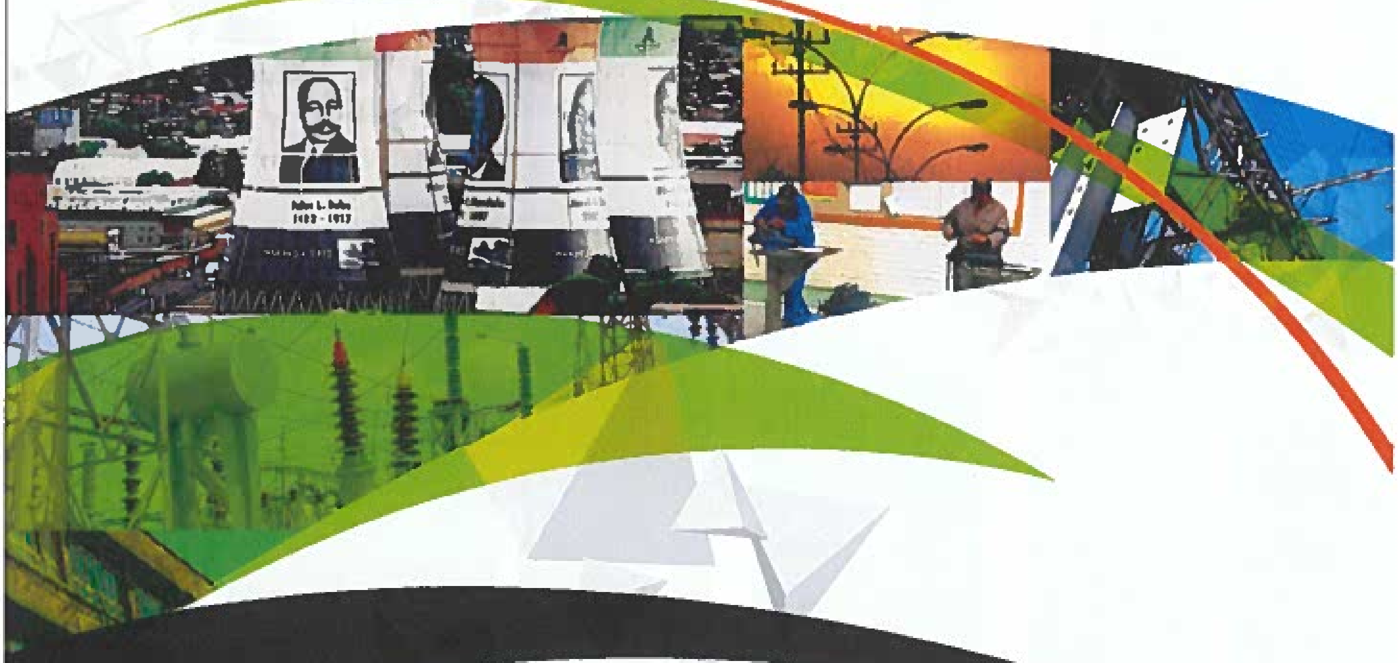
MANGAUNG
AT THE HEART OF IT ALL

CENTLEC
Reg No 2003/011612/30

CENTLEC (SOC) Ltd
INTEGRATED ENERGY PLAN
2025/2026



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ABBREVIATIONS

IEP	Integrated Energy planning
PV	Photovoltaic Plant
NERSA	National Energy Regulator South Africa
ToU	Time of Use
kV	Kilo Volts
kVA	Kilo-Volt Amperes
SFS	Southern Free State
kWh	Kilo-Watt hour
GDP	Gross Domestic Product
SSEG	Small Scale Embedded Generation
CHP	Combined Heat and Power
WWTP	Waste Water Treatment Plant
WtE	Waste to Energy

LEGISLATIVE

- Energy Policy of the Republic of South Africa of 1998
- National Energy Act, 2008 (Act No. 34 of 2008)
- Integrated Energy Plan of South Africa of 2003
- Integrated Resource Plan of South Africa of 2023
- Schedule 2 of Electricity Regulation Act 4 of 2006

1. INTRODUCTION

The Integrated Resource Plan aims to ensure that current and future energy service needs can be met in the most cost effective, efficient, and socially beneficial manner while also considering environmental impacts.

Electricity distribution is one of the biggest sources of revenue for the city and thus needs to be sustained over the long run. The energy sector is a large sector which CENTLEC plays a part in which has an immense amount of economic importance.

CENTLEC policy and strategic plans should be informed by this proposal on connecting Small, Medium and Large Power Systems on to the grid. CENTLEC has seen an increase in its capacity from 2003 to 2009 thus showing constant growth in electricity usage. This trend, however, has decreased from 2009 to date. Mangaung receives its electricity from Harvard via a 132kV connection. Upgrades have been performed in Mangaung Metropolitan Municipality to accommodate the ever-increasing capacity. Upgrades which have increased the network capacity have been through the construction of large-scale capital-intensive supply facilities and the neglect of alternatives that might have been more cost effective in the long term, had greater employment benefits and more favorable environmental impacts. These alternate power systems can come in the form of solar energy or natural gas.

The Integrated Energy Planning (IEP) aims to guide future energy infrastructure investments,

White Paper on the Energy Policy of the Republic of South Africa (December 1998) under Sustainable Energy stipulate in the Integrated Energy Planning (IEP) that " *The Department of Minerals and Energy will ensure that an integrated resource planning approach is adopted for large investment decisions by energy suppliers and service providers, in terms of which comprehensive evaluations of the economic, social and environmental implications of all feasible supply and demand side investments will have to be undertaken*".

CENTLEC's Integrated Energy Plan will identify and recommend policy development for different energy solutions which are available in the CENTLEC area of supply to shape the energy landscape of Mangaung and the Southern Free State municipalities that have a service level agreement with CENTLEC. The company has been able to generate revenue through the supply of electricity; it has an immense amount of economic importance as it is mandated to cater for the electrical needs of all communities within its supply area.

Together with these three (3) requirements; economic, environmental, and social impacts all alternatives should be considered when venturing into the world of alternative sources of energy.

Energy is essential to all human activities and, is indeed, critical to the country's social and economic development. It is essential for CENTLEC as a utility to have affordable energy services for its consumers; this allows for an opportunity cost for consumers to be able to utilize the resource. It has been realized from previous analysis and trends that when the energy service is too expensive or if there is a shortage of energy then this will directly have a negative effect on the Mangaung economy and gross domestic growth. Consumers will face the prospect of deeming energy from the company as a luxury and source other more cost effective sources of energy.

Nationally, a lack of coordinated and integrated planning for the energy sector has led to underinvestment in much needed energy infrastructure. There is currently inadequate supply of electricity due to limited investments in new capacity.

Electricity generation is constrained due to insufficient capacity and inadequate availability of existing infrastructure. CENTLEC should, therefore, not find itself in this position.

CENTLEC is committed to the introduction, promotion, and welcoming various sources of renewable energy to ensure the support of the green economy. Promoting renewable energy will contribute towards the diversification of electricity supply and security. CENTLEC envisage to create an enabling environment to facilitate the introduction of independent power producers that will generate electricity from various renewable energy sources.

2. SCOPE

The development of a National IEP was envisaged in the White Paper on the Energy Policy of the Republic of South Africa of 1998 and, in terms of the National Energy Act, 2008 (Act No. 34 of 2008), the Minister of Energy is mandated to develop and, on an annual basis, review and publish the IEP in the Government Gazette. The purpose of the Integrated Energy Plan is to provide a roadmap of the future energy landscape for South Africa which guides future energy infrastructure investments and policy development. The National Energy Act requires the IEP to have a planning horizon of no less than 20 years. The development of the IEP is therefore a continuous process as it needs to be reviewed periodically to consider changes in the macroeconomic environment, developments in new technologies and changes in local priorities and imperatives, amongst other factors. Since change is on-going, the plan must remain relevant.

3. OBJECTIVES

From the myriad of factors which had to be considered and addressed during the Integrated Energy Planning process, two key strategic pillars from the CENTLEC's approved Strategy were identified to support the objectives of the organization:

- **Pillar 1:** Ensure security of supply through own generation and Independent Power Producers.
- **Pillar 2:** Secure revenue by improving grid functionality, securing funding and implementing systems which will enable personnel in the company to perform optimally.

The government's 20-year Master Energy Plan and the Integrated Resources Plan, as finalized in 2023 encourages the persuasion of diversified energy mix that will provide security of supply while ensuring compliance with Emission Reduction Plan. Reference was made to NERSA's conditions and guidelines (i.e., "Standard Conditions for Embedded Generation within municipal boundaries."). The provisions of the Electricity Regulation Act (Act No. 4 of 2006) ('the Act') authorizes the Energy Regulator to prepare and pass rules designed to implement the national government's Electricity Policy Framework, the Integrated Resource Plan, and the Act. The provisions of the Act further states that non-discriminatory access to the networks must be provided on conditions relating to:

- the circumstances under which access must be allowed,
- the circumstances under which access may be refused,
- the strengthening or upgrading of the transmission or distribution power system to provide for access, including contributions towards such upgrading by the potential users of such systems, if applicable,
- the rights and obligations of other existing or new users regarding the use of such power systems,
- compliance with any rule, code or practice made by the Regulator; or
- the fees that may be charged by a licensee for the use of such power system.

4. ENERGY ASSESSMENT

Mangaung Metro Municipality has experienced fluctuations in electricity demand over the past decade, which can be attributed to various economic factors and changes in tariff structures. Despite an increase in the number of customers, with an average growth of 6.3%, the overall electricity consumption has not followed the same trend and has instead decreased linearly year on year.

4.1. Maximum Demand (kVA)

One significant factor contributing to the decrease in electricity consumption was the substantial Eskom tariff increase of 28.99% in the 2010/2011 financial year. Prior to this increase, the city's electricity demand growth was around 2.76% annually from the 2003/2004 financial year until the 2009/2010 financial year. The closure of the municipality's Power Station due to high running costs also led to the need to purchase all electricity from Eskom at higher tariffs, which were then passed on to consumers through the NERSA tariff approval process.

The Mangaung Metro Municipality had Notified Maximum Demand (NMD) of 323 MVA with Eskom, however, a new NMD of 260 MVA has come into effect in July 2024. Despite the sufficient capacity in the distribution network, the total demand has shown a gradual decline over the past several years.

Demand Analysis

Analysis of maximum demand data over a five-year period from FY 2020/21 through partial FY 2024/25 (up to February 2025) reveals a consistent downward trend in average annual demand. The average maximum demand decreased notably from 220 MVA in 2020/21 to 211 MVA in 2021/22 (a 3.94% reduction), and further to 208 MVA in 2022/23 (a 1.41% reduction). The 2023/24 fiscal year showed a slight stabilization with a marginal increase of 0.26%. Preliminary data for 2024/25 indicates a temporary stabilization with an average of 205 MVA for the first eight months (a 0.78% increase over the same period in the previous year).

The data exhibits clear seasonal patterns across all fiscal years, with higher demand during winter months (May-August) and summer peaks in February-March. July consistently records high demand figures, with 258 MVA in 2020/21 representing the highest monthly value in the five-year period. Even this peak remains well below the NMD of 323 MVA, supporting the decision to reduce the NMD to 260 MVA from July 2024.

Month-to-month comparisons between consecutive years show the most significant decreases occurred between 2020/21 and 2021/22, particularly in September (-12.67%), August (-7.38%), and December (-5.97%). This steeper decline moderated in subsequent years, with mixed patterns of increases and decreases. The most recent data for 2024/25 shows significant increases in July (4.94%), October (4.30%), and January (5.20%), but continued decreases in August (-2.81%) and February (-4.42%).

This evolution from steep decline to modest stabilization in demand can be attributed to several factors:

- The initial sharp decline (2020/21 to 2021/22) likely reflected aggressive customer migration to alternative energy sources and implementation of energy efficiency measures
- The moderation in decline rates suggests a potential approaching equilibrium as the most motivated customers have already implemented alternatives
- Recent monthly increases in certain periods may reflect adaptation to loadshedding schedules or changes in economic activity

The overall demand pattern supports CENTLEC's strategic decision to negotiate a lower NMD with Eskom, allowing for operational flexibility while optimizing costs. The new NMD of 260 MVA provides sufficient capacity for the observed demand patterns while avoiding unnecessary charges for unused capacity.

Table 1: Maximum demand

Financial Year:	2020/21	2021/22	% Growth	2022/23	% Growth	2023/24	% Growth	2024/25	% Growth
Jul	258	250	-2,96%	241	-3,65%	245	1,72%	257	4,94%
Aug	255	256	0,70%	238	-7,09%	232	-2,75%	225	-2,81%
Sep	247	235	-4,79%	210	-10,7%	208	-0,91%	207	-0,65%
Oct	209	209	0,11%	196	-6,41%	196	0,19%	204	4,30%
Nov	200	197	-1,62%	188	-4,88%	187	-0,51%	185	-0,72%
Dec	200	199	-0,95%	179	-9,60%	181	0,88%	182	0,42%
Jan	191	186	-2,67%	190	1,78%	177	-6,57%	186	5,20%
Feb	203	195	-3,54%	181	-7,15%	200	10,05%	191	-4,42%
Mar	194	196	1,40%	188	-4,04%	204	8,57%	189	-7,70%
Apr	206	219	6,44%	204	-7,21%	204	0,28%	205	0,47%
May	223	217	-2,37%	239	9,98%	208	-12,85%		
Jun	259	254	-1,94%	247	-2,88%	252	2,26%		
Average	**220**	**218**	**-1,02%**	**208**	**-4,32%**	**208**	**0,26%**	**203**	**-0,10%**

To address the declining electricity consumption and its impact on the Company's revenue, the following strategies should be considered:

- **Promote economic growth and development:** Encourage the growth of electricity-intensive industries and businesses through incentives, infrastructure development, and streamlined processes to stimulate electricity demand.
- **Implement targeted tariff structures:** Develop tariff structures that balance the need for cost recovery with the promotion of economic growth and the protection of vulnerable consumers.
- **Encourage energy efficiency:** Promote energy efficiency programs and initiatives to help consumers manage their electricity consumption while mitigating the impact on the municipality's revenue.
- **Explore alternative revenue streams:** Diversify the company's revenue sources by investing in renewable energy projects, such as solar PV plants, to reduce reliance on electricity sales and generate additional income.
- **Engage with stakeholders:** Collaborate with businesses, industries, and communities to understand their energy needs and develop strategies that support both economic growth and the financial sustainability of the company's electricity services.

By understanding the relationship between electricity demand and economic factors, the company can develop targeted strategies to stimulate economic growth, manage electricity consumption, and ensure the financial viability of its electricity services in the long term.

4.2. Eskom Energy Purchases (kWh)

Table 2 below provides critical insights into the municipality's electricity consumption patterns over the past five financial years, serving as a valuable foundation for future energy planning initiatives.

Table 2: Bulk kWh Purchases over the past five Financial Years

2020/2021		2021/2022		2022/2023		2023/2024		2024/2025	
Month	kWh	Month	kWh	Month	kWh	Month	kWh	Month	kWh
Jul-20	150 026 451	Jul-21	151 198 161	Jul-22	139 321 366	Jul-23	139 848 889	Jul-24	140 204 903
Aug-20	142 646 462	Aug-21	143 320 359	Aug-22	139 319 067	Aug-23	132 345 518	Aug-24	127 817 873
Sep-20	126 667 740	Sep-21	124 175 500	Sep-22	118 479 156	Sep-23	115 133 409	Sep-24	115 232 244
Oct-20	130 833 381	Oct-21	123 932 089	Oct-22	119 461 115	Oct-23	117 541 514	Oct-24	114 269 901

Nov-20	123 649 720	**Nov-21**	119 040 440	**Nov-22**	114 363 734	**Nov-23**	112 494 321	**Nov-24**	108 633 060
Dec-20	122 969 390	**Dec-21**	115 312 555	**Dec-22**	107 589 332	**Dec-23**	108 386 557	**Dec-24**	109 423 319
Jan-21	123 190 361	**Jan-22**	119 569 037	**Jan-23**	113 411 805	**Jan-24**	111 269 060	**Jan-25**	114 489 132
Feb-21	115 273 343	**Feb-22**	113 076 762	**Feb-23**	105 548 718	**Feb-24**	109 895 323	**Feb-25**	106 292 790
Mar-21	126 435 559	**Mar-22**	122 248 194	**Mar-23**	116 630 512	**Mar-24**	117 495 679	**Mar-25**	115 080 224
Apr-21	121 336 280	**Apr-22**	122 586 863	**Apr-23**	111 616 341	**Apr-24**	120 460 306	**Apr-25**	112 197 058
May-21	137 209 980	**May-22**	133 531 542	**May-23**	130 604 573	**May-24**	120 354 892	**May-25**	
Jun-21	145 239 191	**Jun-22**	141 123 814	**Jun-23**	138 975 391	**Jun-24**	130 023 322	**Jun-25**	
	1 565 477 857		**1 529 115 316**		**1 455 321 110**		**1 435 248 789**		**1 163 640 502**

Below is the visual representation of the table above:

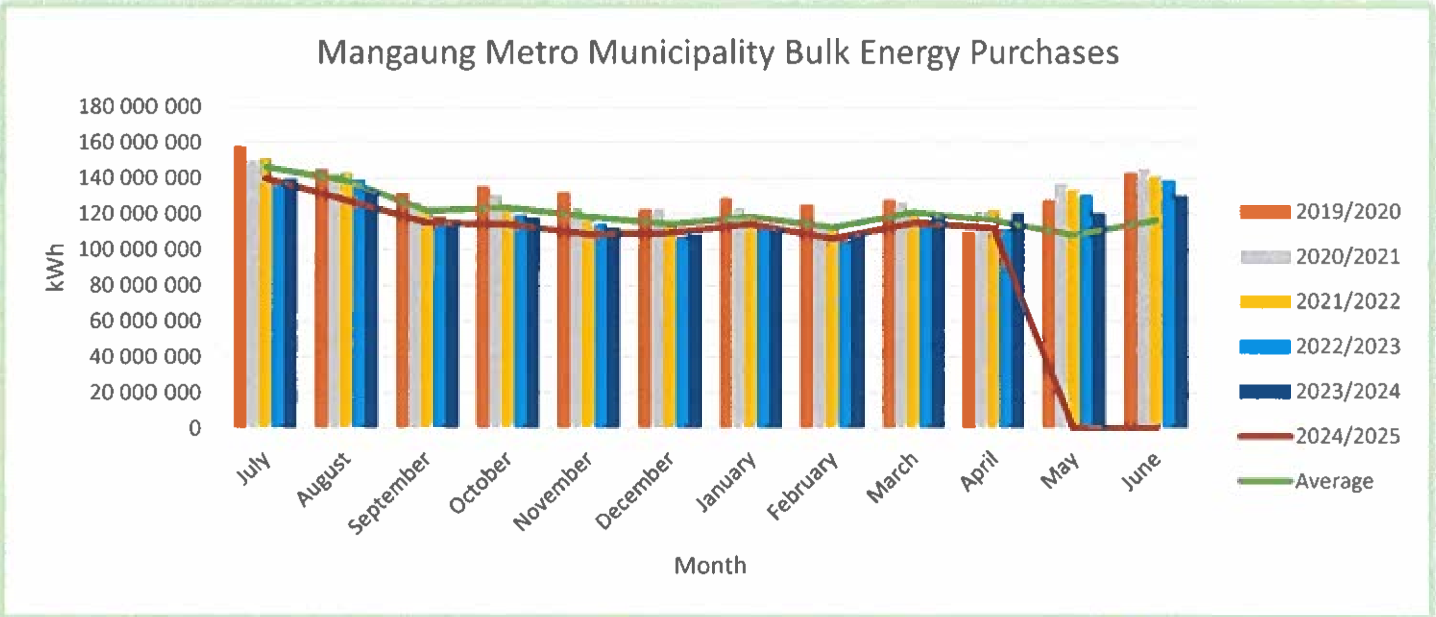


Figure 1: CENTLEC's Energy Purchases.

As illustrated in Figure 1, a clear declining trend in bulk electricity purchases can be observed across the five financial years from 20202021 to 2023/2024. Total annual purchases have decreased from 1 565 477 857kWh in 2020/2021 to 1 435 248 789kWh in 2023/2024, representing an overall reduction of approximately 9.1% over this five-year period.

The data reveals consistent seasonal patterns in electricity consumption, with higher demand during winter months (May-August) and lower consumption during summer periods. This seasonality aligns with expected usage patterns, as heating requirements during winter months typically drive increased electricity consumption. It is worth noting that electricity rates are generally higher during winter months than in summer, further impacting consumer behavior and overall demand.

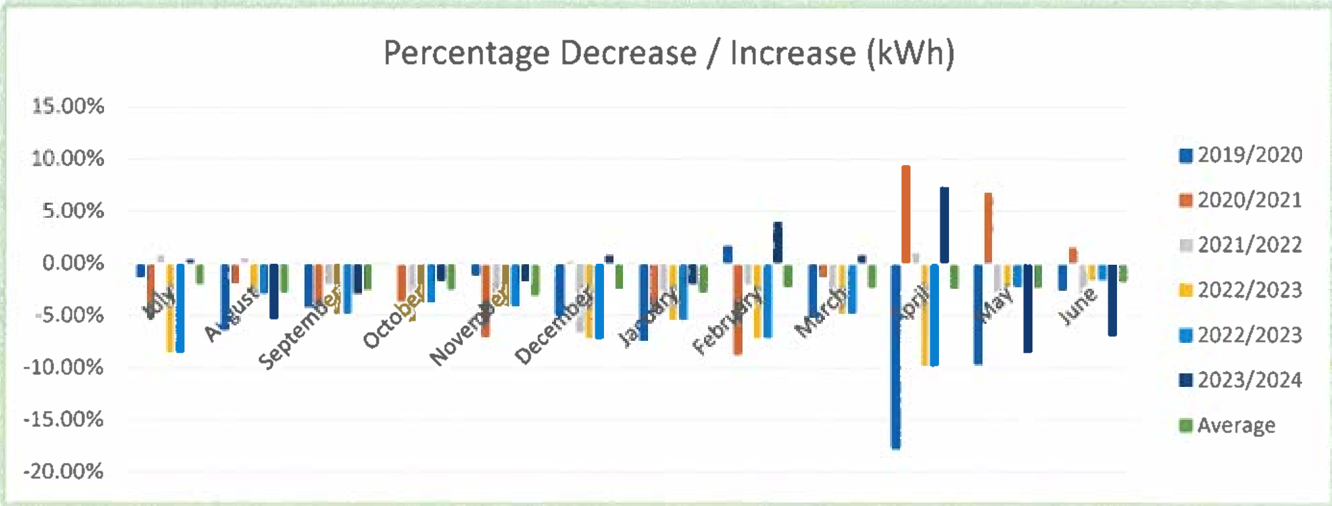


Figure 2: CENTLEC's Energy Purchases Percentage Decrease/Increase.

Figure 2 highlights the year-on-year percentage changes in energy purchases, revealing several significant trends. The most notable decrease occurred during the 2019/2020 financial year, coinciding with the COVID-19 pandemic and the implementation of loadshedding measures. This combination of factors significantly disrupted normal consumption patterns, with commercial and industrial sectors experiencing reduced operations during lockdown periods.

Beyond the pandemic, several other factors have contributed to the continuing decline in energy purchases:

1. The increasing frequency and duration of loadshedding events, particularly during the 2022/23 financial year and part of the 2021/22 financial year

2. Growing penetration of PV generators and other Small Scale Embedded Generation (SSEG) systems among consumers

3. Inclement weather conditions leading to prolonged power outages

4. Infrastructure challenges including vandalism to electrical distribution networks

The financial impact of these disruptions has been substantial. During the 2022/23 financial year and half of the 2021/22 financial year, loadshedding was declared for 379 days, resulting in an estimated revenue loss of R143,299,402.33 for CENTLEC. On average, the company incurs costs of R164,711.96 for every hour of loadshedding.

Furthermore, equipment failures related to loadshedding have compounded these challenges. Analysis indicates that outages caused by equipment failures were 2.25 times longer than the specified loadshedding duration during the evaluated period. With approximately 870 hours of loadshedding implemented during this period, the costs to replace failed equipment amount to approximately R9,724.83 per hour of loadshedding.

These figures underscore the urgent need for comprehensive strategies to enhance grid resilience, diversify energy sources, and implement advanced energy management systems to mitigate the financial and operational impacts of ongoing supply constraints.

4.3. Top 20 Maximum Demand Customers (kVA)

Analysis of CENTLEC's Top 20 Maximum Demand Customers from FY 2020/2021 through FY 2024/2025 (up to February 2025) reveals notable trends in high-consumption patterns. These customers are ranked based on their 2023/2024 maximum demand values.

The highest recorded demand was 11,415 kVA for the Top 1 customer in FY 2023/2024, showing an 11.05% increase from the previous year. However, preliminary FY 2024/2025 data indicates a significant 11.50% decrease to 10,103 kVA for this customer.

Current FY 2024/2025 data shows a predominantly downward trend across most Top 20 customers, with seventeen customers experiencing decreases compared to the previous fiscal year. The most substantial reductions include Top 9 (-51.23%), Top 8 (-32.56%), Top 5 (-18.56%), and Top 11 (-15.62%). Only three customers show increases: Top 16 (11.90%), Top 7 (7.53%), and Top 13 (1.30%).

These reductions likely stem from increased adoption of energy efficiency measures, installation of Small Scale Embedded Generation systems, operational changes responding to rising electricity costs, and the impact of loadshedding on operations.

The overall highest maximum demand across all fiscal years rose from 9,129 kVA in FY 2020/2021 to 11,415 kVA in FY 2023/2024, before declining to 10,103 kVA in the current fiscal year. This trend supports CENTLEC's decision to reduce the Notified Maximum Demand

(NMD) to 260 MVA while highlighting the need for strategies addressing potential revenue impacts from declining maximum demand.

Table 3: Top 20 Maximum Demand Customers (kVA)

Financial Year	2020/2021 FY	2021/2022 FY		2022/2023 FY		2023/2024 FY		2024/2025 FY	
	Max Demand	Max Demand	Inc / Dec	Max Demand	Inc / Dec	Max Demand	Inc / Dec	Max Demand	Inc / Dec
Top 1	9129	9967	9,18%	10279	3,13%	11415	11,05%	10103	-11,50%
Top 2	7865	7774	-1,16%	6125	-21,21%	6449	5,29%	5572	-13,60%
Top 3	5300	5150	-2,83%	5034	-2,25%	5080	0,91%	4706	-7,37%
Top 4	3593	3888	8,20%	3851	-0,94%	4267	10,79%	3837	-10,09%
Top 5	4380	4069	-7,09%	4176	2,61%	4034	-3,38%	3286	-18,56%
Top 6	3985	3776	-5,25%	3724	-1,36%	3937	5,71%	3828	-2,77%
Top 7	2855	2979	4,33%	3542	18,90%	2979	-15,89%	3203	7,53%
Top 8	2327	2225	-4,37%	2288	2,80%	2373	3,74%	1601	-32,56%
Top 9	1822	1981	8,69%	2281	15,14%	2342	2,70%	1142	-51,23%
Top 10	2469	2457	-0,49%	2152	-12,43%	2283	6,10%	2104	-7,85%
Top 11	2234	1937	-13,29%	2045	5,55%	2208	7,98%	1863	-15,62%
Top 12	2068	2068	0,00%	2051	-0,80%	1996	-2,70%	1924	-3,61%
Top 13	1830	1990	8,73%	1821	-8,46%	1929	5,90%	1954	1,30%
Top 14	2077	2076	-0,06%	1963	-5,46%	1854	-5,57%	1758	-5,15%
Top 15	1715	1511	-11,88%	1541	1,97%	1745	13,23%	1491	-14,56%
Top 16	1875	2080	10,89%	1986	-4,50%	1724	-13,18%	1930	11,90%
Top 17	1696	1767	4,20%	1660	-6,03%	1718	3,44%	1516	-11,76%
Top 18	1662	1614	-2,92%	1485	-7,96%	1685	13,45%	1672	-0,79%
Top 19	1806	1582	-12,42%	1572	-0,63%	1677	6,66%	1643	-1,99%
Top 20	1613	1594	-1,19%	1590	-0,24%	1566	-1,52%	1403	-10,38%
Highest MD per Financial Year	**9129**	**9967**	**9,18%**	**10279**	**3,13%**	**11415**	**11,05%**	**10103**	**-11,50%**

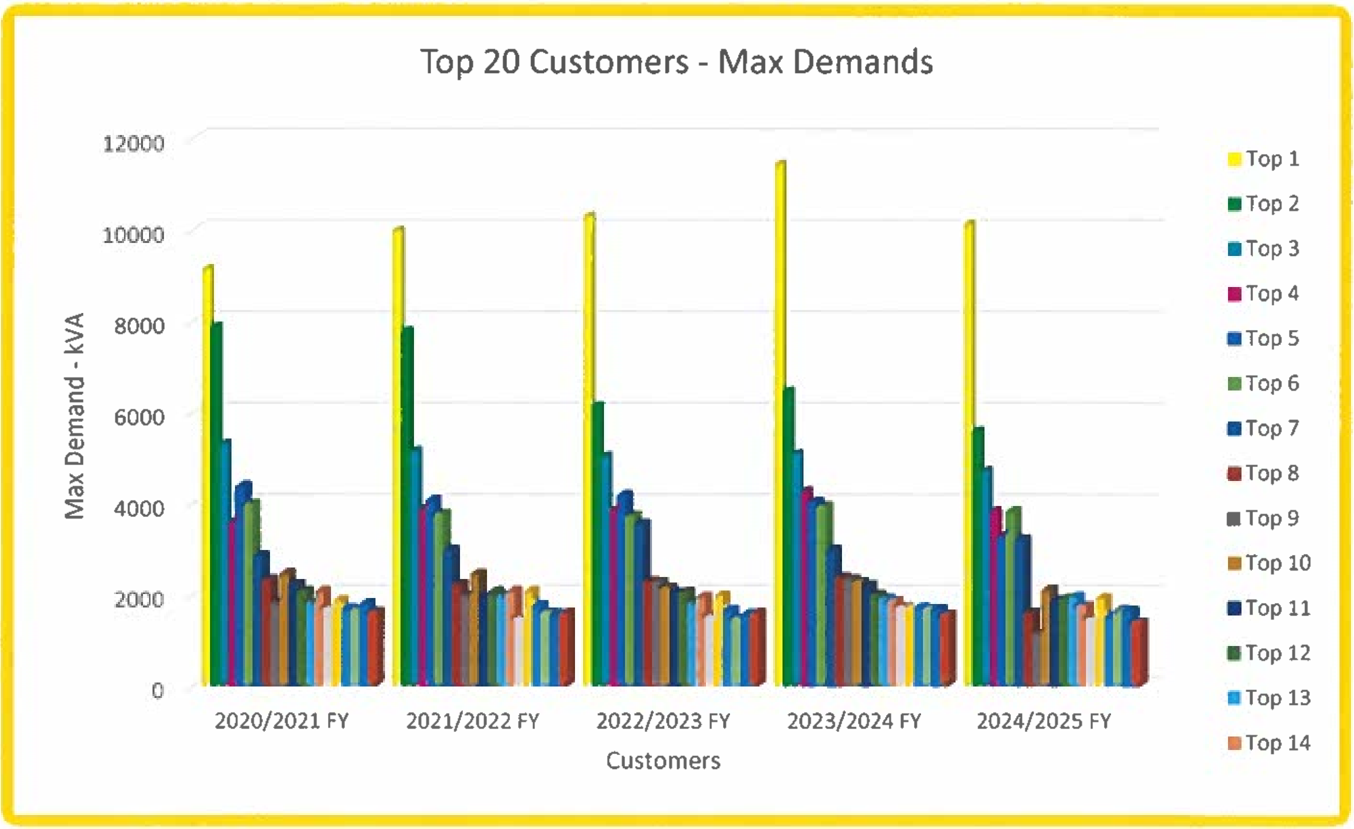


Figure 3: Top 20 Maximum Demand Customers (kVA)

Figure 3 above is a visual representation the kVA of the Top 20 Maximum Demand Customers in the CENTLEC's distribution area.

4.4. Top 20 Energy Consumers (kWh)

Analysis of CENTLEC's Top 20 Energy Consumers from FY 2020/2021 through FY 2024/2025 (up to April 2025) reveals significant consumption trends. After decreases of 2.55% and 6.07% in FY 2021/2022 and FY 2022/2023 respectively, consumption slightly recovered by 1.41% in FY 2023/2024. However, preliminary FY 2024/2025 data shows a dramatic 22.48% decrease across all major consumers, this is expected since the consumption for this current FY is only up to the end of April 2025.

Current data indicates all Top 20 customers experiencing substantial reductions ranging from 8.89% to 54.50% compared to the previous year, with Top 16 (-54.50%) and Top 19 (-41.13%) showing the most significant decreases.

These widespread reductions stem from several factors: increased SSEG installations, energy efficiency implementations, loadshedding impacts, changing operational patterns, and shifts to alternative energy sources.

This consistent downward trend necessitates that CENTLEC adapt its Energy Plan to address revenue impacts while supporting customers' transitions toward greater energy independence and efficiency.

Table 4: Top 20 Energy Consumers (kWh)

Financial Year	2020/2021 FY	2021/2022 FY		2022/2023 FY		2023/2024 FY		2024/2025 FY	
Customer Rank	**kWh**	**kWh**	**Inc / Dec**	**kWh**	**Inc / Dec**	**kWh**	**Inc / Dec**	**kWh**	**Inc / Dec**
Top 1	33077259	36570892	10,56%	37238975	1,83%	35510001	-4,64%	27884799	-21,47%
Top 2	19917591	18630908	-6,46%	15610233	-16,21%	15917334	1,97%	14189086	-10,86%
Top 3	20631421	15703069	-23,89%	15191688	-3,26%	15655000	3,05%	11964362	-23,57%
Top 4	21215567	18678463	-11,96%	17489403	-6,37%	15480307	-11,49%	11274789	-27,17%
Top 5	14129143	14433808	2,16%	15007716	3,98%	14781320	-1,51%	13467315	-8,89%
Top 6	14515166	13941088	-3,96%	13170514	-5,53%	13292319	0,92%	9637432	-27,50%
Top 7	13599928	12929948	-4,93%	11371711	-12,05%	12102882	6,43%	9094609	-24,86%
Top 8	14418697	13877010	-3,76%	12159709	-12,38%	11146381	-8,33%	7779893	-30,20%
Top 9	7585020	8597305	13,35%	8491740	-1,23%	9786371	15,25%	8142044	-16,80%
Top 10	10649516	10627763	-0,20%	10224422	-3,80%	9698057	-5,15%	7850718	-19,05%
Top 11	8985355	8750967	-2,61%	8169847	-6,64%	9180259	12,37%	6720415	-26,79%
Top 12	8359145	8361236	0,03%	7196064	-13,94%	8841750	22,87%	7109998	-19,59%
Top 13	6254011	6442823	3,02%	6895928	7,03%	7747128	12,34%	5527984	-28,64%
Top 14	9310188	9319496	0,10%	7549953	-18,99%	7576914	0,36%	6579575	-13,16%
Top 15	8087292	8755470	8,26%	7837211	-10,49%	7565026	-3,47%	5847979	-22,70%
Top 16	6731545	6529430	-3,00%	6063240	-7,14%	7320260	20,73%	3330933	-54,50%
Top 17	6208781	7092444	14,23%	6820751	-3,83%	6706713	-1,67%	5451134	-18,72%
Top 18	5884086	5574363	-5,26%	5420403	-2,76%	6081568	12,20%	4978037	-18,15%

Top 19	6021172	5836466	-3,07%	5496324	-5,83%	5593977	1,78%	3292922	-41,13%
Top 20	6236601	5000191	-19,83%	3941046	-21,18%	4483093	13,75%	3891194	-13,20%
Total kWh's per Financial Year	**241817483**	**235653141**	**-2,55%**	**221346878**	**-6,07%**	**224466659**	**1,41%**	**141272082**	**-22,48%**

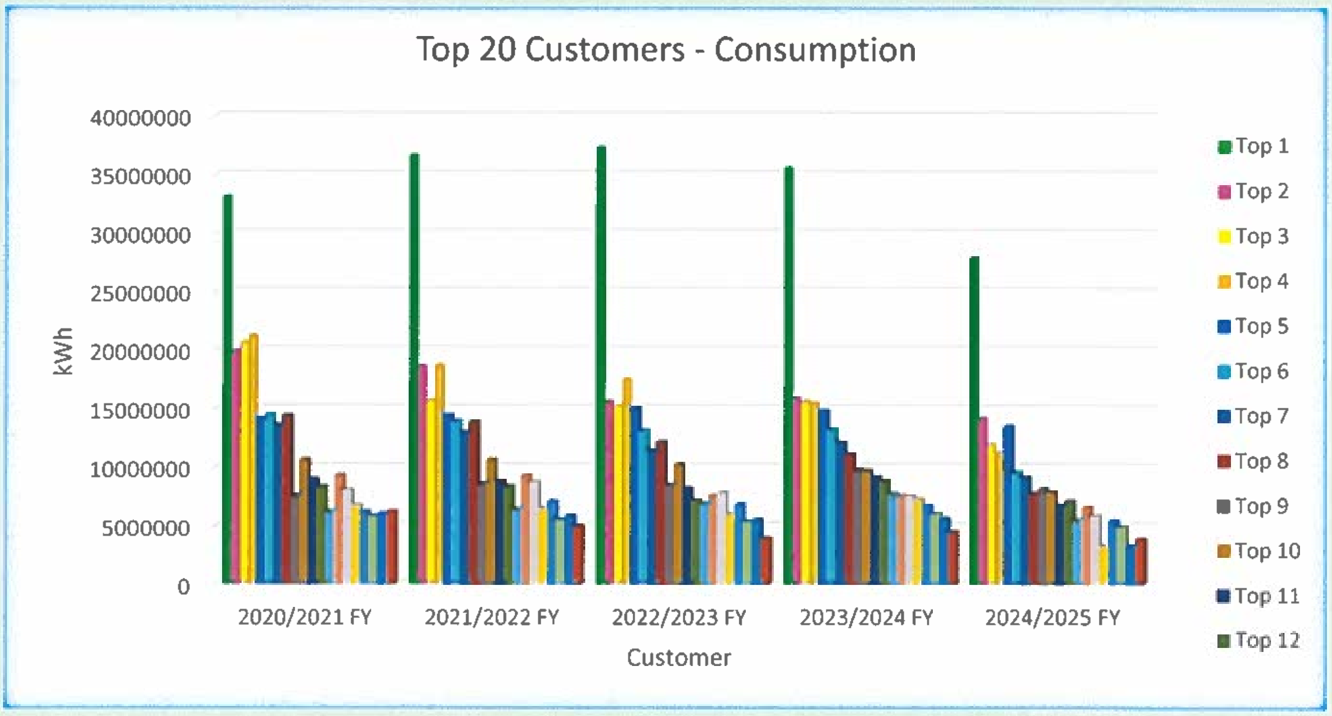


Figure 4: ***Top 20 Energy Consumers (kWh)***

Figure 4 visualizes these consumption patterns specifically within CENTLEC's supply area, distinct from ESKOM-supplied portions of the broader Mangaung Metropolitan Municipality.

5. CUSTOMER ASSESSMENT

5.1 Insights on Time of Use (ToU) Customers and Consumption Patterns

Table 5: Total Number of ToU Customers per Category

ToU Customer Category	Total ToU Customers	Percentage of Total ToU Customer	Average Consumption / Month	Percentage of the Total Average of ToU Customers Monthly
Agricultural - Crop Farming	8	0,42%	91616,92	0,14%
Agricultural - Live-Stock Farming	4	0,21%	167555,67	0,26%
Agricultural - Mixed Farming	13	0,68%	96831,19	0,15%
Commerce - Bank	19	0,99%	359812,45	0,56%
Commerce - Car Dealership & Rental	2	0,10%	5399,89	0,01%
Commerce - Entertainment (Food & Bev)	11	0,58%	144468,42	0,22%
Commerce - Guest House	2	0,10%	4425,59	0,01%
Commerce - Office Block	155	8,11%	1880404,38	2,92%
Commerce - Professional Service	117	6,12%	598018,07	0,93%
Commerce - Retail	266	13,92%	12484961,69	19,39%
Commerce - Small Business	11	0,58%	30272,39	0,05%
Commerce - Warehouse	14	0,73%	88950,14	0,14%
Commerce - Wholesale	7	0,37%	331909,15	0,52%
Communications - Broadcasting	4	0,21%	122662,88	0,19%
Communications - CENTLEC	1	0,05%	6029,20	0,01%
Communications - Radio-Communication	4	0,21%	8663,78	0,01%
Communications - Telecommunication	219	11,46%	2039481,06	3,17%
Education - Creche	1	0,05%	1513,97	0,00%
Education - Private School	3	0,16%	19291,66	0,03%
Education - Public School	58	3,04%	974631,31	1,51%
Education - Tertiary Education	28	1,47%	6753543,08	10,49%
Energy - Eskom	2	0,10%	6803,41	0,01%
Energy - Filling Station	30	1,57%	630795,70	0,98%
Energy - Wholesale	6	0,31%	22524,74	0,03%
Health Care - Private Clinic	1	0,05%	1580,05	0,00%
Health Care - Private Hospital	7	0,37%	1365345,61	2,12%
Health Care - Professional Medical Facilities	14	0,73%	121460,66	0,19%
Health Care - Public Clinic	8	0,42%	45341,78	0,07%
Health Care - Public Hospital	6	0,31%	2222724,23	3,45%
Health Care - Warehouse	1	0,05%	10877,23	0,02%
Hospitality - Guest House	15	0,78%	63041,46	0,10%
Hospitality - Hotel	15	0,78%	494192,25	0,77%
Hospitality - Lodge	18	0,94%	367691,60	0,57%
Hospitality - Public Clinic	0	0,00%	0,00	0,00%
Industrial - Chemicals	7	0,37%	76699,26	0,12%
Industrial - Food & Beverage	28	1,47%	5630286,37	8,74%
Industrial - Iron and steel	18	0,94%	367921,72	0,57%
Industrial - Mining	5	0,26%	139108,68	0,22%
Industrial - Non-Ferrous Metals	3	0,16%	37573,03	0,06%
Industrial - Non-Metallic Minerals	25	1,31%	815722,01	1,27%
Industrial - Pulp and Paper	33	1,73%	1237822,73	1,92%
Industrial - Retail	1	0,05%	521,04	0,00%

ToU Customer Category	Total ToU Customers	Percentage of Total ToU Customer	Average Consumption / Month	Percentage of the Total Average of ToU Customers Monthly
Industrial - Wholesale	16	0,84%	174503,04	0,27%
NGO - Child Welfare	3	0,16%	15008,78	0,02%
NGO - Church	18	0,94%	116629,55	0,18%
NGO - Other NGO	3	0,16%	39688,96	0,06%
Public Services - Bloem water	4	0,21%	20378,09	0,03%
Public Services - CENTLEC	7	0,37%	58860,10	0,09%
Public Services - Correctional Services	2	0,10%	977484,15	1,52%
Public Services - Military	4	0,21%	1010698,55	1,57%
Public Services - Municipal Services - Fire & Rescue	7	0,37%	22843,08	0,04%
Public Services - Municipal Services - Water & Sanitation (Mangaung)	32	1,67%	1466934,48	2,28%
Public Services - Municipality - Offices/Building (Mangaung)	32	1,67%	590612,72	0,92%
Public Services - National Government	24	1,26%	10603261,79	16,47%
Public Services - Other 1	1	0,05%	472,98	0,00%
Public Services - Provincial Government	37	1,94%	832330,79	1,29%
Public Services - Public Clinic	5	0,26%	28140,96	0,04%
Public Services - SAPS	22	1,15%	232534,93	0,36%
Residential - Apartments	101	5,29%	721268,39	1,12%
Residential - Apartments & Businesses	2	0,10%	72585,43	0,11%
Residential - Estate	11	0,58%	1053583,89	1,64%
Residential - Old-Age Homes	29	1,52%	715157,60	1,11%
Residential - Stand-Alone House	61	3,19%	152964,89	0,24%
Residential - Student Housing	25	1,31%	565529,18	0,88%
Residential - Townhouse Complex	3	0,16%	30651,67	0,05%
Residential - Townhouses	147	7,69%	2454881,20	3,81%
Sports & Recreation - Sport Club	6	0,31%	51819,59	0,08%
Sports & Recreation - Sporting Facility	17	0,89%	181167,58	0,28%
Transport - Airport	3	0,16%	279829,17	0,43%
Transport - Bus-Station	4	0,21%	27912,49	0,04%
Transport - Car Dealership & Rental	29	1,52%	295763,55	0,46%
Transport - Car Service & Repairs	22	1,15%	126676,17	0,20%
Transport - Goods Transportation	34	1,78%	403113,27	0,63%
Transport - Rail	10	0,52%	1206206,74	1,87%
Grand Total of ToU Customers - 2024/2025 FY	**1911**	**100,00%**	**64397970,25**	**100,00%**

Analysis of CENTLEC's 1911 Time of Use (ToU) customers through April 2025 provides valuable insights for strategic energy planning and resource allocation. This comprehensive dataset reveals distinct consumption patterns across diverse sectors throughout our service area.

The ToU customer base encompasses several key sectors with notable consumption characteristics:

Commercial Sector:

- **Retail Commerce** emerges as a dominant category with 266 customers (13.92% of total ToU base) consuming 12,484,962 kWh monthly, representing 19.39% of total ToU consumption. This significant concentration presents substantial opportunities for targeted energy management strategies.
- **Office Blocks** constitute 155 customers (8.11%) with monthly consumption of 1,880,404 kWh (2.92% of total).
- **Professional Services** accounts for 117 customers (6.12%) consuming 598,018 kWh monthly (0.93% of total).

Communications:

- **Telecommunication** facilities represent 219 customers (11.46%) consuming 2,039,481 kWh monthly (3.17% of total), reflecting the critical infrastructure nature of this sector.

Government and Public Services:

- **National Government** operations, while comprising only 24 customers (1.26%), consume a substantial 10,603,262 kWh monthly (16.47% of total), representing one of the most energy-intensive customer segments.
- **Public Hospitals** with only 6 customers (0.31%) consume 2,222,724 kWh monthly (3.45% of total).
- **Municipal Water & Sanitation** services utilize 1,466,934 kWh monthly (2.28% of total).

Educational Institutions:

- **Tertiary Education** establishments with 28 customers (1.47%) consume 6,753,543 kWh monthly (10.49% of total), representing another high-intensity consumption category.
- **Public Schools** account for 58 customers (3.04%) with monthly consumption of 974,631 kWh (1.51% of total).

Industrial Sector:

- **Food & Beverage** industries include 28 customers (1.47%) consuming 5,630,286 kWh monthly (8.74% of total).
- **Pulp and Paper** operations account for 33 customers (1.73%) with monthly consumption of 1,237,823 kWh (1.92% of total).

Residential Segment:

- **Townhouses** represent 147 customers (7.69%) consuming 2,454,881 kWh monthly (3.81% of total).
- **Apartments** account for 101 customers (5.29%) with monthly consumption of 721,268 kWh (1.12% of total).

This consumption analysis reveals significant concentration in specific sectors. National Government, Retail Commerce, and Tertiary Education collectively represent only 16.65% of ToU customers but account for 46.35% of total energy consumption. This concentration suggests that targeted interventions in these sectors could yield substantial energy management benefits.

To develop an effective Energy Plan responsive to these consumption patterns, CENTLEC should implement:

1. **Sector-Specific Energy Efficiency Programs** tailored to high-consumption sectors
2. **Strategic Partnerships** with major consumers, particularly government facilities, to implement coordinated energy management initiatives
3. **Technology Optimization** prioritized for the most energy-intensive operations
4. **Enhanced Monitoring Systems** to track consumption trends and identify optimization opportunities

By developing strategies that address the specific needs and consumption patterns of each customer category, CENTLEC can enhance overall system efficiency while supporting customers in optimizing their energy usage and controlling costs.

5.2 TOU Customers with SSEG's

For the past few years, there has been a significant increase in the number of customers who have installed Solar Small-Scale Embedded Generators (SSEGs). Figure 5 illustrates the distribution of 301 confirmed customers across different categories who have adopted this technology. The data reveals that Commercial sectors lead adoption with Retail (60), Professional Services (24), and Office Blocks (13) representing the largest segments. The Residential sector also shows strong uptake with Townhouses (39), Stand-Alone Houses (22), and Old-Age Homes (9) demonstrating significant implementation rates.

The upward trend of SSEG installations can be attributed to several interconnected factors that drive customers toward solar power. Loadshedding mitigation has become a primary motivation, as customers seek energy security during grid outages. The frequency and duration of loadshedding events have prompted businesses and homeowners to invest in self-generation capabilities to maintain operations and comfort.

Cost considerations have become increasingly favorable for SSEG adoption. The combination of rising electricity tariffs and declining solar technology costs has improved the economic case for installation. Many systems now achieve payback periods of 4-6 years, making them attractive long-term investments. Additionally, the potential for revenue generation through excess energy export to the grid provides an additional economic incentive.

Environmental consciousness continues to drive adoption among environmentally aware consumers and businesses with sustainability goals. By generating clean renewable energy, customers can significantly reduce their carbon footprint and contribute to broader climate change mitigation efforts.

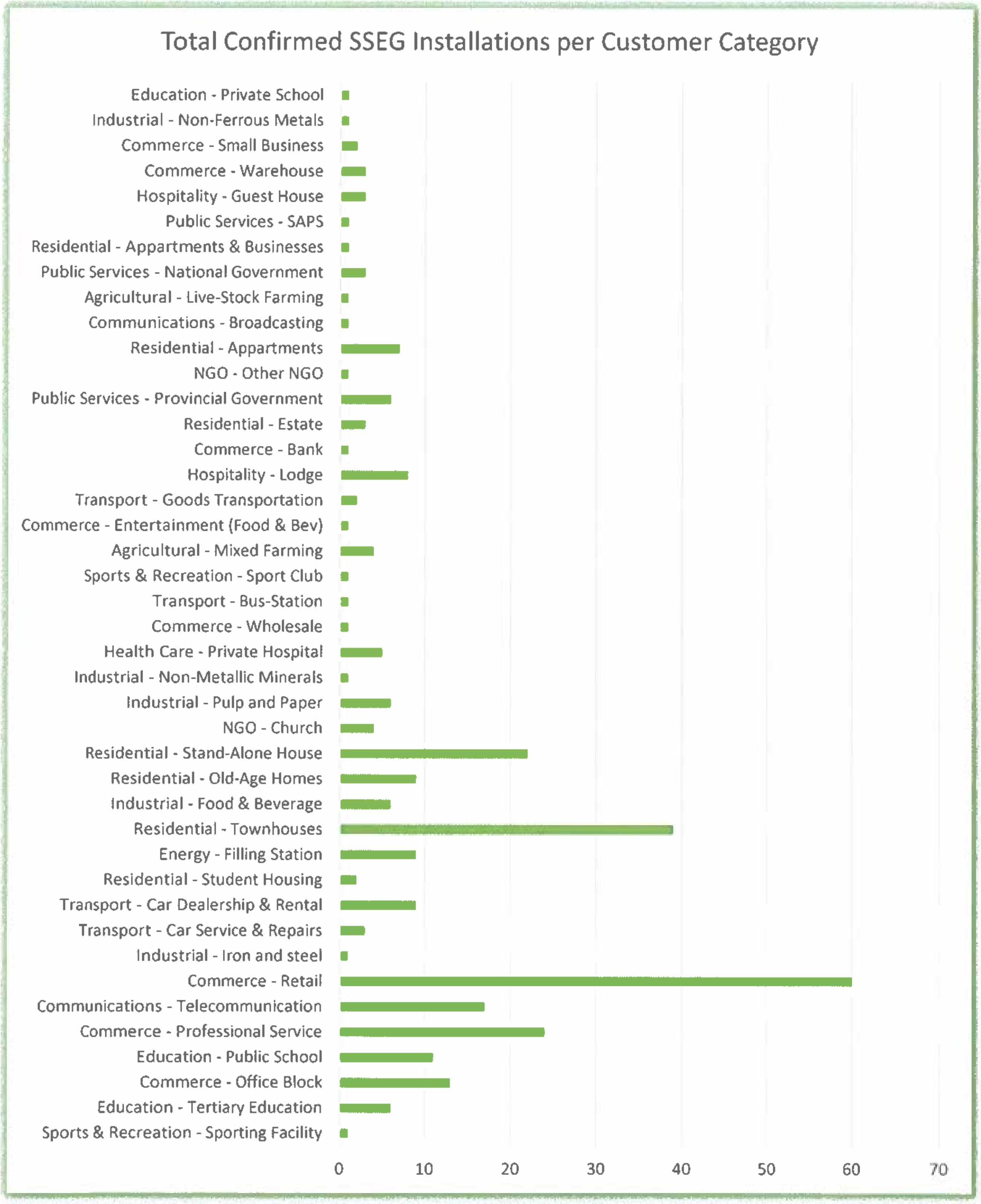


Figure 5: ***ToU Customers with SSEG's***

Government incentives and policies have further accelerated adoption through tax credits, rebates, and supportive regulatory frameworks. These mechanisms help offset initial installation costs and improve overall return on investment. The regulatory environment for grid connection has also evolved to facilitate easier integration of customer-owned generation systems.

Technological advancements in solar panels, inverters, and energy management systems have enhanced system performance while reducing costs. Higher efficiency panels generate more electricity from the same amount of sunlight, maximizing energy yield and improving economic returns. Battery storage technologies have also advanced, allowing for greater energy independence and optimization of self-consumption.

The desire for energy independence has emerged as a significant driver, as customers seek greater control over their energy supply and reduced vulnerability to utility rate hikes and supply disruptions. This aspect of consumer empowerment should not be underestimated as a motivating factor.

Looking ahead, CENTLEC anticipates continued growth in SSEG installations across all customer categories. This trend presents both challenges and opportunities for grid management and business model adaptation. The Integrated Energy Plan must incorporate strategies for grid modernization, tariff structure refinement, and enhanced customer engagement to effectively navigate this evolving energy landscape while ensuring system reliability and financial sustainability.

5.3 Prepayment and Rotational Customers Analysis

This analysis explores the consumption patterns of our prepayment customer base, aiming to uncover insights that not only inform energy planning strategies but also drive revenue generation. Additionally, it focuses on addressing the unique needs of indigent customers and ensuring equitable access to electricity. Table below illustrates the total number of prepayment customers per category, their percentage representation out of the total prepayment customer base, their average monthly purchases or consumption in kilowatt-hours (kWh), and the percentage of the monthly average consumption.

Table 6: Prepayment and Rotational Customers per category

Customer Category	Total Customers	Percentage of Total Prepayment Customers	Average Monthly Purchases/Consumption (kWh)	% of Monthly Average Consumption
Residential	146570	77%	36184089,8	84%
Commercial	2658	1%	2810057,12	6%
Residential Indigents	40907	22%	4249463,74	10%
Total	**190135**	**100%**	**43243610,66**	**100%**

Prepayment and Rotational Customer Categories:

The prepayment and rotational customer base is distributed across three distinct segments with unique characteristics:

1. **Residential Normal:** This forms the largest segment with 146570 customers, representing 77% of the total prepayment and rotational customer base. These residential households form the backbone of the prepayment and rotational customer ecosystem and are the primary focus of standard residential service offerings.

2. **Commercial:** With 2658 customers, this category represents just 1% of the prepayment and rotational customer base. Despite their small numerical representation, these business customers typically have different usage patterns and energy needs compared to residential customers. They often require specialized attention regarding reliability and service quality due to their business operations.

3. **Residential Indigents:** This category encompasses 40907 customers, constituting 22% of the prepayment and rotational customer base. These customers receive Free Basic Electricity (FBE) as part of social support programs, highlighting CENTLEC's commitment to ensuring equitable access to essential services.

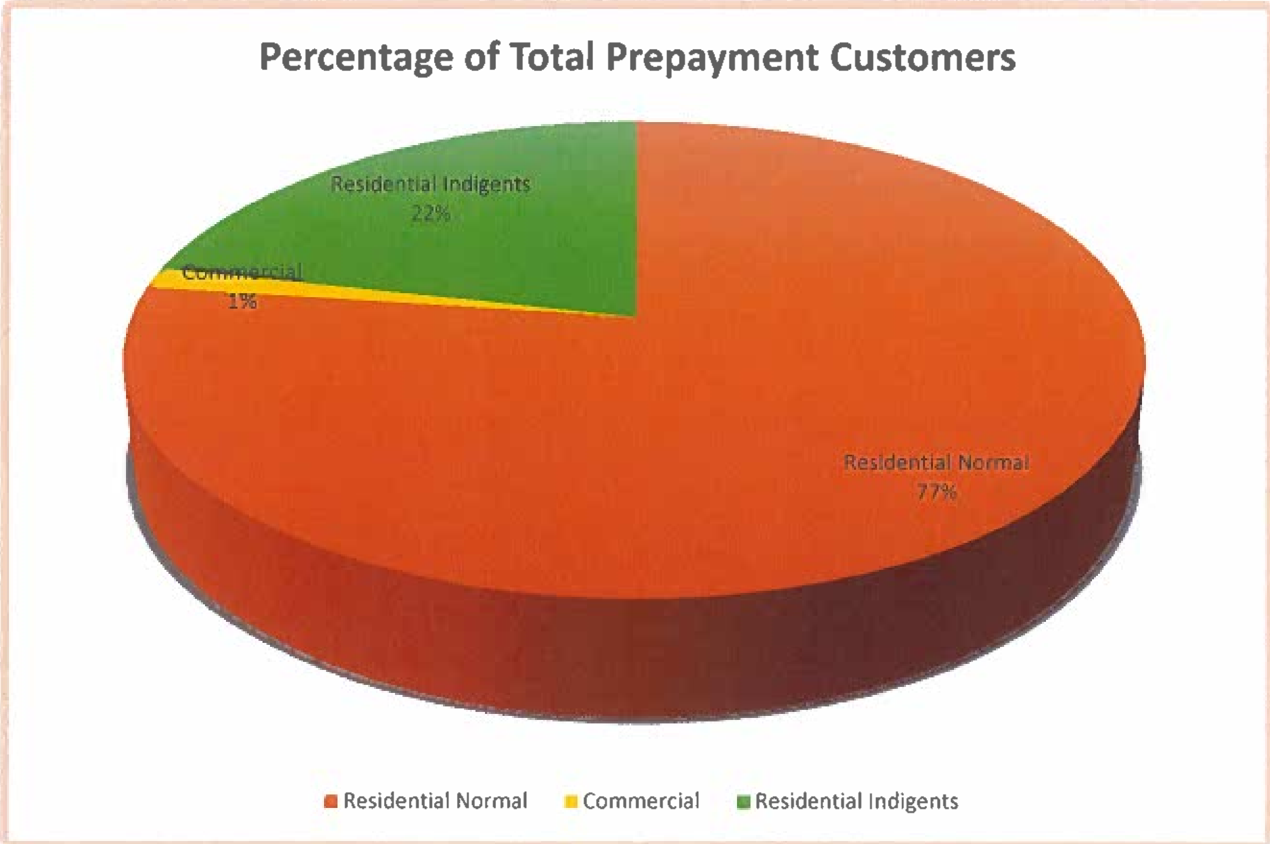


Figure 6: ***Percentage of prepayment and rotational customers***

The distribution patterns illustrated in Figure 6 emphasize the need for differentiated customer management strategies. The predominance of residential customers underscores the importance of residential-focused initiatives in CENTLEC's overall customer strategy.

For the commercial prepayment segment, their unique business requirements suggest opportunities for dedicated business support services and potentially tailored tariff structures that better align with commercial operational patterns. Additionally, transition pathways to time-of-use tariffs might be beneficial for growing businesses in this category.

The substantial indigent customer segment represents a vital social responsibility component of CENTLEC's operations. Effective management of the FBE program ensures these vulnerable customers receive essential services while maintaining system sustainability. Continuous monitoring of this segment helps identify households that may benefit from additional support services or energy efficiency programs to maximize the value of their allocation.

This analysis reinforces the importance of segment-specific approaches in CENTLEC's customer management and energy planning strategies to balance operational objectives with social responsibility while promoting appropriate service delivery across all customer categories.

6. ENERGY EFFICIENCY AND CONSERVATION

Energy efficiency improvements have been fueled by factors such as high energy prices. The municipality may provide an incentive for the use of more energy efficiency equipment and appliances, or even switching to alternative energy sources.

Technological developments and the adoption of technologies that are more energy efficient, methods and processes such as geyser control have reduced total energy consumption and the demand.

By applying the correct energy efficiency in a particular region, less energy intensity will be realized from that region. Energy efficiency can be monitored by the utility by implementing appropriate policies and standards which generally promote the adaptation of more efficient equipment, appliances and methods and that will also generate revenue for the utility.

6.1 Energy Efficiency in Municipal Water and Wastewater Works

Overview:

Water and Wastewater infrastructure accounts for a significant portion of energy consumption in the Mangaung Metro's operations. This represents about 32% of energy consumption in the Public Services ToU Customers of the Metro and about 3% of the total ToU Customers, see Figure 7 below. Energy efficiency in this sector is crucial for reducing operating costs, achieving sustainability, and meeting growing urban energy demand.

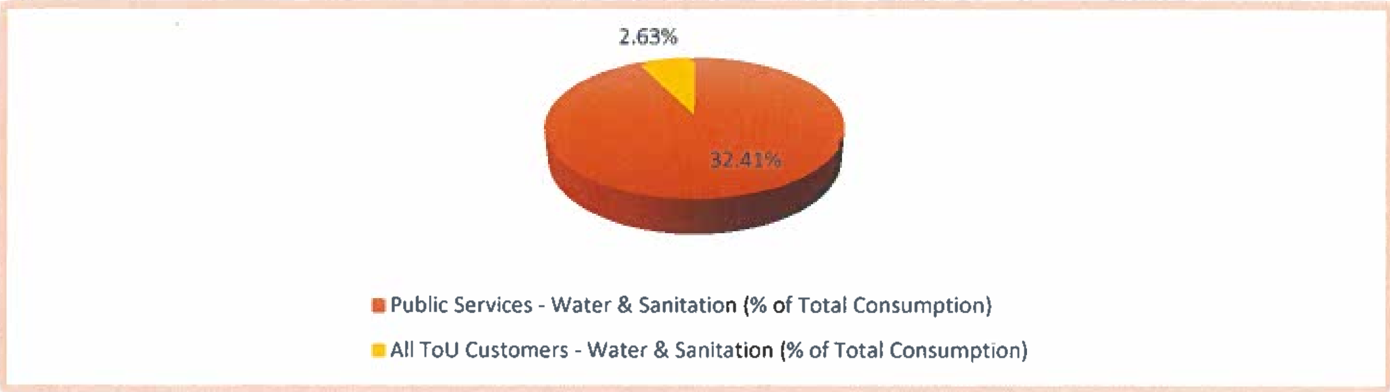


Figure 7: Water & Sanitation percentage Consumption

Energy Consumption in Water and Wastewater Treatment:

Energy is consumed at various points in the water and wastewater treatment infrastructure cycle. Pumping is the most energy-intensive activity, followed by wastewater treatment processes. Groundwater supply systems require less treatment but are more energy-intensive than surface water-based systems. Advanced wastewater treatment with nitrification consumes more energy than simple systems. Administrative and production buildings have a small percentage of total electricity consumption.

Energy Efficiency Approaches:

Efficiency measures focus on optimizing system architecture and operation rather than specific equipment. Implementing best practices, ongoing monitoring, and maintenance are vital for maintaining efficiency. Managing water demand and exploring renewable energy generation, such as biogas from wastewater treatment and mini hydropower within the water distribution system, are additional opportunities.

Potential Energy Savings:

The water and wastewater treatment sector offers significant electricity savings potential. Improving existing pumps, utilizing new pumping technology, and better maintenance can achieve savings of 5-30% in pumping. Aligning control parameters in aerobic sewage treatment can save up to 50% energy. These efficiency measures typically have payback periods of 1-5 years.

Benefits of Energy Efficiency:

Energy efficiency in water and wastewater treatment works provides several benefits, including lower costs to consumers, the ability to serve growing populations, greenhouse gas mitigation, energy security, fiscal stability, and improved environmental ratings (Blue Drop/Green Drop).

Load Shifting Opportunities:

Load shifting in water and wastewater works can lead to substantial financial savings. Running water pumps and reservoirs during off-peak hours when electricity costs less can provide savings that are above 30%. Aeration and mixing chambers in wastewater treatment plants offer flexibility for load shifting. Real-time metering, energy management systems, and dissolved oxygen data collection are necessary for effective load shifting.

Establishing an Energy Management Process:

Institutionalizing energy management within water and wastewater utilities is crucial for realizing energy efficiency potential. This involves establishing an energy management team, conducting facility energy assessments, developing an energy management plan, implementing planned activities, and monitoring, evaluating, and verifying results. Energy efficiency targets should be integrated into strategic planning and water services development plans.

6.2 Energy Efficient Buildings

Overview:

Energy efficient buildings focus on maximizing passive design principles and minimizing the use of active systems to achieve a comfortable indoor climate while reducing energy consumption. Passive solar design utilizes the local climate conditions to harness and retain the sun's warmth in winter while minimizing heat gain in summer. With this initiative, emphasis will be the importance of passive design and minimal use of active systems in achieving energy efficiency. The Company has obtained an Energy Performance Certificate in order to comply with the regulations outlined in Section 19(1)(b) of the National Energy Act of 1998.

Energy Efficiency through Passive Design:

Passive design measures are influenced by the local climate. Key strategies include:

- Orientation: Rooms facing north with overhangs for windows maximize warmth, while south-facing rooms remain cooler. East and west-facing rooms require protection against direct sunlight.
- Shading: Roof overhangs or shading devices on the north side allow lower winter sun and block high summer sun. Vertical protection is essential for east and west-facing windows.
- Landscaping: Evergreen trees block strong winds, while deciduous trees provide shade in summer and allow sunlight in winter.
- Windows: Properly sized and oriented windows allow natural light and winter sun, but excessive window area can impact desired indoor temperatures. Double glazing may help in some cases.
- Ventilation: Natural ventilation through windows and air bricks provides fresh air and cooling breezes. Adequate ventilation is crucial for occupant health.
- Passive Cooling: Orienting the building to utilize prevailing wind breezes and incorporating cross ventilation and the stack effect for hot air escape.
- Lighting: Maximizing natural light through windows and light wells reduces the need for artificial lighting.
- Building Materials: Heavy materials like concrete and brick absorb and release heat, helping to regulate temperatures.
- Surface Colors: Light-colored paints and materials on roofs and facades reflect solar radiation in summer.
- Insulation: Insulating roofs and walls maintains comfortable temperatures throughout the year.

Implementation:

Mangaung Metro can influence energy efficiency in buildings through three approaches:

- Development applications and approval: The Metro is responsible for assessing and approving development applications, ensuring compliance with energy efficiency and usage standards outlined in the National Building Regulations (NBR).
- Low-cost housing: The Metro must ensure that low-cost housing complies with energy efficiency measures, such as the use of standard ceilings.
- Municipal buildings: The Metro should prioritize energy efficiency in its own buildings and facilities, educating staff and political leaders on energy efficiency and allocating budgets for energy-saving measures. It can also set targets for new municipal buildings to achieve

green star ratings and explore grant funding options, such as the Energy Efficiency Demand Side Management (EEDSM) EEDSM program.

- Education and collaboration: The Metro should educate building owners and developers on the benefits of energy efficient buildings through campaigns and collaboration with the local building industry. They can also set conditions for sales of municipal land, requiring buildings to achieve Green Star ratings.

6.3 Sustainable Transport: Enhancing Efficiency and Sustainability in Transportation

Overview:

Transport plays a vital role in enabling trade, commerce, and social interaction. However, the current transport system in the Mangaung Metro heavily relies on fossil fuels and presents numerous negative impacts, such as congestion, air pollution, greenhouse gas emissions, and accidents. These issues not only impact the environment but also pose risks to energy security. To address these challenges, it is crucial to adopt sustainable transport approaches that promote efficiency, reduce emissions, and improve access to transportation.

Key Concepts:

Impacts of Transport on Sustainability:

The transport system has significant impacts on individuals and society, including economic, social, and environmental costs. These costs have been accepted to some extent due to the benefits provided by the transport system, but they need to be addressed for a sustainable future.

Emissions from Conventional Vehicles:

Motor vehicles, especially those using petroleum fuels, are major contributors to air pollution and greenhouse gas emissions. Vehicle size and type significantly influence emissions, highlighting the importance of promoting cleaner and more efficient transportation options.

Useful Transport Indicators:

Various indicators help quantify transport demand and evaluate energy consumption and emissions. These indicators include trips, vehicle kilometers, passenger kilometers, tonne kilometers, fuel consumption, energy intensity, CO_2 intensity, wells-to-wheels CO_2 intensity, and lifecycle CO_2 intensity. Analyzing these indicators allows for a better understanding of transport efficiency and its environmental impact.

Transport, Economy, and the Environment:

There is a direct relationship between trips and economic activity, as transportation enables trade and personal interactions. Balancing economic growth with sustainable transport is essential to mitigate congestion and address the environmental impacts associated with increased transport demand.

Urban Transport in Mangaung Metro:

In Mangaung Metro, there is a stark contrast in mode choice between income groups, with low-income commuters relying heavily on walking, public transport (Taxi & Bus Industry) and higher-income groups predominantly using private cars. Additionally, optimizing logistics and reducing emissions in corridor freight, particularly in the processing of food and petroleum fuels, presents opportunities for sustainability improvements.

Electromobility in Mangaung Metro:

Electromobility refers to vehicles powered by electric motors instead of internal combustion engines. Battery electric vehicles (BEVs), hybrid vehicles, and fuel-cell vehicles are examples of electromobility. BEVs, while having higher initial costs, offer lower operational and maintenance costs. However, the environmental benefits of BEVs depend on the emissions associated with the electricity supply chain. In South Africa, where coal power dominates, the emissions of electric vehicles should consider both vehicle and electricity production emissions.

6.4 Wastewater Biogas to Energy

Overview:

Wastewater Treatment Plants (WWTW) can produce renewable energy by converting organic matter in raw wastewater into biogas through a process called anaerobic digestion. This biogas, which is mainly methane, can be used to generate electricity, heat, and biofuels. By implementing biogas digesters and combined heat and power (CHP) plants at WWTW facilities, electricity can be generated on-site to power various operations, and excess heat can be utilized for heating or other purposes. The installation of these systems requires considerations such as refurbishing digesters, gas scrubbing, engine selection, transformer selection, and heat exchange systems.

Implementation:

WWTW biogas to energy projects can contribute significantly to the electricity needs of wastewater treatment facilities, reducing operational costs and improving sludge management. The viability of such projects depends on factors like the quantity and quality of sludge available, treatment processes employed, and potential income from electricity generation. Assessing feedstock availability and conducting detailed feasibility studies are crucial for determining project viability. Benefits of producing energy from biogas include cost savings, improved sludge management, the production of organic compost, reduced methane and CO_2 emissions, and promoting skills transfer and green economy development.

Plant treatment process, sludge management, and biogas digestion:

Different WWTW plants employ varying treatment processes, resulting in different quantities and qualities of sludge. Digesters are commonly used for sludge management, but many were not initially designed for biogas collection. Refurbishing digesters allows for biogas capture, which reduces the amount of sludge going to drying beds and improves its quality for composting. Future regulations may require improved sludge management practices.

Additional Organic Waste or "Co-digestion":

The Metro can consider adding additional organic waste, such as the organic fraction of Municipal Solid Waste or agricultural waste, to the digesters. Co-digestion can enhance biogas productivity and stability across seasons, but it requires a separate assessment of waste sources, pre-treatment requirements, and related infrastructure.

Project structure and development:

WWTW facilities consume significant electricity, mainly for pumping and aeration. Biogas plants can offset around 60% of the facility's electricity consumption, and with efficiency measures, this offset can reach 80%. On-site consumption of electricity is preferable, as it maximizes the utilization of generated power. Selling excess power to the private sector is complex and costly due to long-term commitments and wheeling arrangements. The heat produced by CHP units should be used on-site to increase biogas production and for sludge drying.

6.5 Waste to Energy: Municipal Landfill Waste Methane Gas to Energy Implementation

Overview:

Waste to Energy (WtE) technology involves generating electricity, gas, or heat from waste sources. This approach helps reduce waste going to landfills, closes the nutrient loop, and mitigates climate change by reducing methane emissions. While the ultimate goal is zero waste through waste reduction, reuse, recycling, and composting, WtE technologies can be utilized to manage waste effectively. The focus for municipalities is primarily on biogas digestion at landfill and wastewater treatment sites.

Landfill Gas:

Landfills release methane gas as organic waste decomposes. This gas can be captured, converted, and used as an energy source. Methane is a clean-burning fuel that can generate electricity or be used directly for heating purposes. Landfills are covered, and the gas is collected through wells and a blower/flare system. The collected gas can be flared for safety and environmental reasons, used for electricity generation, or upgraded for other applications such as vehicle fuel.

Implementation:

Waste-to-energy projects at landfill sites offer opportunities to reduce greenhouse gas emissions, improve air and groundwater quality, and enhance the management of landfill sites. They also provide economic benefits and job creation. Gas collection and flaring are the initial phases of the project, followed by the conversion of gas to electricity or direct use. Feasibility studies determine the most suitable use of the gas, such as electricity generation, direct thermal applications, cogeneration (combined heat and power), or alternative fuel production.

Benefits: Implementing landfill gas-to-energy projects offers several advantages:

- Significant reduction in greenhouse gas emissions by converting methane to less potent greenhouse gases and displacing fossil fuel energy generation.
- Improved site management by mitigating the impact of escaping gas on landfill operations.
- Enhanced groundwater quality through combined leachate collection and disposal.
- Improved local air quality, safety, and reduced odour for nearby communities.

- Economic stimulus and job creation through the design, construction, and operation of gas capture plants, involving engineers, construction firms, equipment vendors, utilities, and distributors.

7. GRID MODERNIZATION AND INFRASTRUCTURE

7.1 Smart Grids

Overview:

Smart grids are a crucial part of modern electricity distribution and are aligned with the concept of smart cities. They integrate the electrical grid with an information and communication technology (ICT) network to enable efficient electricity management. The International Energy Agency (IEA) published a roadmap in 2011 that defined the smart grid and its benefits.

Key Technical Aspects:

Traditional electricity grids have a unidirectional flow of power from large power stations to consumers, which can lead to wastage or power outages. Smart grids, on the other hand, allow for bi-directional flow and incorporate various renewable energy sources, such as wind and solar. They utilize advanced metering infrastructure (AMI), including smart meters, to gather real-time data on power supply and demand. Smart grids also employ storage systems like battery banks and electric cars for efficient energy management.

Smart Streetlights:

The concept of smart streetlights includes the monitoring and controlling public lighting in an effort to reduce energy consumption. The smart streetlight concept is the controlling of LED luminaires and solar powered public lights through a back-end system, remotely.

Smart Meters:

Smart meters are a type of electricity meter that records electricity consumption, allowing for accurate billing. They enable two-way communication between the utility and the customer, facilitating remote meter reading, outage detection, and improved energy monitoring. CENTLEC is currently in a process to start with the implementation of this project. Smart meters are part of the larger AMI infrastructure, which encompasses smart meters, communication networks, and data management systems.

Smart Grid and Smart Meter Policies:

In South Africa, the Smart Grid Initiative (SASGI) aims to create an economically evolved and technology-enabled electricity system. The implementation of smart grids and smart meters aligns with policy objectives outlined in the National Energy Act and the National Climate Change Response Policy White Paper. Government Regulation 773 mandates the rollout of smart metering to customers with a monthly consumption of 1,000 kWh and above.

8. ENERGY NETWORK MODELING

The company designs, analyzes, and simulates energy networks using Digsilent Software.

A technical working group has been established to design and implement a solution for the Solar Plant. A software simulation will also be of necessity for the project as the data is of a large amount. All energy projects shall be technologically feasible, economically viable and with adequate accuracy of costs.

In developing the model structure; CENTLEC considered the following,

- Research, collect and collate required data, including energy and economic data,
- Configure the database on which the calculations were done,
- Determine the primary planning assumptions and scenarios,
- Populate and refine the reference energy system; and
- Undertake the calculations and analyze the results.

The integrated energy and resource planning process considers physical, technical, resource and economic considerations. The modelling process cannot by itself account for matters pertaining to sociological effects, political imperatives, global changes etc.

9. RENEWABLE ENERGY INTEGRATION

9.1 Solar Photovoltaic (PV) Systems

Overview:

Solar PV systems directly convert sunlight into electricity using specially treated semiconductor materials. Multiple modules can be connected to form larger panels or arrays. The electricity generated is typically in the form of direct current (DC) and can be converted to alternating current (AC) using an inverter for compatibility with the existing electricity network. PV systems have minimal moving parts and require little maintenance, with a lifespan of over 30 years.

Usage:

Solar PV systems can be installed on roofs or as ground-mounted arrays for residential, commercial, and industrial buildings. They can also be used for outdoor applications such as security lighting, parking lot covers, and rural water pumping. PV systems can be grid-connected, feeding excess power into the local grid, or stand-alone with battery storage for off-grid usage.

Sunlight Requirements:

PV systems require unobstructed access to sunlight throughout the day to maximize energy output. Most parts of South Africa have ample sunshine, enabling high solar electricity generation.

System Scale:

Solar PV systems can range in size from a single panel charging a battery for lighting in a small rural house to large-scale power stations feeding hundreds of Megawatts into the national grid. The size depends on electricity demand, available roof space, funding, and energy requirements.

Implementation of SSEG:

Solar Photovoltaic Small-Scale Embedded Generation Systems SSEG refers to grid-connected solar PV systems within distribution networks. Municipal distributors have implemented processes to ensure safety and technical standards are met. SSEG systems are typically installed on building rooftops and utilize grid-tied inverters to convert solar power into synchronized AC power for distribution. Excess power is exported to the grid, and when needed, power is drawn from the grid. SSEG systems do not usually have battery backup and shut down during grid failures for safety reasons. The Metro can start to install these SSEG's on most of its buildings. This initiative is currently on the planning stage for CENTLEC's buildings and should be implemented before the end of the next financial year.

Stand-alone Systems:

Stand-alone solar PV systems operate independently from the grid and require battery storage for electricity usage during periods of low solar power generation.

Trends:

Solar PV prices have been decreasing, making PV power cost-competitive globally. In South Africa, accelerated installations of SSEG systems have occurred due to declining PV prices, ample solar radiation, increasing grid power prices, and load shedding. Some installations have been done without official approval, highlighting the need for streamlined procedures for grid connection.

9.2 Proposed Solar Farms

A solar farm, also known as a photovoltaic (PV) farm or solar power plant, is a large-scale installation that utilizes solar panels to convert sunlight into electricity. These farms consist of numerous solar panels arranged in arrays, which capture solar energy and convert it directly into usable electrical power. Solar farms are an environmentally friendly and renewable energy solution that helps reduce reliance on fossil fuels.

Advantages of Solar Farms:

- **Renewable Energy:** Solar farms harness clean and renewable energy from the sun, reducing greenhouse gas emissions and combating climate change.
- **Scalability:** Solar farms can be scaled up or down based on energy demand, allowing for flexible and adaptable power generation.
- **Cost-Effective:** Over time, the costs associated with solar panels and their installation have decreased, making solar farms a cost-effective long-term energy solution.
- **Low Maintenance:** Solar panels have no moving parts and require minimal maintenance once installed, resulting in lower operational costs.
- **Community Benefits:** Solar farms can provide economic opportunities and local job creation during construction and operation phases, contributing to regional development.

The sites which have been identified as potential Solar Farms for the municipality. This is to strengthen the electrical grid whilst achieving the goal of providing clean energy to the CENTLEC area of supply.

The following sites that have been identified for feasibility study for the construction of the solar farms:

- RE of farm Bloemdustria
- Portion 2 of farm Rockland 684, Bloemfontein.
- RE of farm Uitvlugt 2336, Bloemfontein.
- On 500m buffer zone around NEWWTP on farm Sunnyside 2620
- Farm Bloemfontein 654 portion 321
- RE of farm Bloemfontein 654

9.3 Microgrids

Micro grids are strategic initiatives to optimize energy generation, distribution, and consumption at a local or regional level. This initiative enhances energy resilience, reduces reliance on centralized grids, and integrates renewable energy sources efficiently. Microgrids are a solution to supplying green power where there are network challenges in the informal settlements, peri-urban and remote areas within the city. The solutions include improved reliability of supply and also an alternative to avoid costly infrastructure.

Energy Sources

- **Renewable Energy**: Solar, wind, biomass, hydro, and geothermal sources.
- **Distributed Generation (DG)**: Small-scale power generation near demand centers.
- **Energy Storage**: Batteries, pumped hydro, hydrogen storage for grid stability.
- **Backup Systems**: Diesel generators or fuel cells for emergency support.

Microgrid Infrastructure

- **Smart Grid Technologies**: IoT sensors, AI-based demand forecasting, smart meters.
- **Grid Interconnection**: Ability to operate in **island mode** (independent) or **grid-tied mode** (connected to the main grid).
- **Load Management**: Demand response programs to optimize energy use.

10. Electric Vehicle (EV) Charging Stations

CENTLEC has embarked on exploring ingenuities such as charging the stations for electric vehicles. The rise in production of hybrid and fully electric vehicles is one of the other driving forces behind the need for transition from non-renewable energy sources to renewable sources. These electric vehicles operate on rechargeable batteries so the necessity for strategically positioned charging stations should be incorporated into the electrical and road infrastructure of the municipality.

As the local authority for electricity distribution in Mangaung, CENTLEC has a deliberate intention to acquire electric vehicles to reduce its own carbon footprint. These vehicles will require readily accessible charging stations to enable the electric vehicles to recharge as and when necessary, in the pursuit of delivering satisfactory electrical services to communities in Mangaung. The charging stations should be positioned in locations which will be convenient for all electric vehicle users who are travelling within the municipality.

As a result, CENTLEC has placed itself in a position to accommodate the required additional demand load for the Electric Vehicle Charging Stations on 400 V (Low Voltage) up to 1000 kVA as well as Electric Vehicle Charging Stations on 11kV (Medium Voltage) where the demand is greater than 1000kVA. The electricity tariffs for the charging stations should be competitive whilst enabling the required expansion of the charging stations footprint across the municipality.

Below is a list of proposed positions within the municipality:

- CENTLEC (SOC) Ltd premises at Rhodes Ave, Oranjesig, Bloemfontein.
- Kempston Truckstop, Ferreira, Bloemfontein
- Dewetsdorp Road, Bloemside, Bloemfontein
- Main Road, Mandela View, Bloemfontein.
- Orange Street, CENTLEC (SOC) Ltd premises Botshabelo.
- Reahola Shopping Centre, Botshabelo.
- Van Riebeeck Street, Thaba Nchu.
- Voortrekker Street, Dewetsdorp.
- De Beer Street, Wepener.
- Marthinus Street, Van Stadensrus.
- Soutpan

11. POLICY AND REGULATION

The role of urban and local management in sustainable energy development and climate change mitigation is becoming increasingly important. The Metro has the power and responsibility to implement policies and regulations that promote sustainable energy practices and climate change mitigation. It can do this by setting targets for greenhouse gas emissions reduction, developing climate change strategies, and institutionalizing climate change mitigation responsibilities within the municipality. The Metro can also lead by example by implementing energy efficiency and renewable energy projects in its own operations and influencing the broader community to adopt sustainable energy practices.

Constitutionally, the Metro is mandated to provide democratic and accountable government, promote social and economic development, and ensure a safe and healthy environment. It has legislative and executive authority over areas such as air pollution, amenities and facilities, building regulations, electricity and gas reticulation, municipal planning, municipal public works, municipal roads, traffic and parking, refuse removal, and water and wastewater treatment. It has the power to create by-laws, regulate land use and development, and enforce building regulations related to energy efficiency and renewable energy installations.

The Metro face barriers such as unfunded mandates and the difficulty of institutionalizing energy issues, but they also have opportunities to attract funding, save energy costs, promote local economic development, and create innovative developmental approaches. The implementation of sustainable energy and climate change mitigation measures can be integrated into municipal planning processes, regulatory responsibilities, service delivery & budget implementation plan (SDBIP), and communication efforts. By utilizing its powers and functions, it can contribute significantly to sustainable energy development and climate change mitigation within its jurisdictions.

In summary:

Review existing policies and regulations related to energy in the Mangaung Metro Municipality.

Develop new policies to support renewable energy deployment, energy efficiency, and sustainable practices. Establish building codes and standards that promote energy-efficient construction, retrofitting, and renewable energy integration. Collaborate with regional, national, or international bodies to align energy policies and leverage funding opportunities.

12. IMPLEMENTATION

Financing and Investment:

- Identify funding sources, such as government grants, public-private partnerships, and international funding programs, to support energy projects in the Mangaung Metro Area.
- Develop financial mechanisms to facilitate investments in renewable energy and energy efficiency projects.
- Engage with private sector stakeholders, including energy companies and financial institutions, to attract investments and leverage expertise.

Monitoring and Evaluation:

- Develop metrics and indicators to track progress towards energy goals in Mangaung Metro, such as renewable energy capacity installed, energy savings achieved and emission reductions.
- Establish a monitoring and evaluation framework to assess the effectiveness of implemented measures and identify areas for improvement.
- Regularly review and update the energy plan based on new technologies, data, and feedback from stakeholders

Implementation Timelines

The initiatives were consolidated and outlined in Table 7 below.

Table 7: Implementation Timelines

Initiative	Milestones	Timelines
Secure Supply (Energy Mix Solutions, microgrids, Solar PV Farms, Energy Storage)	Requirements and Options	2024/25 – 2026/27 FY
	Business Case & Feasibility	
	Stakeholder Engagement	
	Contracting & Policies	
Secure Revenue (Smart Grids)	Understand landscape and options	2024/25 – 2026/27 FY
	Feasibility Study and Business Case	
	Stakeholder Engagement	
	Execution	
EV Charging Stations	Master Plan	2024/25 – 2025/26 FY
	Stakeholder Engagement	
	Contracting & Policies	

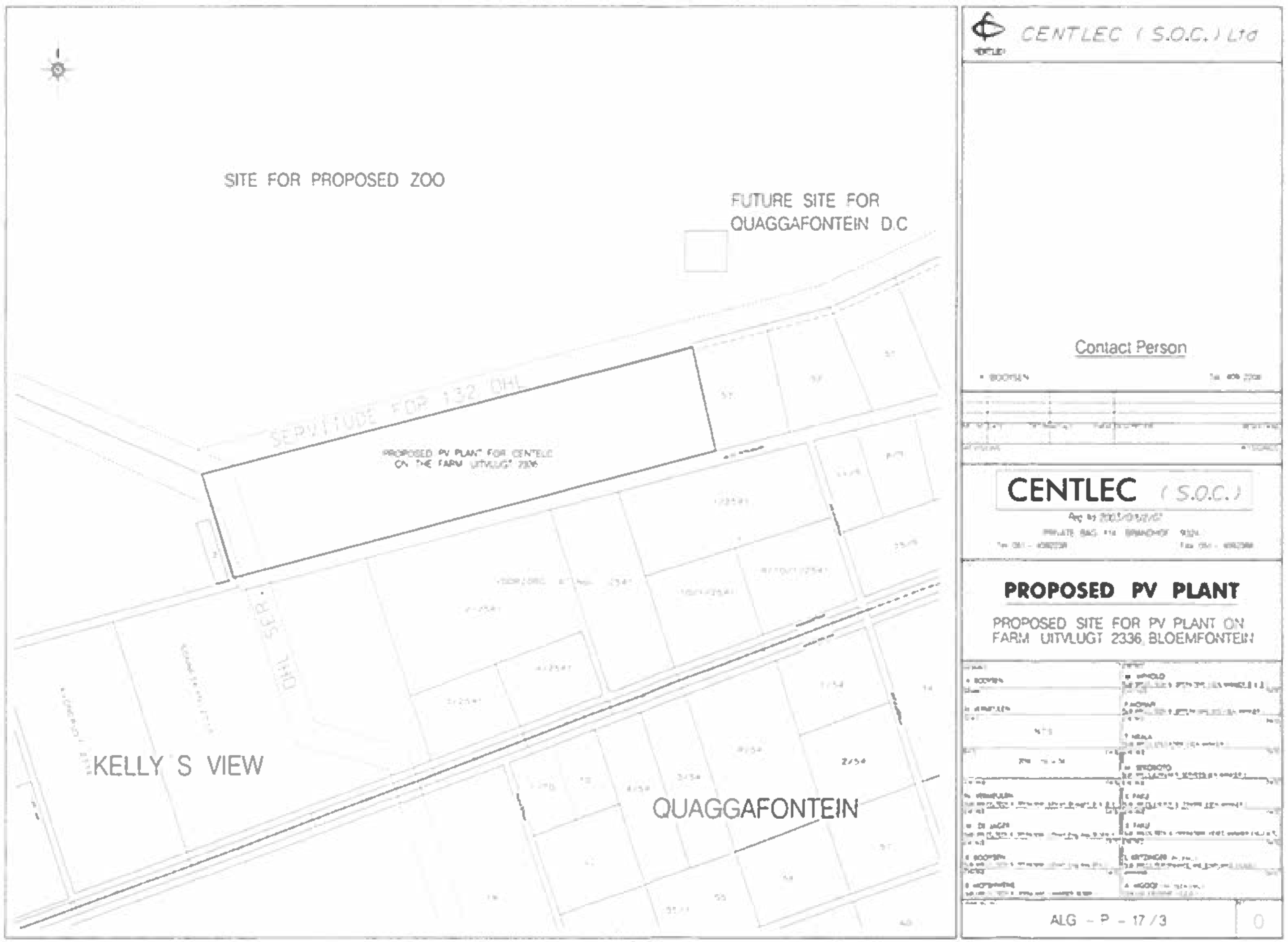
13. CONCLUSION

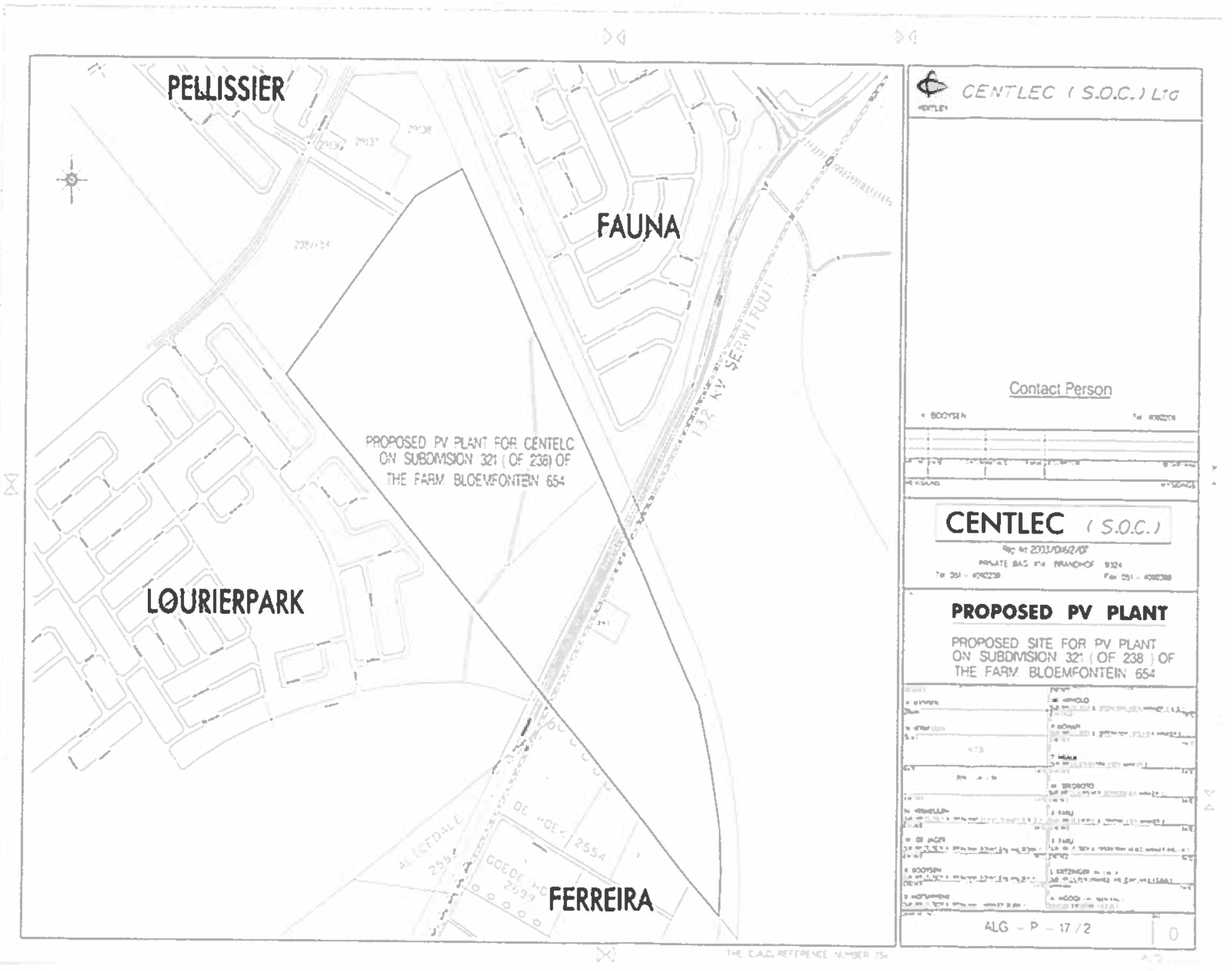
This Plan is aimed to serve as a guiding document for the company to roll out its approved strategy, considering the need for the energy to accommodate the everchanging landscape of energy and environmental conservations, and the genesis of alternative energy sources.

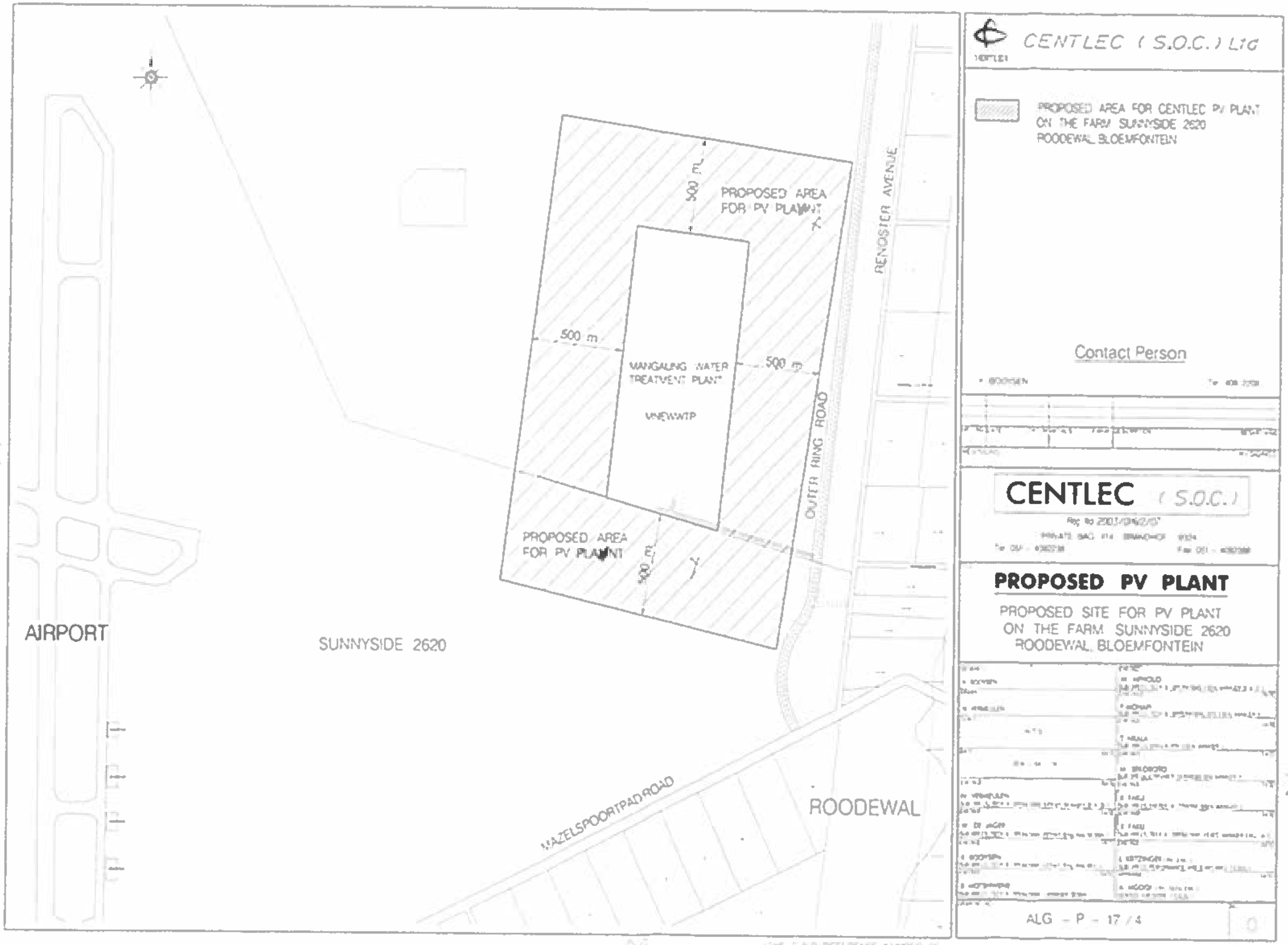
The need to ensure that the energy sector is sustainable has become important for the revenue security of the company. Therefore, the implementation of the outlined initiatives in the approved CENTLEC Strategy is imperative and shall become the focus point of company.

MS Sekoboto
CHIEF EXECUTIVE OFFICER
CENTLEC (SOC) LTD

14. ANNEXURE A - Proposed PV Plant drawings


CENTLEC (S.O.C.) Ltd
Contact Person
CENTLEC (S.O.C.)
PROPOSED PV PLANT
PROPOSED SITE FOR PV PLANT ON
FARM UITVLUGT 2336 BLOEMFONTEIN
ALG - P - 17 / 3
SITE FOR PROPOSED ZOO
FUTURE SITE FOR
QUAGGAFONTEIN D.C
SERVITUDE FOR 132 OHL
PROPOSED PV PLANT FOR CENTLEC
ON THE FARM UITVLUGT 2336
OHL SER.
KELLY'S VIEW
QUAGGAFONTEIN


PELLISSIER
FAUNA
LOURIERPARK
FERREIRA
PROPOSED PV PLANT FOR CENTELC ON SUBDIVISION 321 (OF 238) OF THE FARM BLOEMFONTEIN 654
132 KV SERWITUUT
CENTLEC (S.O.C.) Ltd
Contact Person
CENTLEC (S.O.C.)
PROPOSED PV PLANT
PROPOSED SITE FOR PV PLANT ON SUBDIVISION 321 (OF 238) OF THE FARM BLOEMFONTEIN 654
ALG - P - 17 / 2


CENTLEC (S.O.C.) Ltd
PROPOSED AREA FOR CENTLEC PV PLANT ON THE FARM SUNNYSIDE 2620 ROODEWAL BLOEMFONTEIN
Contact Person
CENTLEC (S.O.C.)
PROPOSED PV PLANT
PROPOSED SITE FOR PV PLANT ON THE FARM SUNNYSIDE 2620 ROODEWAL, BLOEMFONTEIN
ALG - P - 17 / 4
PROPOSED AREA FOR PV PLANT
MANGAUNG WATER TREATMENT PLANT
NEWWTP
500 m
RENOSTER AVENUE
OUTER RING ROAD
AIRPORT
SUNNYSIDE 2620
ROODEWAL
MAZELSPOORTPAD ROAD