	2018/2019 (VAT Excluded	2019/2020 (VAT Excluded
18.4.2	Standard (R/kWh)	R1.0290	R1.0994	R1.2478
18.4.3	Off-Peak (R/kWh)	R0.5860	R0.6261	R0.7012
18.5	**Bulk TOU (Urban): Low Voltage (LV) Customers: Energy Charges: Low Season**			
18.5.1	Peak (R/kWh)	R1.4120	R1.5086	R1.7651
18.5.2	Standard (R/kWh)	R0.7890	R0.8430	R0.9612
18.5.3	Off-Peak (R/kWh)	R0.5630	R0.6015	R0.6858
18.6	**Bulk TOU (Urban): Low Voltage (LV) Customers: Other Charges**			
18.6.1	RE / kVA rh	R0.0250	R0.0267	R0.0305
18.6.2	Bulk Co-Generation (Feed – in Tariff)	R0.0000	R0.0000	R0.4854

***Note 5: Seasonal ***
A two (2) month seasonal bulk consumer will be a bulk consumer whose actual kVA and/or kWh consumed for two (2) months or less in a financial year was in the sole discretion of the Executive Manager: Infrastructural Services and substantially above the average KVA and/or kWh consumption of the remaining ten (10) months of the financial year.
A four (4) month seasonal bulk consumer will be a bulk consumer whose actual kVA and/or kWh consumed for four (4) months or less in a financial year was in the sole discretion of the Executive Manager: Infrastructural Services and substantially above the average KVA and/or kWh consumption of the remaining eight (8) months of the financial year.
A six (6) month seasonal bulk consumer will be a bulk consumer whose actual kVA and/or kWh consumed for six (6) months or less in a financial year was in the sole discretion of the Executive Manager: Infrastructural Services and substantially above the average KVA and/or kWh consumption of the remaining six (6) months of the financial year.
A bulk consumer will have to submit an application to the Executive Manager: Infrastructural Services to be classified as a 2, 4, 6-month seasonal bulk consumer.
Bulk TOU tariff is only available for small and large bulk consumers with a load factor of 50% and above.

***Note 5: " Large power users who lower their Notified Maximum Demand (NMD), to save on these charges, will be allowed to do so subject to the following:**	
(a)	Only one lowering NMD allowed per financial year.
(b)	The capacity that is given up will not be reserved for the customer only, but utilized by the municipality as and when required.
(c)	When the customer wants to take up that capacity sometime in the future, he/she will be required to pay the Developers Contribution at the time MINUS the Development Contribution at the time when the capacity was given up.
(d)	The abovementioned arrangement (c) will be valid for a period of three years. After this period, customers will have to pay the full Developers contribution for any increase of his/her NMD.
(e)	Customers who wishes to extend the arrangement will be required to make a special application to the Deputy Executive Manager: Electro Technical Services for extension

Bulk consumers can take supply at 400V or at 11kV.
Council reserves the right to connect consumers with an estimated demand exceeding 50kVA as Bulk Consumers.
Consumers with expected demand exceeding 100kVA, but does not exceed 500kVA, can only be supplied at 400V with special permission of the Deputy Executive
Manager: Electro Technical Service, whose decision will be based on the capacity of the 400V network.
Where the expected maximum demand of a consumer exceeds 500kVA
However, measurement can be done on Low Tension where possible

Maximum demand charge is only applicable during the Peak and Standard hours whereas Access charge is applicable to all periods.
Access charge is based on the notified demand or the highest maximum demand during previous 12 months unless adjusted as per rules above.
***Note 5: Co-Generation Rules**
All rules applicable to Rural Supply Metering will apply.
The conditions and safety standards of generation will apply as per the Electricity Supply By-Laws, NRS 097, the Electricity Regulation Act and the Occupational Health and Safety Act as well as any other relevant legislation.
The co-generated units will be credited against the units consumed, but not against the basic charges. Co-generated units will expire on 30 June each year

The maximum demand charges illustrated above are only valid during standard and peak times and the access charges discussed above are applicable to standard, peak and off-peak periods. The basis for calculating access charges is the highest notified demand in the previous 12 month period.

Table 6.10 above show the respective kWh charges for time-of-use consumers. The table shows the tariffs that bulk consumers paid in 2017/2018, 2018/2019 and the 2019/2020 financial years. The tariffs are structured per season with the high consumption season being June till August each year and the low consumption season being from May till September each year. The tariffs are further linked to times in a day when electricity is consumed and these times are represented as follows:

Table 6.11: Low and High Season Slots for Drakenstein Municipality for the 2017/2018 - 2019/2020 financial years

Time Periods	Mondays – Fridays	Saturdays	Sundays
Low Season (9 months) (September - May)			
00:00 - 06:00	Off-Peak	Off-Peak	Off-Peak
06:00 - 07:00	Standard Period	Off-Peak	Off-Peak
07:00 - 10:00	Peak Period	Standard Period	Off-Peak
10:00 - 12:00	Standard Period	Standard Period	Off-Peak
12:00 - 18:00	Standard Period	Off-Peak	Off-Peak
18:00 - 20:00	Peak Period	Standard Period	Off-Peak
20:00 - 22:00	Standard Period	Off-Peak	Off-Peak
22:00 - 24:00	Off-Peak	Off-Peak	Off-Peak
High Season (3 months) (June - August)			
00:00 - 06:00	Off-Peak	Off-Peak	Off-Peak
06:00 - 07:00	Standard Period	Off-Peak	Off-Peak
07:00 – 10:00	Peak Period	Standard Period	Off-Peak
10:00 - 12:00	Standard Period	Standard Period	Off-Peak
12:00 - 18:00	Standard Period	Off-Peak	Off-Peak

Time Periods	Mondays – Fridays	Saturdays	Sundays
18:00 - 20:00	Peak Period	Standard Period	Off-Peak
20:00 - 22:00	Standard Period	Off-Peak	Off-Peak
22:00 - 24:00	Off-Peak	Off-Peak	Off-Peak

6.2.3.6 **Bulk time-of-use co-generation tariffs**

The bulk time-of-use co-generation khW charges for purchasing electricity from the municipality and the tariff that is used to credit electricity that has been generated by consumers and pushed back into the municipal grid is the same as the tariffs shown above. This is seen in the table below that represents the 2017/2018 and 2018/2019 financial years. The municipality then changed this tariff structure to a flat rate in the 2019/2020 financial year. The flat rate used was equivalent to the tariff that Eskom charged the municipality in the low season during off- peak times.

Table 6.12: Bulk time-of-use co-generation tariffs pre 2019/2020 financial year

Row Number	Basic, Demand and Energy Tariffs	2017/2018 (VAT Excluded)	2018/2019 (VAT Excluded	2019/2020 (VAT Excluded
24.	**Bulk TOU (Urban): Medium Voltage (MV) Customers: Fixed Charges**			
24.1	Fixed Charge per Month	R1,858.29	R1,985.39	
24.2	**Bulk TOU (Urban): Medium Voltage (MV) Customers: Access Charges**			
24.2.1	Access Charge (NMD) (R/kVA): 12 Months Season	R45.94	R49.08	
24.3.	**Bulk TOU (Urban): Medium Voltage (MV) Customers: Demand Charges**			
24.3.1	Demand Charge (R/kVA)	R54.69	R58.44	
24.4	**Bulk TOU (Urban): Medium Voltage (MV) Customers: Energy Charges: High Season**			
17.4.1	Peak (R/kWh)	R1.9770	R2.1122	
24.4.2	Standard (R/kWh)	R0.8300	R0.8868	
24.4.3	Off-Peak (R/kWh)	R0.4760	R0.5086	
24.5	**Bulk TOU (Urban): Medium Voltage (MV) Customers: Energy Charges: Low Season**			
24.5.1	Peak (R/kWh)	R1.2130	R1.2960	
24.5.2	Standard (R/kWh)	R0.7244	R0.6780	
24.5.3	Off-Peak (R/kWh)	R0.4210	R0.4498	
24.6	**Bulk TOU (Urban): Low Voltage (LV) Customers: Fixed Charges**			
24.6.1	Fixed Charge per Month	R1,858.29	R1,985.39	
24.7	**Bulk TOU (Urban): Low Voltage (LV) Customers: Access Charges**			
24.7.1	Access Charge (NMD) (R/kVA): 12 Months Season	R59.66	R563.74	
24.8	**Bulk TOU (Urban): Low Voltage (LV) Customers: Demand Charges**			
24.8.1	Demand Charge (R/kVA)	R68.36	R73.04	
24.9	**Bulk TOU (Urban): Low Voltage (LV) Customers: Energy Charges: High Season**			
24.9.1	Peak (R/kWh)	R2.2370	R2.3900	
24.9.2	Standard (R/kWh)	R0.9445	R0.8840	
24.9.3	Off-Peak (R/kWh)	R0.5374	R0.5030	

Row Number	Basic, Demand and Energy Tariffs	2017/2018 (VAT Excluded)	2018/2019 (VAT Excluded	2019/2020 (VAT Excluded
24.10	**Bulk TOU (Urban): Low Voltage (LV) Customers: Energy Charges: Low Season**			
24.10.1	Peak (R/kWh)	R1.2130	R1.2960	
24.10.2	Standard (R/kWh)	R0.6780	R0.7244	
24.10.3	Off-Peak (R/kWh)	R0.5171	R0.4840	

***Note 5: Seasonal ***	
A two (2) month seasonal bulk consumer will be a bulk consumer whose actual kVA and/or kWh consumed for two (2) months or less in a financial year was in the sole discretion of the Executive Manager: Infrastructural Services and substantially above the average KVA and/or kWh consumption of the remaining ten (10) months of the financial year.	
A four (4) month seasonal bulk consumer will be a bulk consumer whose actual kVA and/or kWh consumed for four (4) months or less in a financial year was in the sole discretion of the Executive Manager: Infrastructural Services and substantially above the average KVA and/or kWh consumption of the remaining eight (8) months of the financial year.	
A six (6) month seasonal bulk consumer will be a bulk consumer whose actual kVA and/or kWh consumed for six (6) months or less in a financial year was in the sole discretion of the Executive Manager: Infrastructural Services and substantially above the average KVA and/or kWh consumption of the remaining six (6) months of the financial year.	
A bulk consumer will have to submit an application to the Executive Manager: Infrastructural Services to be classified as a 2, 4, 6-month seasonal bulk consumer.	
Bulk TOU tariff is only available for small and large bulk consumers with a load factor of 50% and above.	
***Note 5: " Large power users who lower their Notified Maximum Demand (NMD), to save on these charges, will be allowed to do so subject to the following:**	
(a)	Only one lowering NMD allowed per financial year.
(b)	The capacity that is given up will not be reserved for the customer only, but utilized by the municipality as and when required.
(c)	When the customer wants to take up that capacity sometime in the future, he/she will be required to pay the Developers Contribution at the time MINUS the Development Contribution at the time when the capacity was given up.
(d)	The abovementioned arrangement (c) will be valid for a period of three years. After this period, customers will have to pay the full Developers contribution for any increase of his/her NMD.
(e)	Customers who wishes to extend the arrangement will be required to make a special application to the Deputy Executive Manager: Electro Technical Services for extension

Bulk consumers can take supply at 400V or at 11kV.
Council reserves the right to connect consumers with an estimated demand exceeding 50kVA as Bulk Consumers.
Consumers with expected demand exceeding 100kVA, but does not exceed 500kVA, can only be supplied at 400V with special permission of the Deputy Executive
Manager: Electro Technical Service, whose decision will be based on the capacity of the 400V network.
Where the expected maximum demand of a consumer exceeds 500kVA
However, measurement can be done on Low Tension where possible
Maximum demand charge is only applicable during the Peak and Standard hours whereas Access charge is applicable to all periods.
Access charge is based on the notified demand or the highest maximum demand during previous 12 months unless adjusted as per rules above.

*Note 5: Co-Generation Rules
All rules applicable to Rural Supply Metering will apply.
The conditions and safety standards of generation will apply as per the Electricity Supply By-Laws, NRS 097, the Electricity Regulation Act and the Occupational Health and Safety Act as well as any other relevant legislation.
The co-generated units will be credited against the units consumed, but not against the basic charges.

6.2.3.7 Bulk consumers

In the 2019/2020 financial year the municipality decided to assess the load factors of all the Bulk Time-of-Use consumers and determined that there were consumers whose load factor expressed as: total kWh consumed in a month ÷ (peak demand x number of days in billing cycle, did not justify the consumers being on the bulk time- of-use tariff. The municipality was reserving energy for consumers whose units used did not necessarily require them to be on the time-of-use tariff.

The municipality then identified these consumers and created a new bulk consumers tariff in the 2019/2020 financial year which consisted of a fixed basic charge, a KVA charge and a unit charge per kWh units' consumers. This tariff would then apply to all bulk consumers whose load factor was below 50% and whose KVA requirements were between 0 to 100 KVA.

The tariff was split into two components namely small bulk for consumers pulling from 0 to 40 KVA per month and large bulk for consumers pulling above 40 to 100KVA. Table 6,13 below illustrates these tariffs that were applied by the municipality from the 2019/2020 financial year.

Table 6.13: Bulk Consumers Electricity tariffs 2017/2018 - 2019/2020

Row Number	Basic, Demand and Energy Tariffs	2017/2018 (VAT Excluded)	2018/2019 (VAT Excluded	2019/2020 (VAT Excluded
15.	**Bulk User Tariff: Small Bulk Users (40 kVA to ≤100 kVA)**			
15.1	Fixed monthly basic charge	R0.00	R0.00	R1,368.00
15.2	Demand charge per kVA	R0.00	R0.00	R239.44
15.3	Energy Charge per kWh	R0.000	R0.000	R1.1972
15.4	Bulk Co-Generation (Feed – in Tariff)	R0.000	R0.000	R0.4854
16.				
16.1	Fixed monthly basic charge	R0.00	R0.00	R3,310
16.2	Demand charge per kVA	R0.00	R0.00	R296.45
16.3	Energy Charge per kWh	R0.000	R0.000	R0.9692
16.4	Bulk Co-Generation (Feed – in Tariff)	R0.000	R0.000	R0.4854

*Note 4: Supply Rules:
Small Bulk Users will pay a minimum demand charge for 40 kVA.
Small Bulk Users exceeding 100 kVA will automatically be charged the Large Bulk User kVA rate.
Small Bulk Users exceeding 100 kVA for three consecutive months will become a Large Bulk User.
Large Bulk Users will pay a minimum demand charge for 100 kVA.
Large Bulk Users with a load factor above 50% for a period of three months may convert to Bulk TOU tariffs.
***Note 4: Co-Generation Rules**
All rules applicable to Rural Supply Metering will apply.
The conditions and safety standards of generation will apply as per the Electricity Supply By-Laws, NRS 097, the Electricity Regulation Act and the Occupational Health and Safety Act as well as any other relevant legislation.
The co-generated units will be credited against the units consumed, but not against the basic charges.
The total co-generated units will expire on 30 June each year.

6.2.4 **Eskom tariffs for the 2017/2018 till 2019/2020 financial years**

For purposes of determining the cost of providing electricity to areas within South Africa, Eskom determines transmission based on the distance from the area to the main electricity generation site. Drakenstein Municipality falls in Eskom's zone 4, which categorises all areas that are at a distance of more than 900km from the largest electricity distributor in South Africa.

The various energy tariffs determined by Eskom for its bulk consumers are thus based on the size of the electricity demand of the consumer and the transmission zone that the consumers' geographical area is situated in.

Tables 6.14, 6.15 and 6.16 below illustrate the various energy charges for all the local government Megaflex consumers of Eskom. These are consumers that purchase electricity from Eskom on a time-of-use basis. These consumers also have a notified electricity demand (NMD) with Eskom that is greater than 1 MVA and they have the ability to shift their capacity between different times during the day.

Table 6.14: 2017/2018 Eskom Megaflex tariffs for local authorities

Megaflex tariff — Local authority

Transmission zone	Voltage	Active energy charge [c/kWh] – High demand season [Jun - Aug] – Peak	VAT incl	Standard	VAT incl	Off Peak	VAT incl	Low demand season [Sep - May] – Peak	VAT incl	Standard	VAT incl	Off Peak	VAT incl	Transmission network charges [R/kVA/m]	VAT incl
≤ 300km	< 500V	279.71	318.87	85.11	97.03	46.44	52.94	91.58	104.40	63.20	72.05	40.28	45.92	R 7.79	R 8.88
	≥ 500V & < 66kV	275.30	313.84	83.41	95.09	45.29	51.63	89.81	102.38	61.81	70.46	39.22	44.71	R 7.11	R 8.11
	≥ 66kV & ≤ 132kV	266.61	303.94	80.76	92.07	43.86	50.00	86.97	99.15	59.87	68.25	37.97	43.29	R 6.92	R 7.89
	> 132kV*	251.27	286.45	76.12	86.78	41.33	47.12	81.96	93.43	56.41	64.31	35.79	40.80	R 8.76	R 9.99
> 300km and ≤ 600km	< 500V	281.99	321.47	85.43	97.39	46.38	52.87	91.99	104.87	63.33	72.20	40.17	45.79	R 7.83	R 8.93
	≥ 500V & < 66kV	278.05	316.98	84.23	96.02	45.74	52.14	90.71	103.41	62.43	71.17	39.60	45.14	R 7.18	R 8.19
	≥ 66kV & ≤ 132kV	269.22	306.91	81.55	92.97	44.28	50.48	87.82	100.11	60.44	68.90	38.33	43.70	R 6.97	R 7.95
	> 132kV*	253.77	289.30	76.89	87.65	41.74	47.58	82.77	94.36	56.98	64.96	36.14	41.20	R 8.84	R 10.08
> 600km and ≤ 900km	< 500V	284.80	324.67	86.28	98.36	46.84	53.40	92.90	105.91	63.95	72.90	40.57	46.25	R 7.93	R 9.04
	≥ 500V & < 66kV	280.85	320.17	85.07	96.98	46.20	52.67	91.63	104.46	63.03	71.85	40.00	45.60	R 7.24	R 8.25
	≥ 66kV & ≤ 132kV	271.96	310.03	82.37	93.90	44.73	50.99	88.69	101.11	61.04	69.59	38.72	44.14	R 7.03	R 8.01
	> 132kV*	256.32	292.20	77.66	88.53	42.16	48.06	83.62	95.33	57.55	65.61	36.51	41.62	R 8.96	R 10.21
> 900km	< 500V	287.66	327.93	87.15	99.35	47.33	53.96	93.84	106.98	64.58	73.62	40.98	46.72	R 7.97	R 9.09
	≥ 500V & < 66kV	283.66	323.37	85.92	97.95	46.66	53.19	92.52	105.47	63.68	72.60	40.38	46.03	R 7.31	R 8.33
	≥ 66kV & ≤ 132kV	274.70	313.16	83.22	94.87	45.19	51.52	89.60	102.14	61.66	70.29	39.12	44.60	R 7.08	R 8.07
	> 132kV*	258.84	295.08	78.45	89.43	42.63	48.60	84.48	96.31	58.15	66.29	36.91	42.08	R 9.03	R 10.29

* 132 kV or Transmission connected

Voltage	Distribution network charges – Network capacity charge [R/kVA/m]	VAT incl	Network demand charge [R/kVA/m]	VAT incl	Urban low voltage subsidy charge [R/kVA/m]	VAT incl
< 500V	R 15.54	R 17.72	R 29.45	R 33.57	R 0.00	R 0.00
≥ 500V & < 66kV	R 14.25	R 16.25	R 27.01	R 30.79	R 0.00	R 0.00
≥ 66kV & ≤ 132kV	R 5.10	R 5.81	R 9.42	R 10.74	R 12.48	R 14.23
> 132kV / Transmission connected	R 0.00	R 0.00	R 0.00	R 0.00	R 12.48	R 14.23

Voltage	Ancillary service charge [c/kWh]	VAT incl
< 500V	0.36	0.41
≥ 500V & < 66kV	0.35	0.40
≥ 66kV & ≤ 132kV	0.33	0.38
> 132kV / Transmission connected	0.31	0.35

Customer categories	Service charge [R/account/day]	VAT incl	Administration charge [R/POD/day]	VAT incl
> 1 MVA	R 177.48	R 202.33	R 80.00	R 91.20
Key customers	R 3,477.93	R 3,964.84	R 111.07	R 126.62

Reactive energy charge [c/kVArh] – High season	VAT incl	Low season	VAT incl
12.49	14.24	0.00	0.00

Electrification and rural network subsidy charge [c/kWh]	VAT incl
6.91	7.88

Table 6.15: 2018/2019 Eskom Megaflex tariffs for local authorities

Megaflex tariff — Local authority

Transmission zone	Voltage	Active energy charge [c/kWh] – High demand season [Jun - Aug] – Peak	VAT incl	Standard	VAT incl	Off Peak	VAT incl	Low demand season [Sep - May] – Peak	VAT incl	Standard	VAT incl	Off Peak	VAT incl	Transmission network charges [R/kVA/m]	VAT incl
≤ 300km	< 500V	300.18	345.21	91.34	105.04	49.84	57.32	98.28	113.02	67.83	78.00	43.23	49.71	R 8.36	R 9.61
	≥ 500V & < 66kV	295.45	339.77	89.52	102.95	48.61	55.90	96.38	110.84	66.33	76.28	42.09	48.40	R 7.63	R 8.77
	66kV & ≤ 132kV	286.13	329.05	86.67	99.67	47.07	54.13	93.34	107.34	64.25	73.89	40.75	46.86	R 7.43	R 8.54
	> 132kV*	269.66	310.11	81.69	93.94	44.36	51.01	87.96	101.15	60.54	69.62	38.41	44.17	R 9.40	R 10.81
> 300km and ≤ 600km	< 500V	302.63	348.02	91.68	105.43	49.78	57.25	98.72	113.53	67.97	78.17	43.11	49.58	R 8.40	R 9.66
	≥ 500V & < 66kV	298.40	343.16	90.40	103.96	49.09	56.45	97.35	111.95	67.00	77.05	42.50	48.88	R 7.71	R 8.87
	66kV & ≤ 132kV	288.93	332.27	87.52	100.65	47.52	54.65	94.25	108.39	64.86	74.59	41.14	47.31	R 7.48	R 8.60
	> 132kV*	272.35	313.20	82.52	94.90	44.80	51.52	88.83	102.15	61.15	70.32	38.79	44.61	R 9.49	R 10.91
> 600km and ≤ 900km	< 500V	305.65	351.50	92.60	106.49	50.27	57.81	99.70	114.66	68.63	78.92	43.54	50.07	R 8.51	R 9.79
	≥ 500V & < 66kV	301.41	346.62	91.30	105.00	49.58	57.02	98.34	113.09	67.64	77.79	42.93	49.37	R 7.77	R 8.94
	66kV & ≤ 132kV	291.87	335.65	88.40	101.66	48.00	55.20	95.18	109.46	65.51	75.34	41.55	47.78	R 7.54	R 8.67
	> 132kV*	275.08	316.34	83.34	95.84	45.25	52.04	89.74	103.20	61.76	71.02	39.18	45.06	R 9.62	R 11.06
> 900km	< 500V	308.72	355.03	93.53	107.56	50.79	58.41	100.71	115.82	69.31	79.71	43.98	50.58	R 8.55	R 9.83
	≥ 500V & < 66kV	304.42	350.08	92.21	106.04	50.08	57.59	99.29	114.18	68.34	78.59	43.34	49.84	R 7.85	R 9.03
	66kV & ≤ 132kV	294.81	339.03	89.31	102.71	48.50	55.78	96.16	110.58	66.17	76.10	41.98	48.28	R 7.60	R 8.74
	> 132kV*	277.79	319.46	84.19	96.82	45.75	52.61	90.66	104.26	62.41	71.77	39.61	45.55	R 9.69	R 11.14

* 132 kV or Transmission connected

Voltage	Distribution network charges – Network capacity charge [R/kVA/m]	VAT incl	Network demand charge [R/kVA/m]	VAT incl	Urban low voltage subsidy charge [R/kVA/m]	VAT incl
< 500V	R 16.68	R 19.18	R 31.61	R 36.35	R 0.00	R 0.00
≥ 500V & < 66kV	R 15.29	R 17.58	R 28.99	R 33.34	R 0.00	R 0.00
≥ 66kV & ≤ 132kV	R 5.47	R 6.29	R 10.11	R 11.63	R 13.39	R 15.40
> 132kV / Transmission connected	R 0.00	R 0.00	R 0.00	R 0.00	R 13.39	R 15.40

Voltage	Ancillary service charge [c/kWh]	VAT incl
< 500V	0.39	0.45
≥ 500V & < 66kV	0.38	0.44
≥ 66kV & ≤ 132kV	0.35	0.40
> 132kV / Transmission connected	0.33	0.38

Customer categories	Service charge [R/account/day]	VAT incl	Administration charge [R/POD/day]	VAT incl
> 1 MVA	R 190.47	R 219.04	R 85.86	R 98.74
Key customers	R 3,732.51	R 4,292.39	R 119.20	R 137.08

Reactive energy charge [c/kVArh] – High season	VAT incl	Low season	VAT incl
13.40	15.41	0.00	0.00

Electrification and rural network subsidy charge [c/kWh]	VAT incl
7.42	8.53

Table 6.16: 2019/2020 Eskom Megaflex tariffs for local authorities

Megaflex – Local Authority

Transmission zone	Voltage	Active energy charge [c/kWh] High demand season [Jun - Aug] Peak	VAT incl	Standard	VAT incl	Off Peak	VAT incl	Low demand season [Sep - May] Peak	VAT incl	Standard	VAT incl	Off Peak	VAT incl	Transmission network charges [R/kVA/m]	VAT incl
≤ 300km	< 500V	347.10	399.17	105.62	121.46	57.63	66.27	113.64	130.69	78.43	90.19	49.99	57.49	R 9.67	R 11.12
	≥ 500V & < 66kV	341.63	392.87	103.51	119.04	56.21	64.64	111.44	128.16	76.70	88.21	48.67	55.97	R 8.82	R 10.14
	≥ 66kV & ≤ 132kV	330.85	380.48	100.22	115.25	54.43	62.59	107.93	124.12	74.29	85.43	47.12	54.19	R 8.59	R 9.88
	> 132kV*	311.81	358.58	94.46	108.63	51.29	58.98	101.71	116.97	70.00	80.50	44.41	51.07	R 10.87	R 12.50
> 300km and ≤ 600km	< 500V	349.93	402.42	106.01	121.91	57.56	66.19	114.15	131.27	78.59	90.38	49.85	57.33	R 9.71	R 11.17
	≥ 500V & < 66kV	345.04	396.80	104.53	120.21	56.76	65.27	112.57	129.46	77.47	89.09	49.14	56.51	R 8.92	R 10.26
	≥ 66kV & ≤ 132kV	334.09	384.20	101.20	116.38	54.95	63.19	108.98	125.33	75.00	86.25	47.57	54.71	R 8.65	R 9.95
	> 132kV*	314.92	362.16	95.42	109.73	51.80	59.57	102.71	118.12	70.71	81.32	44.85	51.58	R 10.97	R 12.62
> 600km and ≤ 900km	< 500V	353.42	406.43	107.07	123.13	58.13	66.85	115.28	132.57	79.36	91.26	50.35	57.90	R 9.84	R 11.32
	≥ 500V & < 66kV	348.52	400.80	105.57	121.41	57.33	65.93	113.71	130.77	78.21	89.94	49.64	57.09	R 8.98	R 10.33
	≥ 66kV & ≤ 132kV	337.49	388.11	102.22	117.55	55.50	63.83	110.06	126.57	75.75	87.11	48.04	55.25	R 8.72	R 10.03
	> 132kV*	318.07	365.78	96.37	110.83	52.32	60.17	103.77	119.34	71.41	82.12	45.30	52.10	R 11.12	R 12.79
> 900km	< 500V	356.97	410.52	108.15	124.37	58.73	67.54	116.45	133.92	80.14	92.16	50.85	58.48	R 9.89	R 11.37
	≥ 500V & < 66kV	352.00	404.80	106.62	122.61	57.91	66.60	114.81	132.03	79.02	90.87	50.11	57.63	R 9.08	R 10.44
	≥ 66kV & ≤ 132kV	340.89	392.02	103.27	118.76	56.08	64.49	111.19	127.87	76.51	87.99	48.54	55.82	R 8.79	R 10.11
	> 132kV*	321.21	369.39	97.35	111.95	52.90	60.84	104.83	120.55	72.16	82.98	45.80	52.67	R 11.20	R 12.88

* 132 kV or Transmission connected

Voltage	Distribution network charges: Network capacity charge [R/kVA/m]	VAT incl	Network demand charge [R/kVA/m]	VAT incl	Urban low voltage subsidy charge [R/kVA/m]	VAT incl
< 500V	R 19.29	R 22.18	R 36.55	R 42.03	R 0.00	R 0.00
≥ 500V & < 66kV	R 17.68	R 20.33	R 33.52	R 38.55	R 0.00	R 0.00
≥ 66kV & ≤ 132kV	R 6.32	R 7.27	R 11.69	R 13.44	R 15.48	R 17.80
> 132kV*	R 0.00	R 0.00	R 0.00	R 0.00	R 15.48	R 17.80

* 132 kV or Transmission connected

Voltage	Ancillary service charge [c/kWh]	VAT incl
< 500V	0.45	0.52
≥ 500V & < 66kV	0.44	0.51
≥ 66kV & ≤ 132kV	0.40	0.46
> 132kV*	0.38	0.44

* 132 kV or Transmission connected

Customer categories	Service charge [R/account/day]	VAT incl	Administration charge [R/POD/day]	VAT incl
> 1 MVA	R 220.24	R 253.28	R 99.28	R 114.17
Key customers	R 4,315.89	R 4,963.27	R 137.83	R 158.50

Reactive energy charge [c/kVArh] High season	VAT incl	Low season	VAT incl
15.49	17.81	0.00	0.00

Electrification and rural network subsidy charge [c/kWh]	VAT incl
8.58	9.87

These tariffs are also classified into a low and high season with three months of the year (June to August) representing the high season and nine months of the year (September to May) that represents the low season. In terms of Eskom's criteria Drakenstein Municipality falls in the > 900km and ≥66kV & ≤132kV bracket for pricing purposes.

The tariffs approved and published by Eskom each year are used as a basis to bill the monthly consumption of its consumers on a monthly basis.

6.2.5 **Eskom utility bills for 36 months**

The municipality purchases electricity from Eskom on the megaflex time-of- use tariff, where there is a high season tariff from June to August each year and a low season tariff from May to September each year. As depicted below the information obtained from the municipality shows a similar pattern for the three financial years wherein the municipality has a higher utility bill in the high season and a lower bill in the low season period.

In order to decouple the electricity consumption from the tariffs charged by Eskom, the physical electricity accounts were obtained to determine the number of units that were consumed by the municipality and also to determine if the municipal consumption showed any deviations or changes during the three periods in question. The information on the municipal consumption is shown in table 6.17 below for the three financial years under study.

Table 6-17 : Eskom Payments from 2017/2018 till 2019/2020

	2017-2018		2018-2019		2019-2020	
Month	**NMD**	**Bulk Purchases**	**NMD**	**Bulk Purchases**	**NMD**	**Bulk Purchases**
July	1,230,100.00	74,108,040.21	1,230,100.00	79,906,970.54	1,421,600.00	98,388,627.60
August	1,230,100.00	76,005,832.77	1,230,100.00	82,526,395.59	1,421,600.00	91,147,206.71
September	1,230,100.00	43,140,235.41	1,230,100.00	46,303,310.22	1,540,433.63	53,301,062.48
October	1,230,100.00	44,047,027.16	1,230,100.00	48,380,456.31	1,390,000.00	54,805,068.21
November	1,230,100.00	44,044,050.16	1,230,100.00	48,171,740.98	1,390,000.00	54,748,698.75
December	1,230,100.00	45,792,725.99	1,230,100.00	44,265,925.67	1,390,000.00	50,392,643.30
January	1,230,100.00	48,489,210.32	1,230,100.00	51,274,999.37	1,395,305.58	60,015,645.19
February	1,230,100.00	45,894,636.10	1,230,100.00	51,442,722.31	1,395,305.58	58,954,004.83
March	1,230,100.00	46,138,697.63	1,230,100.00	48,643,803.24	1,395,305.58	58,361,225.01
April	1,230,100.00	41,841,921.18	1,230,100.00	46,701,629.52	1,395,305.58	46,508,987.01
May	1,230,100.00	44,943,768.59	1,230,100.00	48,019,221.60	1,395,305.58	51,471,921.44
June	1,230,100.00	73,223,503.83	1,230,100.00	73,295,363.91	1,395,305.58	84,856,525.31
Total	**14,761,200.00**	**627,669,649.35**	**14,761,200.00**	**668,932,539.26**	**16,925,467.11**	**762,951,615.84**

6.2.6 **Municipal Cost of Supply Study**

The Policy Position 23 of the Electricity Pricing of 1998 requires that electricity distributors carry out a cost of supply study at least every five years or whenever significant changes in customer behaviour occurs. NERSA further requires these studies to be the basis of the electricity distributor’s tariff setting framework.

During the 2017/2018 financial year, the Drakenstein Municipality authorized Lyners and Associates to conduct a comprehensive electricity pricing study on behalf of the municipality. This study contained the following three components:

(a) An electricity service ring-fencing exercise where all the correct costs and revenue related to the electricity service were to be determined;

(b) A cost of supply study to determine the revenue requirements of the electricity service and do determine and allocate the current cost to different load types on the municipal grid and;

(c) To analyse the tariff structure of the municipality and determine how the tariff structure differ from the municipal cost model and map out the cross-subsidisation within the different tariff categories.

The municipality disagreed with the results of this study and never implemented the recommendations.

6.3 Phase Two Data Analysis & Key Findings– Quantitative data

The aim of this section of the chapter is to analyse the data that were obtained from the municipality to determine the past and current trends relating to electricity sales, the trend of the generation of electricity by prosumers and how this trend has affected the overall electricity sales of the municipality and the overall revenue generation by the municipality from these services. To properly assess how the implementation of SSEG tariffs in the municipality has affected the topics above. To start off, a trend analysis was conducted. To further validate the findings from the trend analysis the researcher then proceeded to use the statistical functions in Excel for trends and growth to forecast the perceived future of SSEG.

A time series is regarded as an assembly of chronological data that is spaced equally (Lee, Tay, Choy; 2018,218). Lee et al (2018) further stipulates that in a time series one can include data modules that looks at long term patterns, data that repeats itself in certain periods in a particular manner, seasonal data and data that presents uneven and unexplainable patterns. Forecasting can also be described as using historical and present data as a basis to predict future charges.

For this part of the study the historical and present data that were obtained from the municipality will thus be arranged in a time series to determine the trends associated with the particular data series. After the results of the trend analysis were obtained, the researcher then moved on to conduct a forecasting of the future impact using the identified trends during the trend analysis process.

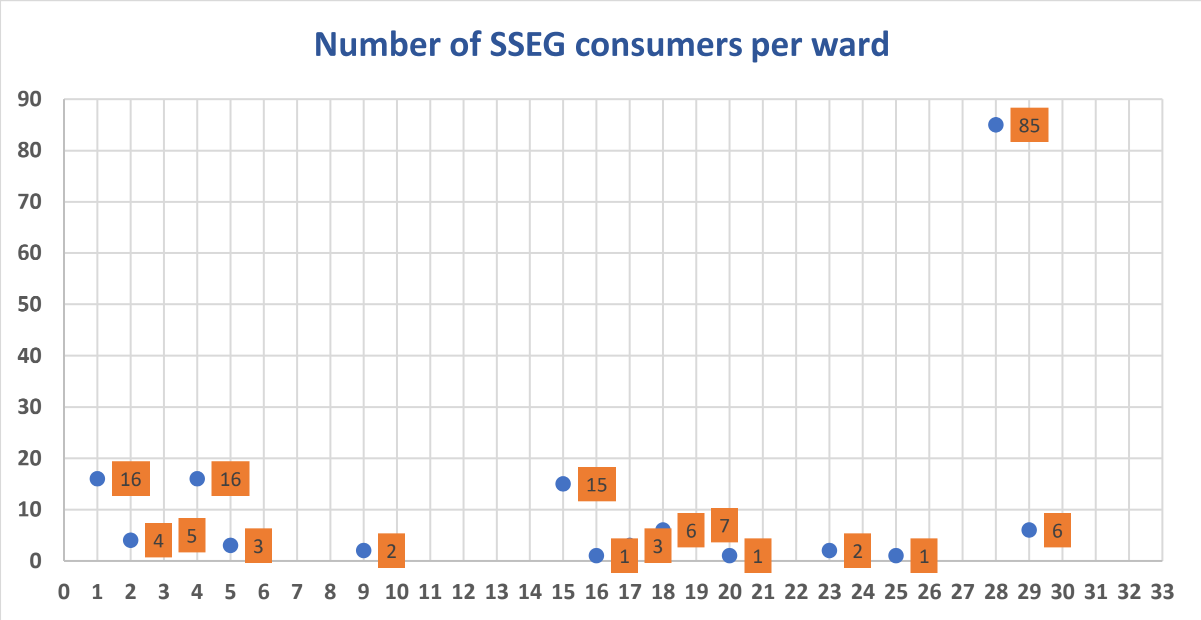
6.3.1 **Trend Analysis**

6.3.1.1 **Electricity sales**

The first examination conducted by the researcher was to identify where the spread of co-generation consumers is in the municipality. This was conducted by taking the consumer information that were obtained from the municipality and plotting the consumers on a scatter diagram to see where these consumers are located. The municipality as indicated above in the data collection phase is demarcated into 33 wards from the North to the South end of the municipality. According to graph 6.1 below you can see that the majority of co-generation consumers are situated on the

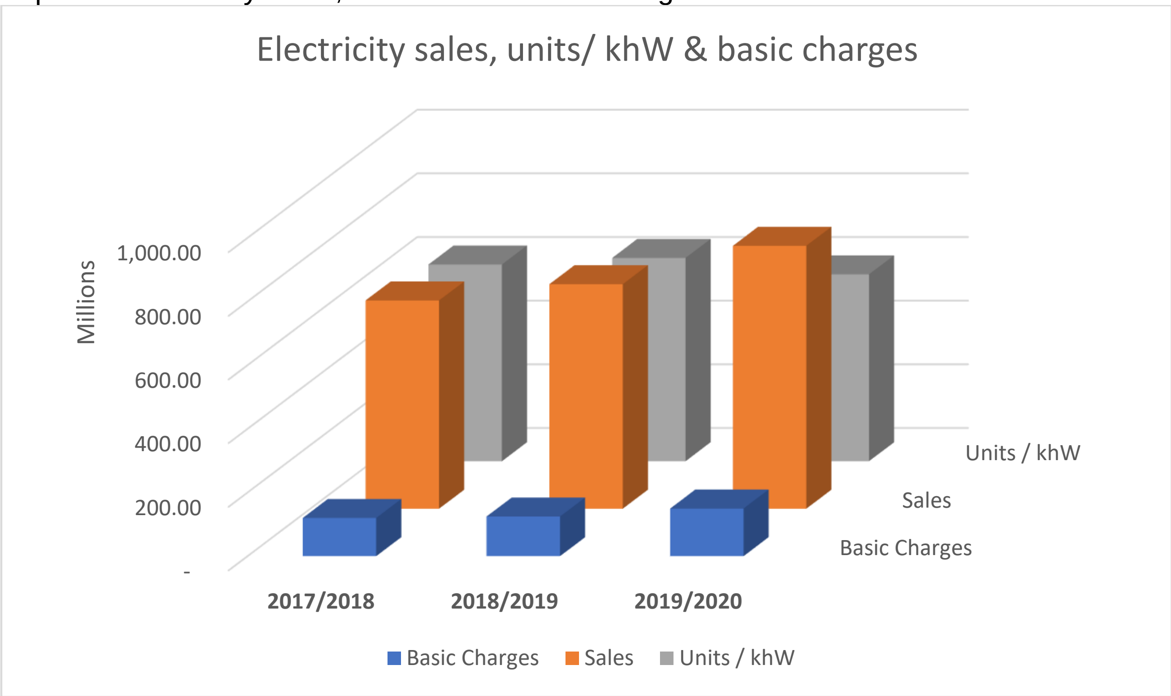
South end of the municipality. This side of the municipality consists of mostly low density gated villages and rural developments that have the largest electricity connections and consumes the most electricity.

Graph 6.1: SSEG consumers per ward



From the above graph it is evident that the most consumers with installed SSEG are in the South side of the municipality specifically in ward 28 which mostly consist of gated villages such as Pearl Valley and Val de Vie. The second largest group of consumers are situated in wards 2 and 5 which are in Wellington. The consumers are mostly business consumers while the third largest group of consumers are situated in ward 15 which is also in Southern Paarl. The researcher aimed to determine how the electricity sales, units and basic charges have performed for the three financial years.. To determine this the researcher plotted the information received from the municipality and developed a column graph which showed the units, sales and basic charges generated by the municipality over the three financial years. The results are illustrated in graph 6.2 below.

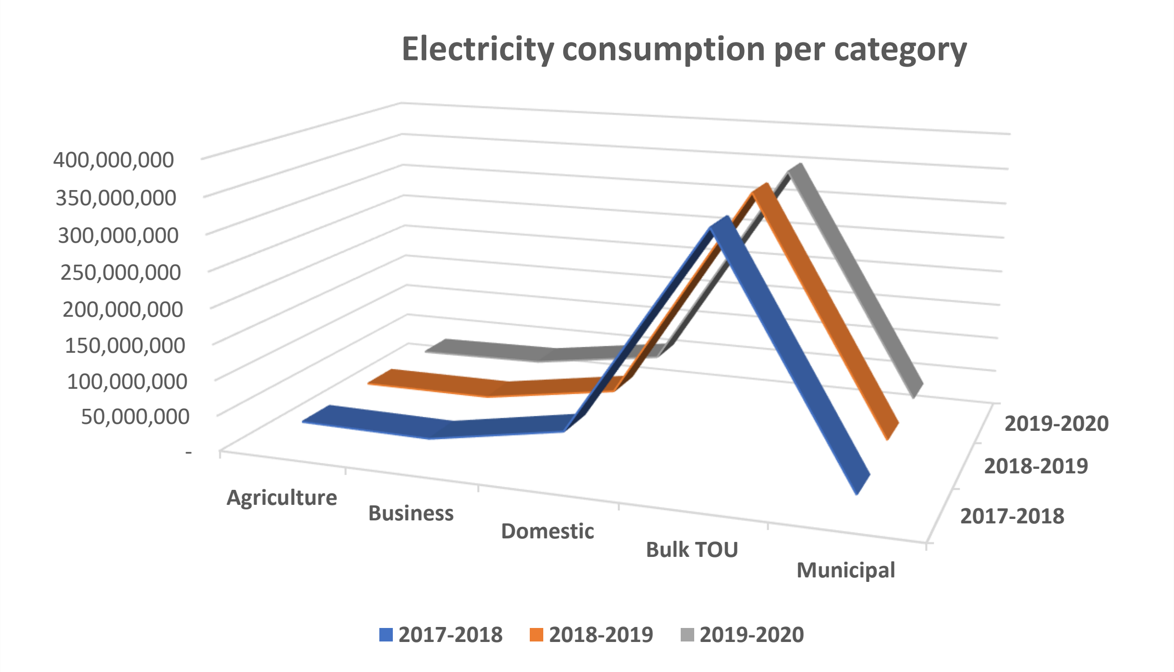
Graph 6.2: Electricity sales, units/ khW & basic charges



In the graph above it is evident that the basic electricity charges show an inclining trend over the three financial years and that the revenue generated by the municipality from electricity basic charges has in total increased with 25% or 29 million from 2017/2018 till 2019/2020. The sales generated from the selling of electricity units also increased from the 2017/2018 financial year to the 2019/2020 financial showing a 26% or 171 million increase over the three financial years. In turn the electricity units/ kWh decreased by 5% or 30 million units over the same period. The decrease in electricity khW is a warning signal that the municipality is losing electricity kWh sales due to various reasons of which the consumers going off the grid is one. Thus based on the trend it is evident that there is a decline in the electricity units that are purchased from the municipality.

When the basic charges, sales and electricity unit's data was further broken down the researcher could see who the biggest contributors to the electricity revenue of the municipality were during the period under review. From graph 6.3 below one can infer that the Bulk consumers followed by domestic and other business consumers contributes the most to the electricity usage of the municipality. Thus any disruption in the consumption of these consumers will affect the revenue of the municipality.

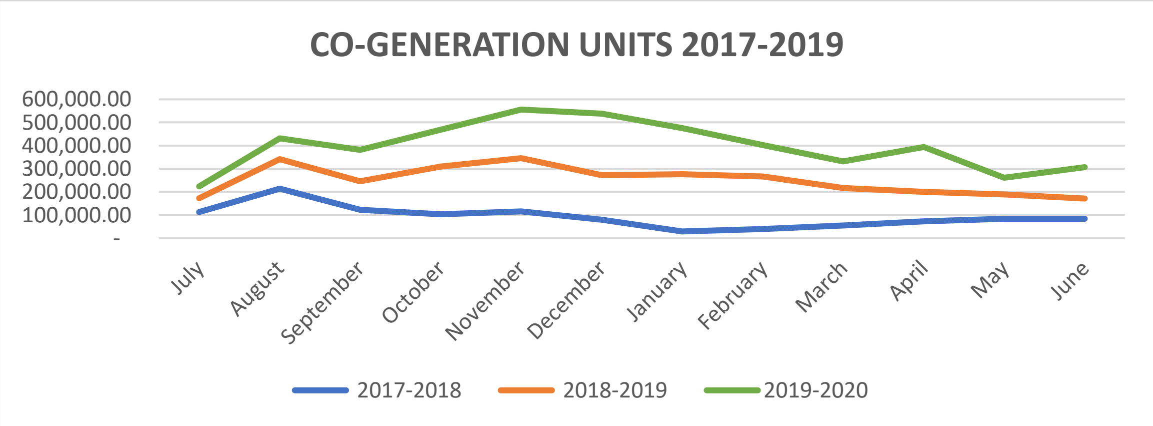
Graph 6.3: Electricity consumption per category



Due to the system used by the municipality to reimburse consumers for electricity units being of an offsetting nature, the electricity units generated by the prosumers is not evident in the data of the municipality. This is because the units that are fed into the municipal grid are all offset from the total units sold to consumers in a specific year. This means that the captured electricity units that are fed into the municipal grid are already offset from the reported total electricity units consumed by the municipality. Thus the ultimate decrease in electricity sales discussed above are nett the units generated by the prosumers.

In order to identify the contribution of the co-generation consumers to the decline above a detailed analysis of the electricity units that are generated by prosumers is analysed below.

Graph 6.4: Co-generation khW generated from prosumers from 2017/2018 – 2019/2020

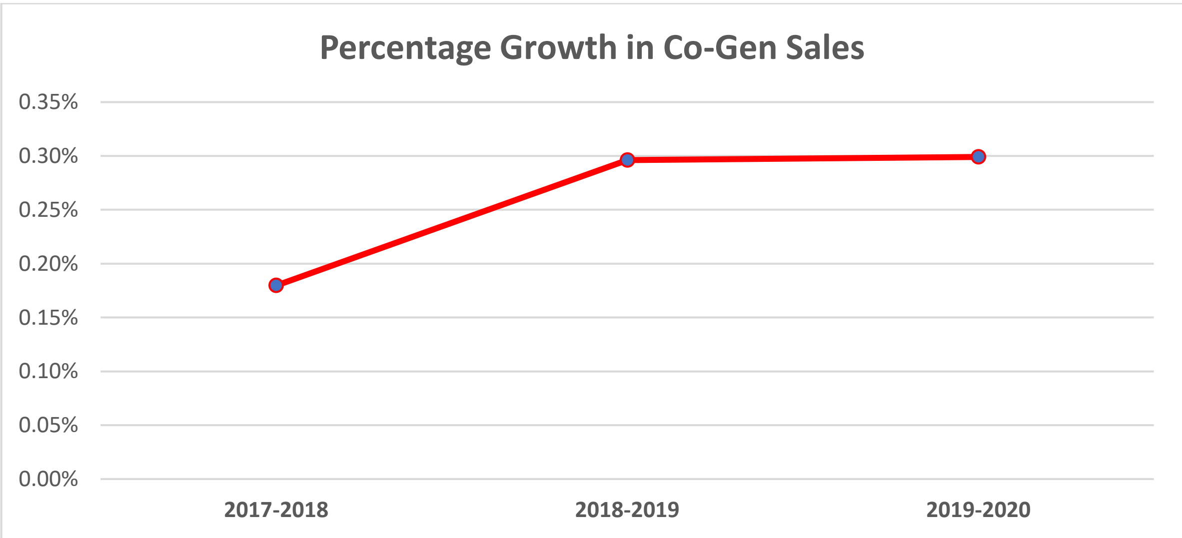


From graph 6.4 above one can deduce that the generation of electricity by prosumers has shown a growth from a total of 1,112,325 units in the 2017-2018 financial year, to 1,897,101 in the 2018-2019 financial year followed by a slight decrease to 1,761,179 units in the 2019-2020 financial year. The graph also shows the periods when the prosumers generated the most and the least amount of electricity units. From the above graph one can see that the period between November and February each year is the time when the prosumers are producing the most electricity. The graph also shows the cumulative growth of 58% in generated electricity from the 2017-2018 to the 2019-2020 financial year.

A further test was conducted to compare the units generated by prosumers with the units sold by the municipality. In order to properly see the researcher had to add the co-generated sales back to the units sold by the municipality before determining what percentage of the total units sold the co-generated units actually presented. This trend comparison is illustrated in graph 6.5 below.

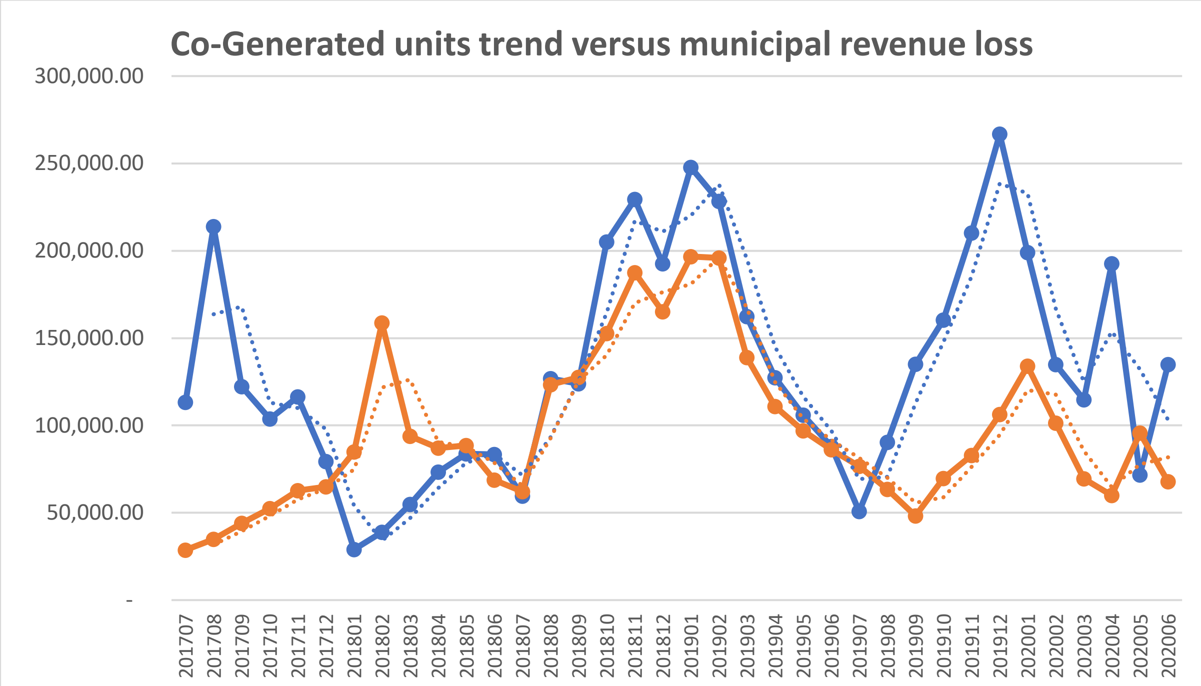
Graph 6.5 clearly show that the small the percentage of co-generated electricity units is showing an inclining trend in the three financial years.

Graph 6.5: Co-generation electricity units as a percentage of total electricity sales 2017-2018-2019-2020



The researcher plotted the trend of electricity units back into the municipal grid and the revenue generated by the prosumers from those electricity units on a time series to show a pattern of how the co-generated units and the revenue made by prosumers performed during the three financial years under review.

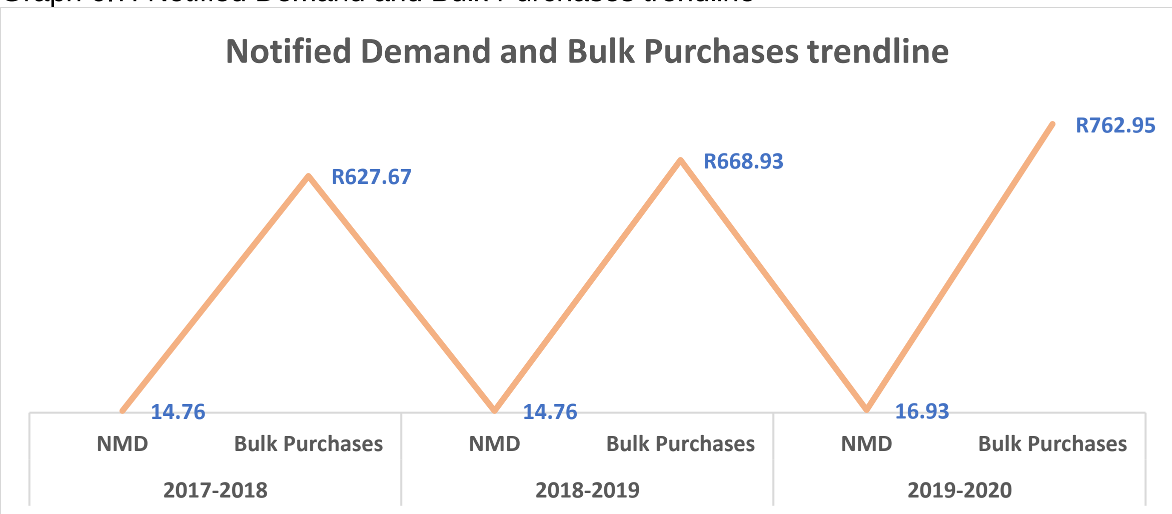
Graph 6.6: Co-generated units' trend versus municipal revenue loss trend



6.3.1.2 **Electricity purchases**

An assessment of the electricity purchases of the municipality is illustrated in graph 6.7 below that give an indication of how much the municipality has had to pay for electricity bulk purchases over the three financial years. From the graph below, it is seen that the demand required by the municipality from Eskom has remained constant between the 2017/2018 and 2018/2019 financial years at 14.76 million KVA for the year while increasing with 2.16 million KVA or 15 % in the 2019/2020 financial year. In turn the electricity bulk purchases in rand value has increased by 7% from 2017/2018 to 2018/2019 and by 14% in the 2019/2020 financial year.

Graph 6.7: Notified Demand and Bulk Purchases trendline



6.3.1.3 **Electricity tariff structuring & Eskom tariffs**

The tariff structure of the municipality has stayed mostly the same for the 2017/2018 and 2018/2019 financial years, with the municipality increasing the tariff in line with the approved NERSA increases. In the 2019/2020 financial year the municipality introduced two major changes in their tariffs which were a new Bulk Consumers tariff and also changed the manner in which the feed-in tariff for co-generation consumers would be applied. On the other hand the electricity tariffs charged by Eskom stayed the same for all three financial years under review with only the year on year tariff increases being applied to the previous year's tariffs.

Table 6.18 shows the respective municipal tariff increases for the three years under review.

Table 6.18: Average Electricity tariff increases 2017-2018 till 2019-2020

Row Number	Consumer Category	2017/2018	2018/2019	2019/2020
1	Domestic Consumers	1.93%	6.84%	13.93%
2	Business Consumers	1.93%	6.84%	13.93%
3	Rural Consumers	5.01%	6.84%	13.93%
4	Bulk Consumers	N/A	N/A	100.00%
5	Bulk Time of Use Consumers	1.88%	6.84%	17.00%
6	Co-gen Domestic Consumers	1.98%	6.84%	-240.00%
7	Co-Gen Business Consumers	1.98%	6.84%	-240.00%
8	Co-Gen Rural Consumers	1.98%	6.84%	-240.00%
9	Co-Gen Bulk Consumers	N/A	N/A	100%
10	Co-Gen Bulk Time of Consumers	1.98%	6.84%	-122.66%

As indicated above there were two major changes implemented on the municipality's electricity tariff structure in the 2019/2020 financial year. The first change refers to bulk consumers where bulk consumers with a load factor of less than 50% per annum were de-linked from the bulk time-of-use tariff. A new tariff consisting of a fixed basic charge per month, a KhW tariff per unit and a KVA tariff were developed.

The second major change made refer to the feed-in tariff across all consumer categories, which resulted in the municipality paying less for electricity fed back into the municipal grid than what the municipality paid in the preceding financial years. As seen above, there was an overall decrease of up to 240% in the tariff that resulted in co-generation consumers being compensated less for generated electricity units.

6.3.1.4 Cross-subsidisation model

In the absence of the municipality having an approved cost of supply study, the researcher analysed the electricity sales data per tariff category for the three years under review to determine which tariff category is generating the most revenue and which the least. Because the cost information of the municipality's electricity departments is not linked to the different tariff categories it became difficult for the researcher to include the cost items in this particular analysis, and that is why the revenue was used to determine the cross-subsidisation model of the municipality. The results of this analysis are illustrated in table 6-19 below.

Table 6.19 Electricity revenue per tariff Category 2017-2018 till 2019/2020

	2017/2018		2018/2019		2019/2020	
Tariff Category	**Total**	**%**	**Total**	**%**	**Total**	**%**
Agriculture	39,676,156.50	6%	41,585,555.57	6%	43,189,895.84	6%
Business - 1X20A	338,215.70	0%	394,612.31	0%	427,676.16	0%
Business - 1X30A	1,207,183.50	0%	1,260,578.90	0%	1,253,660.20	0%
Business > 1X30A	4,402,604.17	1%	6,044,895.02	1%	6,141,838.91	1%
Business >3X30A	40,548,744.98	6%	44,434,637.92	7%	50,202,485.03	7%
Business 1X20A	777,123.79	0%	866,359.97	0%	864,864.20	0%
Business 1X30A	3,155,140.20	0%	3,521,397.04	1%	261,896.39	0%
Domestic > 3X30A	30,174.44	0%	38,970.53	0%	67,298.21	0%
Domestic >1X30A	58,221,197.31	9%	6,408,360.23	1%	7,481,132.01	1%
Domestic >3X30A	20,987,737.00	3%	22,382,115.57	3%	25,557,772.60	3%
Domestic 1X20A	940,592.48	0%	952,728.01	0%	1,114,265.80	0%
Domestic 1X30A	11,338,545.89	2%	11,031,282.93	2%	11,708,839.24	2%
Domestic 3X20A	140,102.97	0%	145,095.33	0%	194,035.18	0%
Domestic 3X30A	949,514.81	0%	906,681.31	0%	837,905.51	0%
High Volt	274,723,095.17	42%	247,462,852.20	38%	290,775,672.52	38%
High Volt - KVA	1,627,588.96	0%	39,134,809.99	6%	102,334,964.96	13%
Low Volt	154,147,059.77	24%	148,173,643.56	23%	115,456,028.17	15%
Low Volt - KVA	1,015,549.88	0%	28,964,494.22	4%	46,869,367.59	6%
Municipal	39,040,988.71	6%	46,009,268.32	7%	54,468,023.52	7%
Municipal KVA	922,893.62	0%	1,084,695.85	0%	5,722,917.50	1%
Total	**654,190,209.85**	**100%**	**650,803,034.78**	**100%**	**764,930,539.54**	**100%**

Tariff Category	Total	%	Total	%	Total	%
Agriculture	39,676,156.50	6%	41,585,555.57	6%	43,189,895.84	6%
Business - 1X20A	338,215.70	0%	394,612.31	0%	427,676.16	0%
Business - 1X30A	1,207,183.50	0%	1,260,578.90	0%	1,253,660.20	0%
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Total	**654,190,209.85**	**100%**	**650,803,034.78**	**100%**	**764,930,539.54**	**100%**

Table 6.19 above illustrates the electricity revenue per tariff category that shows which category of consumers contributed the most to the electricity revenue of the municipality for the three financial years under review. From this table one can see that the high voltage bulk consumers contributed the most to the electricity revenue, followed by the business consumers and then domestic consumers. This pattern is prevalent for all three financial years.

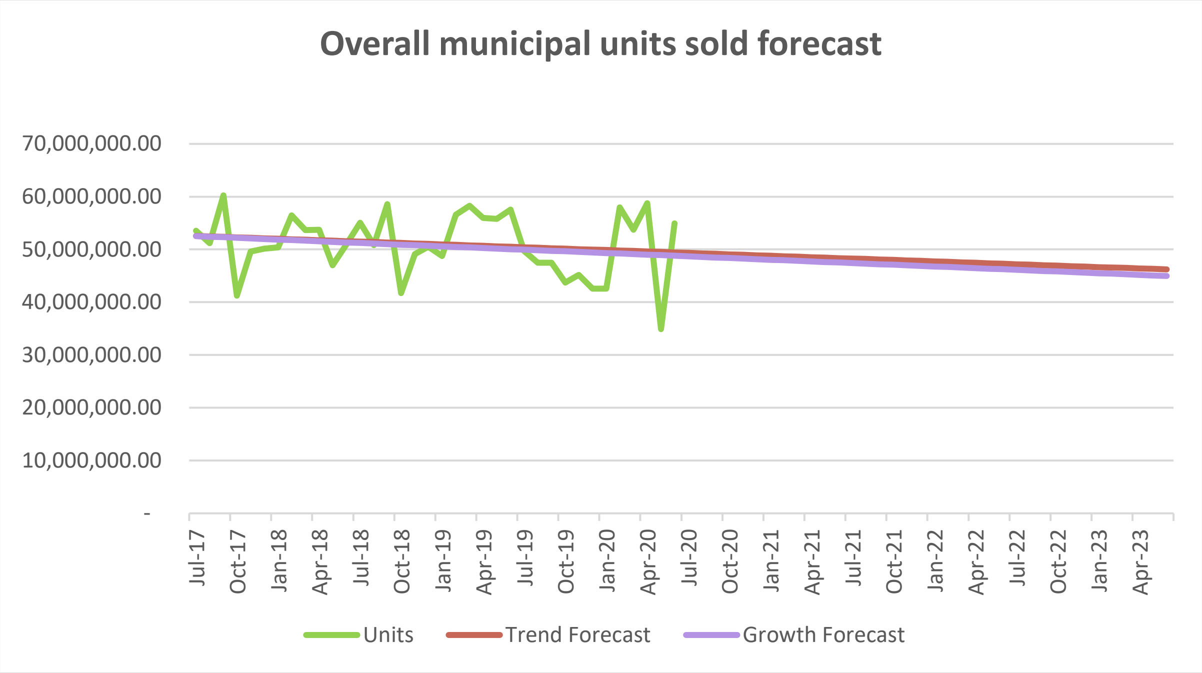
6.3.2 **Forecasting**

Although the trend analysis discussed in paragraph 6.3.2 above shows a cumulative declining trend in electricity sales from 2017/2018 to the 2019/2020 financial year, there is no clear pattern in the time series since there was an increase between the first and second year of the time series and a slight overall decline in units that were generated in the 2019/2020 financial year. The changes in the data in the 2019/2020 financial year has created a slight distortion in the electricity sales data of the municipality due to the changes in the tariff structure of the municipality relating to bulk consumers and co-generation consumers coupled with the fact that the last three months in that financial year was during the hard lockdown of the COVID pandemic.

It became necessary for the researcher to look at all the available data to conduct the forecasting of both the overall electricity units that were sold by the municipality and the electricity units that were generated by the prosumers during the three financial years under review.

The researcher used the trend and growth forecasting function of Excel to create the following data based on the resultant revenue generated from sale of electricity by the municipality for the three financial years under review.

Graph 6.8: Overall municipal electricity sold forecasted till June 2023



The researcher plotted the total electricity sold by the municipality per month from July 2017 till June 2020 in the graph above. A linier trendline was then selected on a line graph which is the blue line in the graph. This blue line shows the amount of electricity units sold in each of these months and also how the consumption patterns of consumers fluctuated between the months.

The researcher also determined the linier trend and growth forecast patterns of the data by using the following equation :

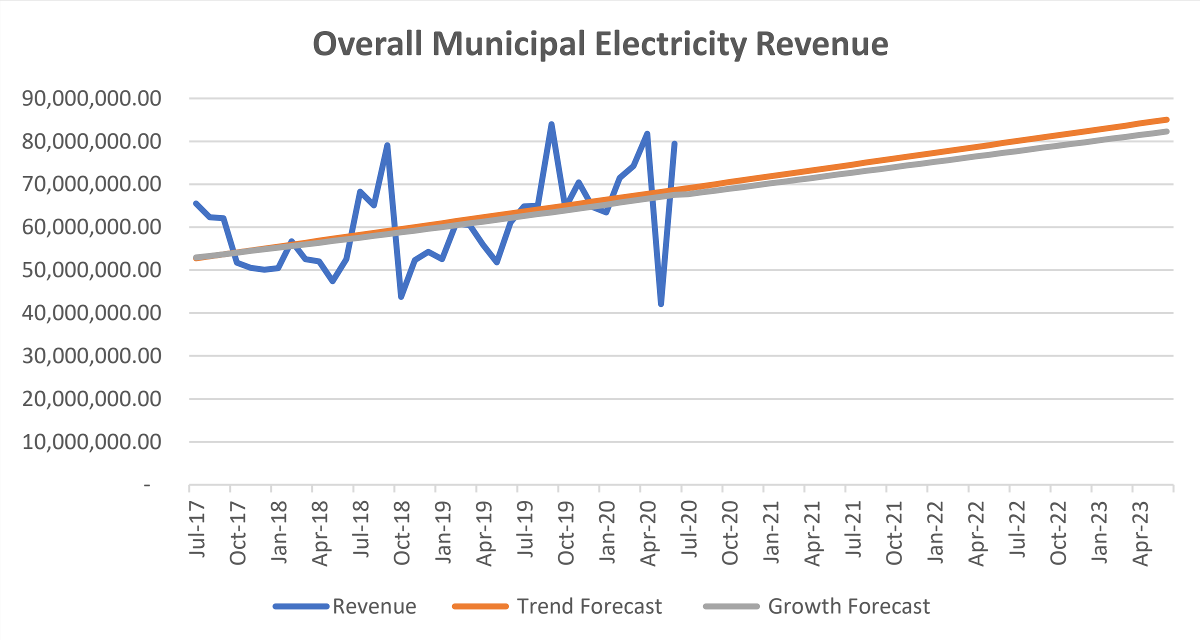
Trend Forecast = (known y,[known x], [new x],[constant]) and;

Growth Forecast = (known y,[known x], [new x],[constant])

The output of the two formulas is shown on graph 6.8 above with the red line representing the trend and the purple one representing the growth forecast. The forecast was done until June 2023 to properly illustrate the pattern of both the trend and the growth. From this graph it is evident that the electricity units sold by the municipality on a monthly basis are on a decline. From the actual data obtained from the municipality the negative growth trend is already visible which compounds further as the data is projected forward. The graph shows a compounded growth decline of 8% until June 2023.

To determine if the revenue also follow the same trend, the same formulas were applied to the revenue that were generated from electricity sales and the results were different. Graph 6.9 below illustrates how the electricity revenue growth trend for the same period looked like

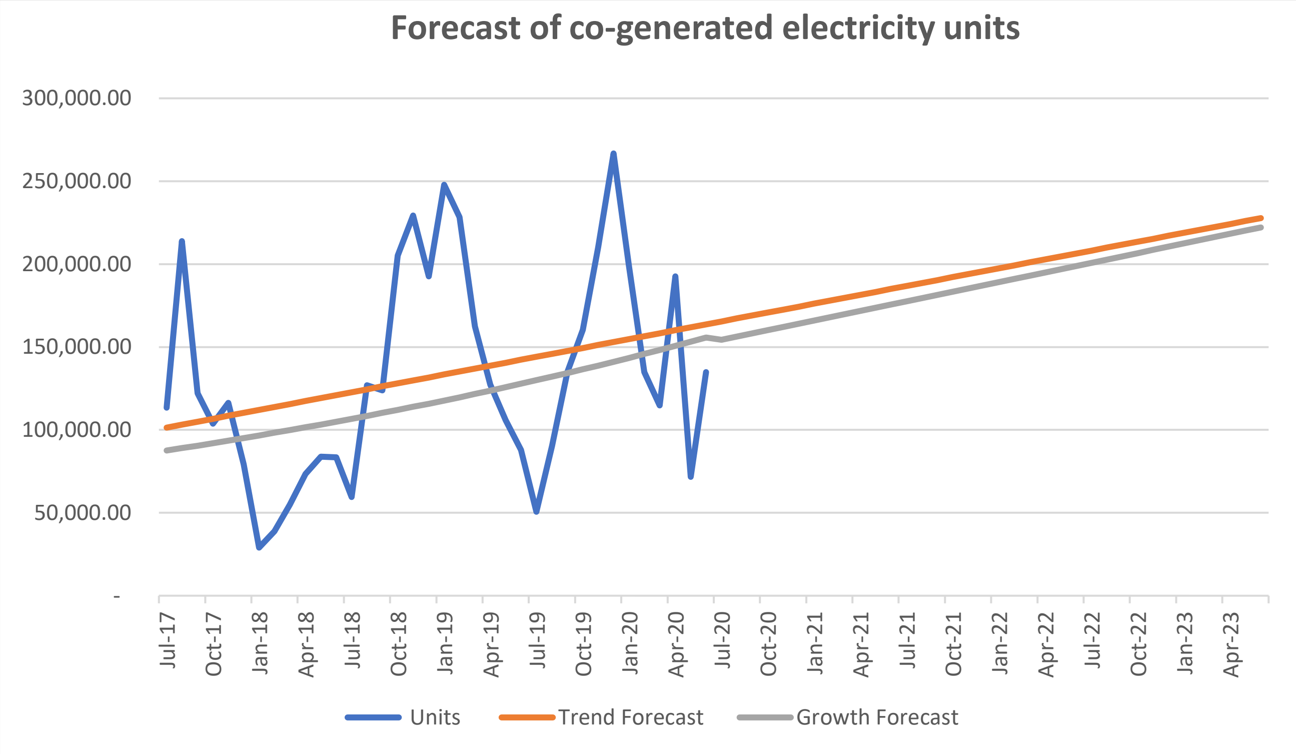
Graph 6.9: Overall municipal revenue generated from electricity sold forecasted till June 2023



The electricity revenue forecast shows a different pattern than the units that were sold. The forecasted revenue shows an inclining trend suggesting that the electricity revenue will increase till June 2023. The percentage growth between the forecasts are not the same if you compare the trend forecast with the growth forecast. The trend forecast shows a cumulative increase of 27% in revenue whilst the growth trend ends up at a 24% cumulative increase. Thus one can assume that although the revenue from electricity sales shows an inclining trend over the medium term of three years, there are signs that the growth trend is starting to show signs of decline.

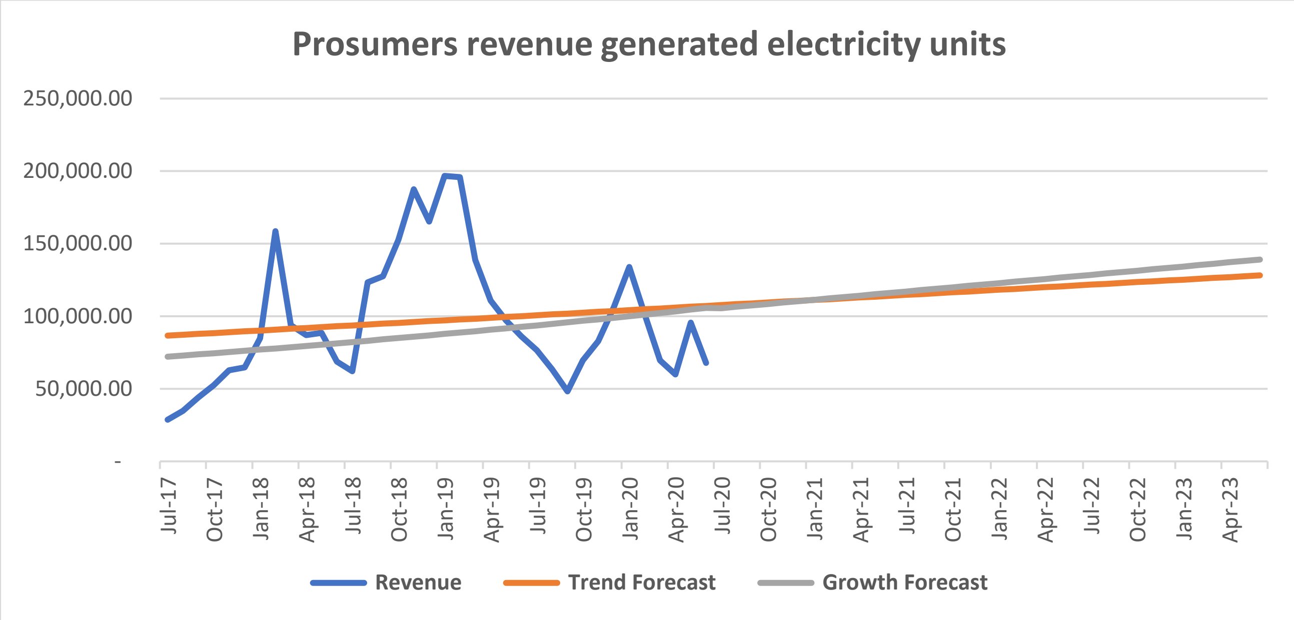
A different trend and growth pattern emerge when taking the same formulas and applying it on the electricity units generated by prosumers.. Graph 6.10 show the forecasted co-generated units. In this graph there is a strong inclining trend and growth forecast over the three forecasted financial years with the trend forecast showing a cumulative 22% increase in co-generated units and the growth forecast showing a 26% cumulative growth in forecasted co-generated electricity units till July 2023.

Graph 6.10: Co-generated units forecasted till June 2023



The same formulas were again used to determine the effect of the increased co-generated units on the revenue of the municipality and graph 6.11 below has revealed that if the current trend prevails , the revenue which is generated by prosumers will follow an inclining trend showing an increase of 48% on the trend forecast and 42% on the growth forecast.

Graph 6.11: Prosumers revenue from generated units forecasted till 30 June 2023



Based on the above analysis it is evident that the prominence of co-generated electricity by means of PV systems in Drakenstein Municipality is on the incline.

6.3.3 **Conclusion on quantitative data analysis**

Given the above trends it is evident that there is an increase in electricity generated from alternative sources by consumers and a related decrease in the subsequent revenue generated by the municipality. The question now remains how the municipality will deal with the eminent increase in co-generated electricity.

6.4 Phase-Three qualitative data collection & analysis

Subsequent to the quantitative data analysis above, the researcher had an interview with the Senior Manager: Electrical Engineering at Drakenstein Municipality. The main reason for the interview was to find out if the results of the quantitative analysis were in line with the expectations of the municipality relating to the growth of SSEG and also how the municipality is seeing the future of SSEG. This is in terms of the tariff setting and revenue impact on the municipality.

From the interview, the following was observed:

- The municipality has an approved SSEG policy and guidelines on how the installations of SSEG infrastructure should be in the Drakenstein areas and the criteria that should be followed.

- The municipality is aware of the eminent threat of SSEG to the revenue of the municipality and has made changes in their tariff structure in the 2019/2020 financial year, to curb these perceived increases.
- A flat rate feed-in tariff was developed by the municipality to counter the municipality losing revenue during times when the co-generation consumers are not nett metering.
- The flat rate feed-in tariff is used to flatten the curve of possible future revenue losses.
- The municipality focus on load management to decrease their bulk electricity costs which enable savings, which will offset any revenue losses resultant from people going off the electricity grid.
- The municipality's current tariff structure limits cross-subsidisation because it focused on the load use by each consumer, who is not able to afford a higher load and who is being restricted to 20 Amp. Thus consumers use what they can afford and there is no real cross-subsidisation.

The detailed interview questions and answers are attached as Appendix A.

6.4.1 **Conclusion on qualitative data analysis**

The qualitative analysis revealed that the municipality is aware of the eminent increase of co-generation consumers and have started looking at strategies of how the effect of this growth in SSEG can be mitigated.

6.5 Final conclusions on quantitative and qualitative data analysis

The combined results of quantitative and the qualitative data analysis have shown that the uptake of SSEG in the municipality is on the increase. The municipality has seen and identified these increases and have started implementing strategies on how to best mitigate this risk of loss of revenue due to SSEG. The question now remains if the municipalities' strategies are indeed altering the projected increase in SSEG installations.

CHAPTER 7

7 STUDY RECOMMENDATIONS AND CONCLUSION

7.1 Introduction

In this chapter of the study, recommendations are made to control the impact of the findings that were concluded from the analysis. The main aim in this chapter is to identify possible solutions for the identified problem.

7.2 Mitigation of revenue loss

When looking at the results of the data analysis in the previous chapter, municipalities are facing a big threat in losing income due to the rapid start of SSEG or co-generation. To ease these revenue losses the municipality needs to go back and re-assess their tariff setting principles to see if the set tariffs accommodates the strong emergence of electricity co-generation in the Drakenstein municipal area. The main recommendations from this study in terms of the mitigation of revenue losses are stipulated below.

7.2.1 Possible future tariff adjustments

Looking at the current trends in electricity tariff setting in South Africa, where Eskom is proposing a move away from the inclining block tariffs and the return to splitting fixed charges from per kWh charges, Drakenstein Municipality's tariff structure is already on the right path. The positive changes that resulted from the SSEG tariff changes in the 2019/2020 financial year are also already showing positive results.

To substantiate the above statement, the researcher applied the municipality's tariffs to the G:ENESIS SSEG toolkit. The G:ENESIS SSEG toolkit is a model that is developed by the South African Local Government Association (SALGA) in consultation with the German Cooperation, the GIZ, Sustainable Energy Africa, CSIR, 21st Power Partnership, Eskom and GreenCape. The toolkit was designed to test the impact of SSEG on the municipal electricity revenue stream and to determine the future impacts of the uptake of solar PV and other electricity generation technologies by prosumers.

In order to determine if the SSEG tariff changes implemented by the municipality in the 2019/2020 financial year had any impact on the municipal revenue, the toolkit was used on the 2018/2019 SSEG tariffs and subsequently on the revised 2019/2020 tariff which showed the following trend:

Graph 7.1 Total revenue impact (%) – Using 2018-2019 SSEG tariff structure

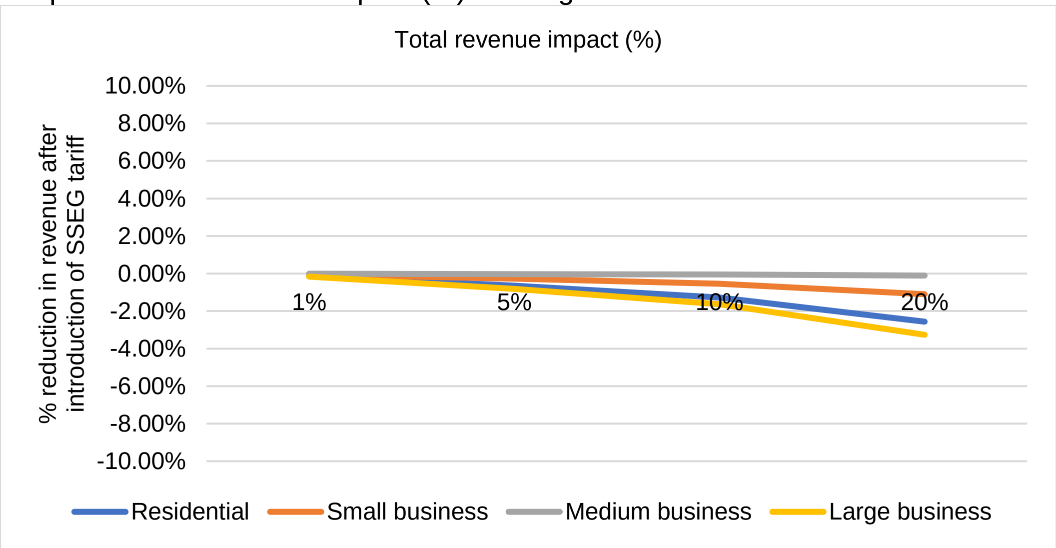


Table 7.1 Total revenue impact (%) – Using 2018-2019 tariff structure

% of customers on the relevant tariff that install rooftop PV	Residential	Small business	Medium business	Large business	Total
1%	-0.13%	-0.05%	-0.01%	-0.16%	-0.09%
5%	-0.64%	-0.27%	-0.03%	-0.82%	-0.45%
10%	-1.28%	-0.55%	-0.05%	-1.63%	-0.91%
20%	-2.56%	-1.10%	-0.11%	-3.26%	-1.81%

When looking at graph 7.1 and table 7.1 above with regards to the 2018/2019 tariffs, the municipality is showing a negative cumulative revenue growth trend of up to -1.81%% if 20% of the electricity consumers install PVs or alternative electricity generation devices on their properties. All of the different categories of services show a negative revenue growth. The detailed report for the 2019/2020 financial year is annexed as Appendix C.

When looking at the toolkit results that were plotted based on the 2019/2020 revised SSEG tariffs, the picture changes as illustrated in graph 7.2 and table 7.2 below. The detailed report for the 2019/2020 financial year is annexed as Appendix D.

Graph 7.2 Total revenue impact (%) – Using 2019-2020 SSEG tariff structure

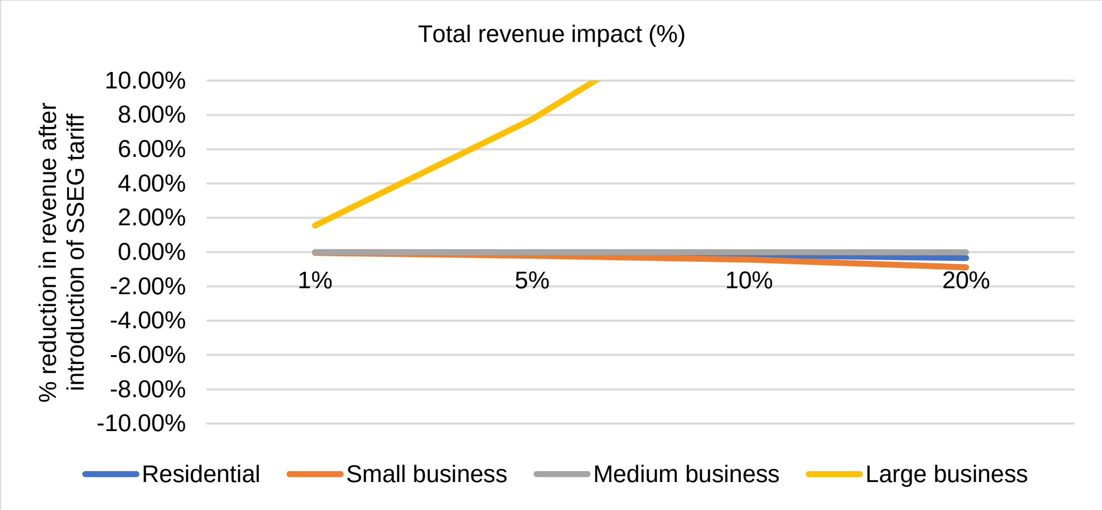


Table 7.2 Total revenue impact (%) – Using 2018-2019 tariff structure

% of customers on the relevant tariff that install rooftop PV	Residential	Small business	Medium business	Large business	Total
1%	-0.02%	-0.04%	0.00%	1.55%	0.14%
5%	-0.09%	-0.22%	0.00%	7.74%	0.68%
10%	-0.17%	-0.44%	-0.01%	15.49%	1.36%
20%	-0.35%	-0.89%	-0.02%	30.97%	2.72%

The picture illustrated by graph 7.2 and table 7.2 above have changed from that in graph 7.1 and table 7.1. In this second picture there is an accumulated positive growth trend on all the growth trends percentages that are used in the model. The changes made by the municipality are thus already showing the desired results.

Based on the above positive direction which the municipality have already taken, I recommend the following:

- **Development of a detailed municipal cost of supply study**

The municipality needs to conduct a detailed cost of supply study that will summarise the impact of co-generation on the business model of the municipality. The supply study should not only look at the conventional requirements of the electricity business but must include the costs related to an increase uptake of SSEG by consumers.

- **Adoption of energy as an service business model**

Demand side management in electricity is loosely translated as the achievement of savings in the electricity business model by modifying the total electricity consumption. The demand side management has evolved with the introduction of co-generated electricity and new technologies. According to the IRENA Innovation Landscape for a renewable power future, there are various technologies that can enable demand side management.

In the Drakenstein Municipality it is recommended that the municipality adopt the Energy as an service Business Model which will allow the municipality to offer advice to consumers on future energy solutions. This business model can allow the municipality to manage energy through the optimisation of load without burdening the consumers, whilst driving the market mix in terms of grid based electricity and SSEG, themselves. The municipality would have various revenue models to choose from such as subscription or performance based contracts.

By adopting this strategy the municipality will be building on the current work they have done to minimise the effects of the uptake of SSEG and would ensure that the municipality is at a place where they can manage demand and the ultimate generation mix which will inform how the municipality's revenue remains sustainable.

7.3 Cross-subsidisation model

The current tariff structure of the municipality, allows for proper allocation of demand depending on the amperage of the consumer, but limits cross- subsidisation. However in the absence of a detailed cost of supply study per tariff one cannot properly determine the contribution that each tariff has on the profit margins of the municipality.

A detailed cost of supply study is recommended that can reveal the true impacts of the tariff structure and also who of the consumers are cross subsidised.

7.4 Conclusion

In conclusion it can be said that SSEG is here to stay and other municipalities need to plan for the future impacts that SSEG will have on the revenues of municipalities just like Drakenstein Municipality did.

Good things have emerged from the research that was done on Drakenstein Municipality. The strategies of municipalities pertaining to tariff setting are already yielding signs of mitigation of possible future impacts. What is left now for the municipality is how they can maintain these good signs in order to still be financially viable and sustainable in the electricity sphere.

The introduction of new business models is also something that the municipality must invest in, in order to unlock other revenue sources to supplement and absorb whatever losses future revenue losses arising from the rapid uptake of SSEG might have.

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Appendices

Appendix A: Interview with the Chief Electrical Engineer.

Interviewee : Mr. Charles Geldenhuys

Q1: Does Drakenstein Municipality have a policy guiding the installation of rooftop PVs? If so, what are the standard size of PVs that are allowed per category i.e. residential, small Business, medium business and large business?

A1: Yes. The municipality has an approved Small-Scale Embedded Renewable Energy Generation Policy. The criteria set by the municipality depend on the individual consumers' current Amp connection prior to the installation of SSEG. These requirements are set in line with all of the related safety requirements in terms of the NRS standards.

Q2: In the Drakenstein electricity context, what is regarded as a residential connection, small business connection, medium business connection and large business connection?

A2: The various consumers of the municipality are allowed connection to the municipal grid as follows:

a. **Domestic Consumers**
   - 20 Amp to 80 Amp on single-phase connections.
   - 20 Amp to 100 Amp on three-phase connections.

b. **Small Business Consumers**
   - 20 Amp to 80 Amp on single-phase connections.
   - 20 Amp to 150 Amp on three-phase connections.

c. **Medium Business Consumers**
   - Up to 100 kVA

d. **Large Business Consumers**
   - 100kVA to 1 MVA

Q3: How sensitive is the electricity service to any changes in the market?

A3: Sensitivity all depends on the profit margins. If the municipality is the distributor of electricity to it consumers, the municipality has the ability to set the profit margins it requires to maintain the electricity service. In instances where municipalities are giving the distribution to a third party, the profit margins diminish as a result of the price the municipality is being charged by the third party. That is now higher than the prices charged by Eskom. The cost incurred to maintain the system are in most instances not recovered in this scenario and municipalities are not in a space to regulate their tariffs in a sustainable manner..

Q4: What model is used to determine the electricity tariffs of the municipality?

A4: The municipality's tariff principles are based on load management. The municipality aim to ensure that the tariff that the consumer is in is justified by the units consumed and the needs of the consumer. Hence the fixed charges of the municipality are determined per Amp and are not just a flat rate irrespective of the load impact the consumer has on the municipality. Since the municipality did not accept the recommendations of a cost of supply study, this load management approach tariff setting is currently the best.

Q5: How much energy purchases in Megawatt is required on a monthly basis to service the above consumers?

A5: For the first two years under review the megawatts required per month were on average 1.23 million MVA and 1.41 million MVA for the 2019/2020 financial year.

Q6: What informs the cross- subsidisation of lifeline consumers?

A6: The lifeline consumers in Drakenstein are placed on a 20 Amp connection when they apply for an electricity connection. No fixed charges are levied on this tariff. The consumers on this tariff can only use simultaneous electrical appliances whose accumulated load are 20Amp at a given time and cannot use more than that. For this reason the municipality is able to limit the consumption of lifeline consumers in order to enable them to pay for their own consumption and maintenance without being subsidized by the other consumer groups.

I believe that the rapid introduction of SSEG will also not affect this model, due to the limited cross-subsidisation that is currently occurring because of how the tariffs of the municipality are structured.

Q7: How was the Co-generation tariff developed by the municipality?

A7: Our feed-in tariff for the 2019/2020 financial year is based on the Megaflex low season off-peak tariff charged by Eskom to us. The rationale behind the flat feed-in tariff is based on the premise that consumers are not nett metering for the entire day. There are instances where consumer's generate electricity during off-peak periods and sell the units during periods when they are not nett metering. The flat tariff helps the municipality to take advantage of this.

In previous years the municipality had a step tariff that depended on the amount of kWh fed into the municipal grid by the prosumers. When the results of these tariffs were analysed, a general incline in the registered co-generation consumers, and kWh fed into the system as well as revenue loss was observed, hence the change in rationale to the flat rate.

Q8: How do you think the introduction of a mixed electricity distribution model on a rapid scale will affect the current tariff structuring of the municipality?

A8: The tariff changes we implemented during the 2019/2020 financial year have placed us on a good path of handling any increased uptake in SSEG. The current focus of the municipality is towards load management, where the aim is to reduce the monthly unit charge on the Eskom bill by 7c per month to enable an approximate saving of R35 million on the annual Eskom bill.

If we are able to maintain the flat feed-in tariff discussed above and improve our profit margins with load management as discussed above, the introduction of SSEG on a rapid scale should not have a severe negative effect on our revenue.

Q9: What is your opinion on alternative SSEG tariff principles such as Power Purchase Agreements?

A9: These agreements can be risky for municipalities as they are normally long-term in nature and have many hidden costs. The fixed costs expected to be borne by the municipality and that are binding for the long agreement period of normally 20 years can be to the detriment on municipalities especially since the future price of electricity is unknown and might still come to a decrease in the future. These agreements can also be risk averse if the municipality can invest in the infrastructure themselves, which is also not likely since the capital investment required setting up these arrangements is very significant. The lifespan of batteries and other alternative storage facilities required is also shorter than the agreement periods which will require reinvestment during the contract period.

Q10: Drakenstein was announced as one of the Western Cape municipalities that are earmarked by the Provincial Government to go off the grid. What is the progress on this announcement?

A10: We have met with the Provincial Government and the project is still in its initial stages and there is nothing to report at the moment on how the project will be rolled out.

Q11: When conducting my analysis on your data and forecasting future SSEG we found that the impacts on the revenue that were based on the 2019/2020 tariff is not significant, even if 20% of the current consumers would take up SSEG. What is your view on this analysis?

A11: As indicated the rationale behind the flat tariff is based on the premise that we want to reduce any negative impact that the uptake of SSEG will have on the future revenue of the municipality. The results of your analysis are in line with our planning. Although we do support the uptake of green electricity, we do so with the sustainability of the municipality in mind where, we would like to keep the mix between SSEG and electricity consumption in a manner that will still ensure that the municipality are able to operate in the future. We employ the principles of revenue protection and financial sustainability, where our current strategies are able to ensure that the municipality is still financially stable in the future.

[END]

Appendix B: Detailed Electricity Sales Statistics 2017/2018 till 2019/2020

	2017/18												
	July	August	September	October	November	December	January	February	March	April	May	June	Total
Basic Rand Value	**12,072,356.52**	**9,949,313.75**	**9,881,331.19**	**9,639,732.00**	**9,779,202.56**	**9,787,818.00**	**9,700,885.34**	**9,716,723.34**	**9,806,045.46**	**9,811,580.73**	**9,870,448.47**	**9,845,707.41**	**119,861,144.77**
Agriculture	1,234,168.02	1,234,168.02	1,236,175.20	1,232,546.39	1,233,625.96	1,219,999.80	1,219,999.80	1,214,173.30	1,216,114.71	1,216,913.05	1,223,628.61	1,220,580.41	14,702,093.27
Business	953,334.15	934,910.13	946,100.95	941,991.66	943,609.07	946,741.89	951,141.08	945,190.80	954,576.79	957,129.43	957,938.19	955,839.40	11,388,503.54
Domestic	8,727,673.87	6,619,826.94	6,536,715.33	6,298,232.49	6,431,777.89	6,444,115.89	6,352,099.42	6,379,714.20	6,450,882.36	6,451,822.76	6,502,433.61	6,476,138.99	79,671,433.75
High Tension													-
Low Tension	633,211.66	636,439.84	634,825.75	634,825.75	636,439.84	639,668.02	639,668.02	639,668.02	646,124.38	647,738.47	649,840.94	654,683.21	7,693,133.90
Low Tension - KVA													-
Municipal	523,968.82	523,968.82	527,513.96	532,135.71	533,749.80	537,292.40	537,977.02	537,977.02	538,347.22	537,977.02	536,607.12	538,465.40	6,405,980.31
Consumption Rand Value	**65,538,713.36**	**62,331,730.00**	**62,122,607.68**	**51,702,374.31**	**50,509,588.00**	**50,089,655.17**	**50,484,513.72**	**56,761,713.32**	**52,574,859.70**	**52,046,831.58**	**47,440,756.17**	**52,586,866.84**	**654,190,209.85**
Agriculture	3,177,152.79	3,610,203.61	2,717,217.16	3,207,830.64	3,268,770.05	2,976,654.41	4,063,490.44	4,166,406.40	3,623,820.60	3,223,802.16	2,794,379.46	2,846,428.78	39,676,156.50
Business	2,704,152.85	4,529,822.76	4,239,409.34	3,747,245.22	4,218,746.28	4,007,327.80	4,260,921.22	4,584,511.22	4,642,308.44	4,501,606.92	4,324,188.61	4,093,504.45	49,853,745.11
Domestic	9,230,687.75	10,128,665.88	8,962,713.51	8,133,231.81	7,549,720.73	6,575,928.32	7,031,410.27	7,217,775.46	7,114,283.78	6,582,113.91	6,609,312.79	7,021,947.30	92,157,791.51
High Tension	27,207,526.27	27,394,312.98	28,263,758.72	21,110,986.31	21,182,170.08	21,475,540.20	20,550,350.23	22,661,275.92	22,408,575.37	22,591,127.59	19,726,288.52	21,187,240.42	275,759,152.61
High Tension - KVA	117,787.68	121,724.40	153,343.16	124,853.38	124,236.78	131,272.84	128,083.48	146,873.63	155,029.34	156,643.77	132,797.71	128,611.96	1,621,258.13
Low Tension	13,942,248.85	13,924,418.16	15,061,216.04	11,378,254.23	12,111,861.22	12,575,996.63	12,439,840.22	13,717,297.25	12,616,924.11	12,772,306.15	11,589,952.09	12,016,744.82	154,147,059.77
Low Tension - KVA	77,969.37	66,380.36	283,924.92	(154,666.36)	80,197.10	90,584.41	96,513.33	110,542.05	99,200.73	100,889.62	83,657.52	80,356.83	1,015,549.88
Municipal	1,939,497.39	2,128,880.03	2,091,839.32	139,707.34	80,431.84	127,055.21	131,312.02	152,790.17	93,996.42	79,753.58	81,988.28	63,656.16	7,110,907.76
Municipal	229,042.20	293,061.82	203,660.58	309,300.21	397,560.49	382,614.72	(141,654.46)	188,188.17	251,506.19	257,843.71	192,047.93	347,580.45	2,910,752.01
Municipal Low and High Tension	58,336.87	68,172.23	73,421.98	1,488,736.37	1,417,665.36	1,692,917.50	1,733,089.33	1,687,484.67	1,652,246.51	1,716,579.79	1,692,178.36	1,772,501.04	15,053,330.01
Municipal Low and High Tension - KVA	17,355.45	18,805.49	18,326.73	18,032.80	17,912.37	19,292.81	18,112.63	17,778.99	17,795.54	18,451.53	16,614.18	16,793.80	215,272.32
Municipal Street Lights	6,836,955.89	47,282.28	53,776.22	2,198,862.36	60,315.70	34,470.32	173,045.01	2,110,789.39	(100,827.33)	45,712.85	197,350.72	3,011,500.83	14,669,234.24
Units	**53,524,111.90**	**51,166,610.68**	**60,244,774.62**	**41,215,703.12**	**49,598,876.38**	**50,127,146.31**	**50,372,089.73**	**56,444,550.98**	**53,676,778.49**	**53,741,680.61**	**46,977,445.67**	**50,911,489.62**	**618,001,258.10**
Agriculture	2,849,699.00	3,125,022.00	2,328,550.00	2,757,009.00	2,810,666.00	2,559,527.00	3,494,020.00	3,582,149.00	3,115,958.00	2,772,055.00	2,402,805.00	2,447,558.00	34,245,018.00
Business	1,779,055.00	2,937,360.00	2,741,253.00	2,420,840.00	2,728,385.00	2,591,420.00	2,755,337.00	2,965,880.00	3,003,373.00	2,912,104.00	2,796,911.00	2,647,678.00	32,279,596.00
Domestic	6,547,641.00	7,063,987.00	6,235,367.00	5,681,787.00	5,305,997.00	4,584,675.00	4,895,282.00	5,018,044.00	4,951,258.00	4,586,762.00	4,598,176.00	4,881,016.00	64,349,992.00
High Tension	19,151,635.20	19,462,657.99	19,647,898.77	19,179,314.50	18,830,328.29	19,103,787.86	18,172,530.52	19,939,236.09	20,579,162.65	20,806,126.82	17,425,422.26	18,999,883.75	231,297,984.70
High Tension - KVA	4,823,537.00	4,870,447.00	6,133,715.00	4,994,126.00	4,969,460.00	5,250,902.00	5,123,329.00	5,874,933.00	6,201,162.00	6,265,739.00	5,311,899.00	5,144,468.00	64,963,717.00
Low Tension	8,515,587.34	8,592,615.86	9,524,083.44	8,691,064.26	9,564,922.63	9,993,169.18	9,989,942.28	11,180,224.11	9,889,408.08	10,217,553.31	9,005,307.30	9,481,963.02	114,645,840.81
Low Tension - KVA	3,192,846.00	2,655,835.00	11,343,997.00	(6,186,431.00)	3,207,845.00	3,623,337.00	3,860,494.00	4,421,640.00	3,967,987.00	4,035,550.00	3,346,260.00	3,214,237.48	40,683,597.48
Municipal	1,244,345.31	1,438,265.89	1,341,273.47	129,336.48	43,362.23	105,869.91	108,552.79	136,529.64	49,480.21	45,674.31	40,707.82	30,375.61	4,713,773.67
Municipal	158,914.00	200,733.00	137,756.00	208,988.00	272,562.00	262,727.00	(98,619.00)	125,904.00	171,883.00	176,939.00	131,527.00	234,301.00	1,983,615.00
Municipal Low and High Tension	30,344.06	36,842.94	42,981.93	1,199,731.87	1,109,801.22	1,257,701.36	1,234,666.15	1,122,029.13	1,100,579.55	1,155,519.17	1,126,074.29	1,208,185.76	10,624,457.44
Municipal Low and High Tension - KVA	710,678.00	752,215.00	733,065.00	721,308.00	716,490.00	771,709.00	724,501.00	711,156.00	711,817.00	738,057.00	664,563.00	671,748.00	8,627,307.00
Municipal Street Lights	4,519,830.00	30,629.00	34,834.00	1,418,629.00	39,057.00	22,321.00	112,054.00	1,366,826.00	(65,290.00)	29,601.00	127,793.00	1,950,075.00	9,586,359.00

	2018/19												
	July	August	September	October	November	December	January	February	March	April	May	June	Total
Basic Rand Value	10,806,385.49	10,667,634.91	10,469,793.72	10,415,269.07	10,202,445.80	10,289,404.98	10,332,398.34	10,331,857.52	10,251,361.97	10,243,723.88	10,185,700.50	10,230,816.52	**124,426,792.70**
Agriculture	1,293,148.19	1,294,066.59	1,283,319.18	1,294,999.49	1,251,560.73	1,168,870.57	1,298,223.14	1,256,631.66	1,245,313.23	1,232,921.34	1,182,151.95	1,185,924.76	14,987,130.83
Business	981,790.81	1,015,668.33	1,018,382.53	1,013,223.75	1,015,455.90	1,023,286.08	1,023,681.60	1,023,390.92	1,025,065.04	1,013,674.35	1,000,571.53	1,011,585.46	12,165,776.30
Domestic	7,257,305.14	7,082,034.15	6,896,195.67	6,828,361.94	6,655,020.79	6,813,390.97	6,726,636.24	6,768,532.19	6,718,215.74	6,742,982.68	6,755,799.52	6,784,240.13	82,028,715.16
High Tension	-	-	-	-	-	-	-	-	-	-	-	-	-
Low Tension	699,462.05	701,186.54	702,911.03	701,186.54	702,911.03	706,360.01	706,360.01	697,317.57	687,651.52	679,029.07	675,510.04	679,289.97	8,339,175.38
Low Tension - KVA	-	-	-	-	-	-	-	-	-	-	-	-	-
Municipal	574,679.30	574,679.30	568,985.31	577,497.35	577,497.35	577,497.35	577,497.35	585,985.18	575,116.44	575,116.44	571,667.46	569,776.20	6,905,995.03
Consumption Rand Value	68,291,811.50	65,056,607.24	79,063,732.72	43,722,417.51	52,318,470.90	54,247,006.68	52,547,962.82	60,754,497.04	60,528,407.09	55,887,601.36	51,804,206.92	61,113,392.30	**705,336,114.08**
Agriculture	3,127,182.36	3,346,832.95	3,542,137.10	3,902,947.45	2,676,592.91	3,359,245.36	4,328,476.90	4,320,068.90	4,377,926.32	3,020,433.56	3,519,590.79	2,064,120.97	41,585,555.57
Business	4,369,658.21	4,475,378.95	4,733,431.84	4,642,462.66	4,376,753.84	5,484,823.79	4,077,291.29	4,969,304.68	4,621,527.75	4,672,749.96	5,105,934.34	4,075,509.02	55,604,826.33
Domestic	8,649,782.18	8,798,210.53	9,863,527.93	9,626,493.17	7,084,493.14	7,108,581.82	8,571,691.24	7,497,599.52	7,955,047.38	6,134,805.86	7,483,832.72	7,059,745.00	95,833,810.49
High Tension	27,336,287.83	29,321,238.09	29,596,838.11	17,620,103.94	18,055,675.32	18,239,542.60	16,777,607.81	20,203,024.00	22,262,366.51	22,257,523.64	16,924,930.34	20,277,282.87	258,872,421.06
High Tension - KVA	156,376.09	166,278.55	150,155.86	2,878,324.46	3,034,949.88	3,036,015.07	3,000,729.33	3,501,597.65	4,148,051.26	3,838,870.20	3,107,008.51	2,881,700.45	29,900,057.31
Low Tension	13,197,877.10	13,786,310.82	14,347,622.52	10,122,876.03	11,633,508.46	11,901,055.96	10,924,698.48	12,405,425.88	12,180,350.10	10,861,123.48	10,381,579.06	10,180,823.58	141,923,251.47
Low Tension - KVA	1,789,467.98	1,937,924.38	2,018,914.48	1,941,953.00	2,276,565.11	2,251,212.84	2,207,943.04	2,414,832.71	2,489,938.76	2,264,175.32	2,074,339.41	1,918,282.90	25,585,549.93
Municipal	2,481,464.85	2,750,339.11	3,021,625.03	101,180.68	181,708.29	106,442.12	80,019.68	144,669.71	141,095.07	108,632.71	72,509.26	131,171.19	9,320,857.70
Municipal	355,525.52	275,355.03	498,593.78	234,519.11	262,579.30	982,701.72	254,943.26	(87,838.68)	183,632.10	265,333.91	740,370.38	325,209.89	4,290,925.32
Municipal Low and High Tension	66,663.66	66,275.24	70,391.29	2,219,575.75	2,000,279.67	1,635,647.22	1,950,978.27	1,973,160.10	1,847,639.65	1,933,282.39	1,904,156.05	1,967,211.84	17,635,261.13
Municipal Low and High Tension - KVA	28,850.01	31,371.77	36,059.70	349,228.27	311,873.70	255,392.82	272,183.97	298,038.97	306,969.04	303,804.12	299,691.24	305,970.61	2,799,434.22
Municipal Street Lights	6,732,675.71	101,091.82	11,184,435.08	(9,917,247.01)	423,491.28	(113,654.64)	101,399.55	3,114,613.60	13,863.15	226,866.21	190,264.82	9,926,363.98	21,984,163.55
Units	55,033,145.40	50,797,837.50	58,579,079.70	41,692,708.00	49,100,315.50	50,539,141.60	48,773,983.00	56,582,759.40	58,287,921.90	55,947,000.90	55,807,948.10	57,558,918.60	**638,700,759.60**
Agriculture	2,668,915.00	2,718,948.00	2,855,711.00	3,131,757.00	2,153,959.00	2,702,679.00	3,483,712.00	3,476,935.00	3,523,500.00	2,430,953.00	2,832,590.00	1,661,273.00	33,640,932.00
Business	2,808,123.00	2,732,774.00	2,867,647.00	2,769,194.00	2,647,624.00	3,319,755.00	2,465,037.00	3,012,644.00	2,797,436.00	2,826,008.00	3,091,458.00	2,466,874.00	33,804,574.00
Domestic	5,977,720.00	5,765,571.00	6,424,787.00	6,264,535.00	4,604,648.40	4,619,544.50	5,578,225.00	4,867,159.00	5,168,908.00	4,013,263.00	4,854,461.00	4,593,586.00	62,732,407.90
High Tension	19,369,507.20	19,688,114.00	19,453,861.90	16,868,285.10	16,701,059.30	17,452,677.00	15,981,388.20	19,262,451.30	21,907,345.20	22,708,468.20	25,754,333.30	23,407,228.30	238,554,719.00
High Tension - KVA	5,448,807.60	5,467,907.70	4,979,291.90	4,326,245.80	5,928,733.70	5,041,525.80	5,056,987.50	6,085,203.40	7,362,853.10	7,811,609.50	4,149,378.80	5,170,515.60	66,829,060.40
Low Tension	9,318,095.10	9,196,802.80	9,445,079.00	8,640,902.50	10,183,940.90	10,461,907.30	9,686,363.30	11,151,107.10	10,889,810.60	9,651,913.70	8,888,642.70	8,626,925.10	116,141,490.10
Low Tension - KVA	2,957,887.80	2,954,636.00	2,937,811.90	2,834,416.80	3,768,345.50	3,965,856.00	3,872,788.70	4,498,200.70	4,301,442.30	3,869,975.70	3,420,782.40	3,037,688.70	42,419,832.50
Municipal	1,214,649.70	1,304,726.20	1,615,033.70	63,645.80	144,329.60	65,456.20	34,875.00	111,530.90	101,413.80	66,494.60	34,907.10	99,646.10	4,856,708.70
Municipal	242,574.00	177,348.00	318,846.00	149,439.00	168,346.00	633,198.00	161,166.00	(60,862.00)	118,791.00	169,209.00	488,024.00	206,291.00	2,772,370.00
Municipal Low and High Tension	48,528.70	44,633.70	48,911.70	1,915,693.00	1,701,766.70	1,284,522.80	1,598,954.30	1,596,699.20	1,481,207.90	1,581,199.60	1,512,121.00	1,604,255.90	14,418,494.50
Municipal Low and High Tension - KVA	619,131.30	684,996.10	857,107.60	739,411.00	840,885.40	1,061,664.00	793,028.00	693,931.80	625,251.00	680,403.60	665,930.80	655,764.90	8,917,505.50
Municipal Street Lights	4,359,206.00	61,380.00	6,774,991.00	(6,010,817.00)	256,677.00	(69,644.00)	61,458.00	1,887,759.00	9,963.00	137,503.00	115,319.00	6,028,870.00	13,612,665.00

	2019/20												
	July	August	September	October	November	December	January	February	March	April	May	June	Total
Basic Rand Value	12,958,182.53	12,920,805.04	12,596,188.11	12,517,751.18	12,319,493.54	12,442,118.17	12,320,743.57	12,400,688.40	12,295,175.25	12,331,022.19	12,241,408.79	12,182,512.54	**149,526,089.31**
Agriculture	1,348,979.41	1,344,528.12	1,352,979.05	1,352,979.05	1,348,474.55	1,344,989.68	1,318,976.77	1,333,872.08	1,341,326.27	1,358,428.60	1,360,283.77	1,370,782.83	16,176,600.18
Business	1,134,533.43	1,123,072.39	1,113,421.47	1,118,241.53	1,029,557.78	1,173,417.24	1,144,341.81	1,154,116.77	1,186,105.69	1,167,161.93	1,220,495.95	1,214,730.19	13,779,196.18
Domestic	9,058,539.38	9,096,404.53	8,735,087.33	8,676,704.10	8,595,632.63	8,568,242.67	8,497,805.04	8,499,950.72	8,426,576.59	8,434,200.06	8,331,038.01	8,313,812.76	103,233,993.82
High Tension	-	162,190.00	237,888.26	208,530.00	221,770.00	215,150.00	228,390.00	297,900.00	225,080.00	284,660.00	251,560.00	248,250.00	2,581,368.26
Low Tension	772,131.03	377,224.32	324,218.76	324,351.71	172,894.48	295,646.13	286,847.66	310,424.18	280,953.53	277,024.11	330,071.28	269,761.98	4,021,549.17
Low Tension - KVA	-	290,016.00	329,265.87	329,688.00	439,380.39	336,818.16	336,528.00	292,752.00	307,742.84	290,016.00	240,216.55	247,608.00	3,440,031.81
Municipal	643,999.28	527,369.68	503,327.37	507,256.79	511,783.71	507,854.29	507,854.29	511,672.65	527,390.33	519,531.49	507,743.23	517,566.78	6,293,349.89
Consumption Rand Value	64,871,318.80	64,988,669.52	84,000,074.53	64,464,184.00	70,426,114.75	64,705,532.41	63,419,770.62	71,483,852.33	74,260,233.71	81,751,721.99	42,062,486.43	79,461,862.14	**825,895,821.23**
Agriculture	2,876,427.07	5,057,182.21	1,750,845.04	3,297,598.92	3,458,025.88	3,353,952.32	4,541,170.42	4,156,711.78	4,229,051.63	3,613,786.90	3,817,213.57	3,037,930.10	43,189,895.84
Business	4,264,434.13	4,084,109.63	4,828,640.01	4,888,358.81	5,061,042.19	5,171,987.81	4,963,325.44	6,000,838.47	6,166,386.12	10,516,862.42	(21,688.54)	5,646,698.93	61,570,995.42
Domestic	9,750,478.12	10,229,340.91	8,743,016.76	9,122,748.58	7,886,145.03	7,451,812.37	8,076,278.17	8,869,651.13	8,725,016.36	11,286,098.74	4,496,914.95	8,624,019.74	103,261,520.86
High Tension	29,324,466.06	32,216,255.80	36,278,301.53	24,297,363.99	22,910,613.44	21,711,161.52	20,736,794.06	23,662,633.91	21,841,453.93	24,694,025.31	19,696,137.32	21,809,309.64	299,178,516.51
High Tension - KVA	141,076.98	3,904,119.34	7,174,512.58	9,397,684.11	9,298,303.87	9,521,839.02	9,224,188.71	11,716,098.51	12,347,132.64	11,045,951.43	5,954,612.74	6,781,382.09	96,506,902.02
Low Tension	12,340,748.30	4,315,479.11	15,386,675.22	7,770,297.90	9,890,065.97	9,437,169.42	8,376,429.72	9,018,414.25	13,431,537.76	10,008,231.69	4,865,061.92	6,803,526.47	111,643,637.73
Low Tension - KVA	1,798,563.20	2,267,730.49	4,648,179.86	4,090,015.94	4,799,357.90	4,846,365.00	4,847,782.94	4,674,957.53	4,094,332.80	4,100,952.08	2,423,956.98	2,646,005.07	45,238,199.79
Municipal	2,201,249.15	1,644,727.41	1,408,373.01	9,246.00	(145,686.46)	-	-	-	-	-	-	-	5,117,909.11
Municipal	917,458.61	427,508.08	1,347,396.49	(1,380,320.83)	412,023.46	298,618.33	234,140.57	409,651.68	190,973.97	908,891.57	19,875.47	2,623,209.07	6,409,426.47
Municipal Low and High Tension	326,561.54	-	295,922.24	1,933,334.69	2,208,817.24	1,682,995.34	1,539,543.41	1,633,529.32	1,321,574.28	1,972,054.88	1,440,972.59	1,471,149.04	15,826,454.57
Municipal Low and High Tension - KVA	54,943.58	10,643.03	41,172.75	818,400.22	840,122.75	766,990.67	814,973.55	815,253.56	870,248.49	992,182.17	600,545.41	644,845.18	7,270,321.36
Municipal Street Lights	874,912.06	831,573.51	2,097,039.04	219,455.67	3,807,283.48	462,640.61	65,143.63	526,112.19	1,042,525.73	2,612,684.80	(1,231,115.98)	19,373,786.81	30,682,041.55
Units	49,695,374.80	53,325,178.50	47,506,003.90	43,739,668.30	45,203,169.80	44,755,534.10	42,568,284.70	57,973,590.50	53,741,902.60	58,741,190.60	34,891,768.40	54,938,858.30	**587,080,524.50**
Agriculture	2,275,338.00	3,644,818.00	1,197,460.00	2,327,979.00	2,441,728.00	2,368,334.00	3,207,181.00	2,922,337.00	2,978,576.00	2,551,850.00	2,677,558.00	2,131,937.00	30,725,096.00
Business	2,563,032.00	2,243,273.00	2,599,957.00	2,616,873.40	2,718,662.20	2,942,249.00	2,667,584.00	3,211,520.30	3,314,049.00	5,632,962.00	(1,617.00)	3,040,096.00	33,548,640.90
Domestic	6,299,006.00	5,893,380.00	5,008,171.00	5,237,694.00	4,521,455.00	4,270,654.00	4,634,511.00	5,081,425.00	5,013,442.00	6,478,722.00	2,579,577.00	4,958,401.00	59,976,438.00
High Tension	20,498,455.00	31,567,227.90	22,523,171.90	20,516,878.60	18,488,271.50	20,193,993.60	18,848,605.50	22,190,720.30	23,451,229.40	25,589,431.90	19,639,509.30	20,355,273.90	263,862,768.80
High Tension - KVA	4,545,405.30	2,346,244.90	4,706,237.60	3,521,459.30	3,100,304.50	3,024,498.60	2,718,561.40	3,752,301.20	4,003,244.60	3,932,497.20	2,838,889.40	4,054,988.70	42,544,632.70
Low Tension	7,880,680.10	4,938,958.60	6,551,715.60	6,783,080.90	7,984,416.90	8,198,596.40	7,002,062.80	7,632,249.50	11,132,501.60	8,497,150.80	4,881,683.70	5,546,553.10	87,029,650.00
Low Tension - KVA	2,595,521.70	690,632.90	1,647,665.70	1,399,049.30	1,565,352.90	1,601,128.30	1,648,230.20	10,912,292.20	1,869,978.70	1,925,881.60	1,403,598.10	1,246,067.50	28,505,399.10
Municipal	1,055,815.40	933,646.20	699,452.00	5,000.00	(88,000.00)	-	-	-	-	-	-	-	2,605,913.60
Municipal	585,622.00	244,622.00	772,097.00	(840,426.00)	221,245.00	168,095.00	132,372.00	227,127.00	97,333.00	511,042.00	21,148.00	1,503,071.00	3,643,348.00
Municipal Low and High Tension	251,597.90	-	215,742.20	1,578,524.30	1,750,796.50	1,412,133.40	1,321,079.80	1,369,294.60	1,059,741.60	1,950,331.80	1,212,456.60	1,258,803.10	13,380,501.80
Municipal Low and High Tension - KVA	641,610.40	348,952.00	450,308.90	474,879.50	458,170.30	337,225.80	352,869.00	389,815.40	258,810.70	258,448.30	304,721.30	344,332.00	4,620,143.60
Municipal Street Lights	503,291.00	473,423.00	1,134,025.00	118,676.00	2,040,767.00	238,626.00	35,228.00	284,508.00	562,996.00	1,412,873.00	(665,756.00)	10,499,335.00	16,637,992.00

Appendix C: G:ENESIS model detailed report 2018/2019

This report was generated on	6/30/2019
For	**Cape Town**

Developed by

G:ENESIS UNLOCKING VALUE

Table 1: SSEG tariffs chosen by the municipality

	Summer				Winter			
	Residential	Small business	Medium business	Large business	Residential	Small business	Medium business	Large business
TOU or flat tariff structure	Flat	Flat	TOU	TOU	Same as summer			
Monthly or annual clearing of balances	Annual clearing	Annual clearing	Annual clearing	Annual clearing				
Payment of credit balances to customers	No payments	No payments	No payments	No payments				
Escalation of export tariff	Constant over 20 years	Constant over 20 years	Constant over 20 years	Constant over 20 years				
Import tariff								
Fixed charge (R/m)			1,725	1,965			1,725	1,965
Monthly demand charge (R/kVA)			59	68			59	71
Peak (c/KWh)			151	177			298	349
Standard (c/KWh)			84	96			103	125
Off-peak (c/KWh)			52	69			77	70
Export tariff								
Peak (c/KWh)			130	130			211	211
Standard (c/KWh)			68	68			89	89
Off-peak (c/KWh)			45	45			51	51
Import tariff								
Fixed charge (R/m)	588	1,434			588	1,434		
Monthly demand charge (R/kVA)	-	-			-	-		
Variable charge (c/KWh)	165	165			165	165		
Export tariff								
Variable charge (c/KWh)	165	165			165	165		

Table 2: Total revenue impact * (%)

% of customers on the relevant tariff that install rooftop PV	Residential	Small business	Medium business	Large business	Total
1%	-0.13%	-0.05%	-0.01%	-0.16%	-0.09%
5%	-0.64%	-0.27%	-0.03%	-0.82%	-0.45%
10%	-1.28%	-0.55%	-0.05%	-1.63%	-0.91%
20%	-2.56%	-1.10%	-0.11%	-3.26%	-1.81%

Notes: *Total revenue impact = (Reduction in municipal revenue + Value of Solar)/Municipal revenue prior to introduction of Solar PV SSEG tariffs*

Chart 1: Total revenue impact (%)

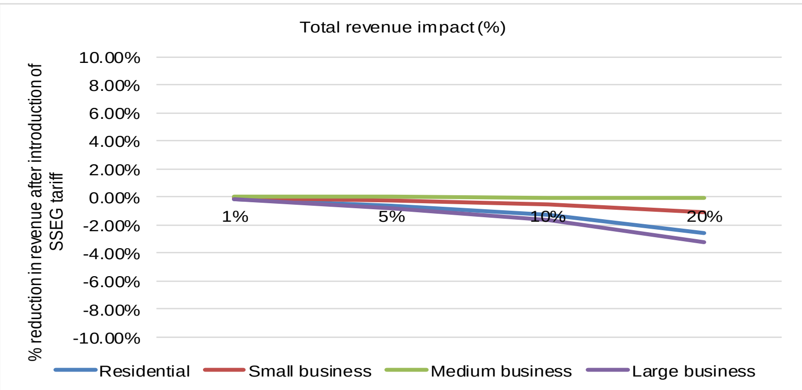


Table 3: Reduction in revenue, Value of Solar and Total effect (Rm)

	Residential	Small business	Medium business	Large business	Total
1% of customers install rooftop PV					
Reduction in revenue (Rm) (A)	-1.2	-0.2	-0.1	-1.5	-3.1
Value of Solar (Rm) (B)	0.5	0.1	0.1	1.3	2.1
Total effect (Rm) (A + B)	**-0.7**	**-0.1**	**0.0**	**-0.2**	**-1.0**
5% of customers install rooftop PV					
Reduction in revenue (Rm) (A)	-6.2	-0.9	-0.5	-7.7	-15.3
Value of Solar (Rm) (B)	2.7	0.6	0.4	6.6	10.4
Total effect (Rm) (A + B)	**-3.5**	**-0.3**	**-0.1**	**-1.1**	**-4.9**
10% of customers install rooftop PV					
Reduction in revenue (Rm) (A)	-12.4	-1.7	-1.0	-15.4	-30.5
Value of Solar (Rm) (B)	5.4	1.2	0.8	13.3	20.7
Total effect (Rm) (A + B)	**-7.0**	**-0.5**	**-0.2**	**-2.1**	**-9.8**
20% of customers install rooftop PV					
Reduction in revenue (Rm) (A)	-24.8	-3.5	-1.9	-30.8	-61.0
Value of Solar (Rm) (B)	10.8	2.5	1.6	26.6	41.4
Total effect (Rm) (A + B)	**-14.0**	**-1.0**	**-0.3**	**-4.2**	**-19.6**

Table 4: Business case for the Solar PV customer for the chosen SSEG tariffs

	Residential	Small business	Medium business	Large business
Net present value (Rands)	-11,451	- 42,342	495,565	138,955
Pay-back period (PBP) (Years)	>26	>26	7	15
Internal rate of return	-4%	-6%	16%	6%
LCOE (Rands)	1.07	1.18	1.10	1.01
Monthly bill for one Solar PV customer (Rands)	R 768	R 1,917	R 122,747	-R 3,890

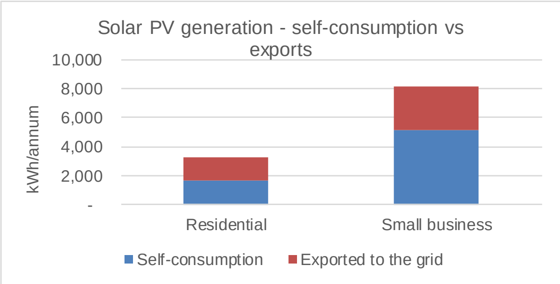
Key for PBP and IRR results:	Key for NPV results:
Unfavourable	Negative
Average	Positive
Very good	

Table 5: Average electricity consumption per annum, average solar self-consumption rate per annum and peak demand per season

	Residential	Small business	Medium business	Large business
Avg elect cons/annum (KWh/a)	4,570	11,671	1,277,650	163,904
Avg solar self-cons rate/annum*	52%	63%	100%	27%
Summer peak demand (kW)	0.93	1.62	177.39	23.48
Winter peak demand (kW)	1.42	2.28	249.22	34.14

Notes: ** Avg solar self-cons rate/annum = Rooftop PV electricity consumed on-site/Total rooftop PV electricity produced*

Chart 2: Energy balances



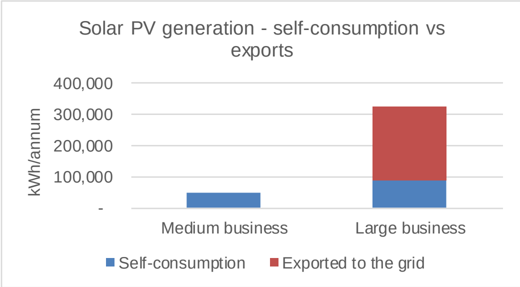


Table 6: Revenue Available for Network Costs and Average Bulk Energy Costs

		Residential	Small business	Medium business	Large business
Revenue per customer available for Network Costs (ZAR/month)	non-SSEG	R 594	R 1,469	R 29,343	R 8,326
	SSEG*	R 370	R 1,154	R 28,687	R (10,531)
Average Bulk Purchase Costs (c/kWh)	non-SSEG	104.73	91.47	91.47	90.45
	SSEG	114.03	96.16	91.86	90.17

*Includes value of solar exports

Appendix D: G:ENESIS model detailed report 2019/2020

This report was generated on	6/30/2020
For	**Cape Town**

Developed by

G:ENESIS UNLOCKING VALUE | SALGA Inspiring service delivery | german cooperation DEUTSCHE ZUSAMMENARBEIT | giz

Table 1: SSEG tariffs chosen by the municipality

		Summer				Winter			
		Residential	**Small business**	**Medium business**	**Large business**	**Residential**	**Small business**	**Medium business**	**Large business**
Tariff type	TOU or flat tariff structure	Flat	Flat	Flat	TOU	Same as summer			
	Monthly or annual clearing of balances	Annual clearing	Annual clearing	Annual clearing	Annual clearing				
	Payment of credit balances to customers	No payments	No payments	No payments	No payments				
	Escalation of export tariff	Constant over 20 years	Constant over 20 years	Constant over 20 years	Constant over 20 years				
TOU tariffs	**Import tariff**								
	Fixed charge (R/m)				1,965				1,965
	Monthly demand charge (R/kVA)				68				71
	Peak (c/KWh)				177				349
	Standard (c/KWh)				96				125
	Off-peak (c/KWh)				69				70
	Export tariff								
	Peak (c/KWh)				-				-
	Standard (c/KWh)				-				-
	Off-peak (c/KWh)				-				-
Flat tariffs	**Import tariff**								
	Fixed charge (R/m)	451	2,619	3,310		451	2,619	3,310	
	Monthly demand charge (R/kVA)	-	-	296		-	-	296	
	Variable charge (c/KWh)	181	185	97		181	185	97	
	Export tariff								
	Variable charge (c/KWh)	49	49	49		49	49	49	

Table 2: Total revenue impact * (%)

% of customers on the relevant tariff that install rooftop PV	Residential	Small business	Medium business	Large business	Total
1%	-0.02%	-0.04%	0.00%	1.55%	0.14%
5%	-0.09%	-0.22%	0.00%	7.74%	0.68%
10%	-0.17%	-0.44%	-0.01%	15.49%	1.36%
20%	-0.35%	-0.89%	-0.02%	30.97%	2.72%

Notes: *[*] Total revenue impact = (Reduction in municipal revenue + Value of Solar)/Municipal revenue prior to introduction of Solar PV SSEG tariffs*

Chart 1: Total revenue impact (%)

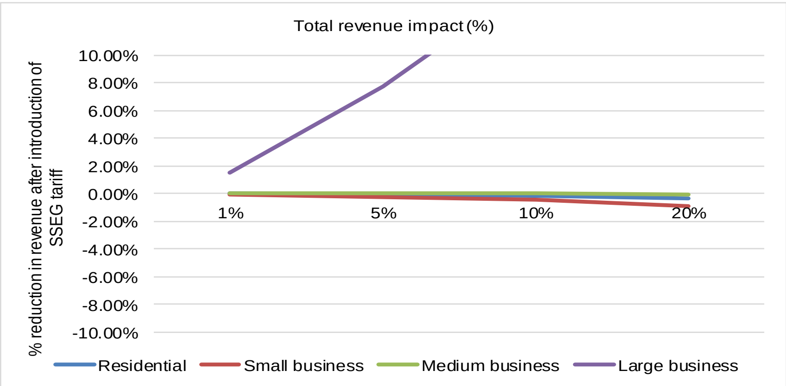


Table 3: Reduction in revenue, Value of Solar and Total effect (Rm)

	Residential	Small business	Medium business	Large business	Total
1% of customers install rooftop PV					
Reduction in revenue (Rm) (A)	-1.8	-0.4	-0.1	-0.6	-2.8
Value of Solar (Rm) (B)	1.7	0.3	0.1	2.6	4.6
Total effect (Rm) (A + B)	**-0.1**	**-0.1**	**0.0**	**2.0**	**1.8**
5% of customers install rooftop PV					
Reduction in revenue (Rm) (A)	-8.8	-1.8	-0.5	-2.9	-14.0
Value of Solar (Rm) (B)	8.3	1.4	0.5	12.9	23.1
Total effect (Rm) (A + B)	**-0.5**	**-0.4**	**0.0**	**10.0**	**9.1**
10% of customers install rooftop PV					
Reduction in revenue (Rm) (A)	-17.6	-3.6	-1.0	-5.8	-27.9
Value of Solar (Rm) (B)	16.5	2.8	0.9	25.8	46.1
Total effect (Rm) (A + B)	**-1.1**	**-0.8**	**0.0**	**20.1**	**18.2**
20% of customers install rooftop PV					
Reduction in revenue (Rm) (A)	-35.2	-7.2	-1.9	-11.5	-55.9
Value of Solar (Rm) (B)	33.0	5.7	1.9	51.7	92.2
Total effect (Rm) (A + B)	**-2.2**	**-1.5**	**-0.1**	**40.1**	**36.3**

Table 4: Business case for the Solar PV customer for the chosen SSEG tariffs

	Residential	Small business	Medium business	Large business
Net present value (Rands)	65,824	128,427	488,482	- 522,234
Pay-back period (PBP) (Years)	8	6	8	19
Internal rate of return	15%	20%	15%	3%
LCOE (Rands)	1.07	1.18	1.10	1.01
Monthly bill for one Solar PV customer (Rands)	R 821	R 3,504	R 160,461	R 11,475

Key for PBP and IRR results:	Key for NPV results:
Unfavourable	Negative
Average	Positive
Very good	

Table 5: Average electricity consumption per annum, average solar self-consumption rate per annum and peak demand per season

	Residential	Small business	Medium business	Large business
Avg elect cons/annum (KWh/a)	4,570	11,671	1,277,650	163,904
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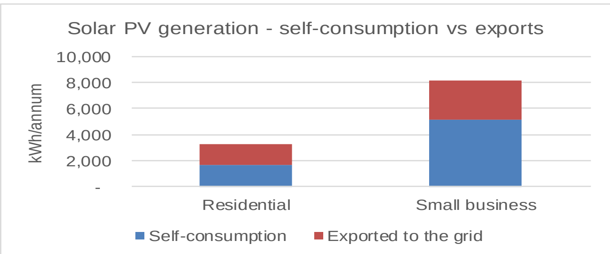
Summer peak demand (kW)	0.93	1.62	177.39	23.48
Winter peak demand (kW)	1.42	2.28	249.22	34.14

Notes: ** Avg solar self-cons rate/annum = Rooftop PV electricity consumed on-site/Total rooftop PV electricity produced*

Chart 2: Energy balances



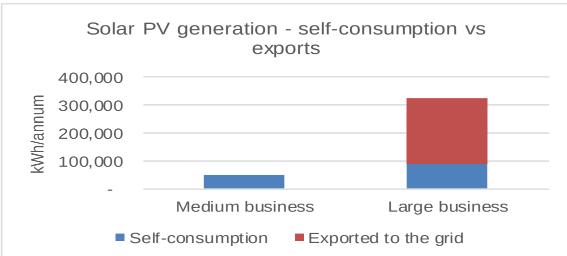


Table 6: Revenue Available for Network Costs and Average Bulk Energy Costs

		Residential	Small business	Medium business	Large business
Revenue per customer available for Network Costs (ZAR/month)	non-SSEG	R 678	R 3,389	R 51,807	R 6,395
	SSEG*	R 546	R 2,979	R 51,701	R 20,517
Average Bulk Purchase Costs (c/kWh)	non-SSEG	121.09	105.76	105.76	104.58
	SSEG	131.85	111.18	106.22	104.26

*Includes value of solar exports