Gauteng Department of Economic Development (GDED)

SME Green Support Incentive Program

ENERGY CONSUMPTION ASSESSMENT FOR SWAGEFAST (PTY) LTD

09 MONUMENT DIENSPAD ST, OLIVANNA, KRUGERSDROP, GAUTENG

15 APRIL 2022

REPORT

Prepared for: **CSIR** National Cleaner Production Centre South Africa
CSIR Pretoria Campus
Pretoria

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Department:
Trade, Industry and Competition
REPUBLIC OF SOUTH AFRICA

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This report was prepared on behalf of the National Cleaner Production Centre South Africa by **CSIR Energy Supply and Demand Research Group**

I, Paseka Mabina in my capacity as the technical consultant hereby confirm that I have assessed **Swagefast (PTY) LTD** and have analysed and compiled this Energy Efficiency Assessment report, and I confirm that all the report findings are a representative reflection of the current operational status of **Swagefast (PTY) LTD.**

DOCUMENT CONTROL

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Nomenclature

CDD	Cooling Degree Days
CFL	Compact fluorescent lamp/light
CO_{2e}	Carbon dioxide equivalents
CP	Cleaner Production
Deg.C	Degrees Celsius
Hr	Hours
kL	Kilolitres
kVA	Kilovolt Amperes
kW	Kilowatts
kWp	Kilowatt Peak
kWh	Kilowatt-hours
LED	Light-emitting diode
NCPC-SA	National Cleaner Production Centre of South Africa
R	Rands
PV	Photo-voltaic
RECP	Resource Efficient and Cleaner Production
W	Watts

EXECUTIVE SUMMARY

The CSIR Energy Centre has completed the energy consumption assessment of Swagefast (Pty) Ltd, based at 09 Monument Dienspad Street, Olivanna, Krugersdorp in Gauteng Province.

The scope of the assessment covered energy consumption assessment for all sources used on-site and with a focus on solar PV generation options. Data contained in the assessment report has been used to draw conclusions on the state of energy consumption and recommendations made for renewable energy options on site.

A summary of the main energy and water recommendations made in the assessment report is presented in Table 1.

Table 1 Estimated Quantitative Energy Savings

No.	Energy saving opportunities	Projected Annual Savings			Investment	Payback	Priority Ranking
		Energy (kWh)	Cost (R/year)	CO2 emissions (tons)	(R)	(Years)	
Energy Saving Recommendations							
1	Replacing existing inefficient 12000BTU, 18000BTU, and 24000BTU aircons with equivalent inverter technology.	9712	17 967.20	9.07	120 000.00	6.68	High
2	Replacing existing inefficient incandescent bulbs with 5W LED lighting technology	1822	3 370.70	1.70	1 700.00	0.50	High
3	Replacing existing 150L electric water heaters with the equivalent 5 kW heat pumps, using the same tank.	4550	8 417.50	4.25	55 500.00	6.59	High
	Subtotal	**16 084**	**29 755.40**	**15.02**	**177 200.00**	**5.96**	
Alternate Energy Source Opportunity							
4	Installing grid-tied 8 kWp PV system on the rooftop	14 400	26 640.00	13.45	296 987.00	11.15	High
	Subtotal	**14 400**	**26 640.00**	**13.45**	**296 987.00**	**11.15**	
	Total	**30 484**	**56 395.40**	**28.47**	**474 187.00**	**8.4**	

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1. INTRODUCTION

Swagefast (Pty) Ltd is a small manufacturing business located in the Olivanna area of Krugersdrop in Gauteng Province. Swagefast is a leading supplier of complete Fastening Systems, including a range of Standard and Industrial fasteners, Bearings, Belting, Swagebolt Pins and Collars, installation equipment, and spare parts as well as specialised fasteners designed to customer specifications. These products are mainly sold in the local South African market and neighbouring countries. The company employs about 19 people working in a single 8-hour shift.

The factory consumes electricity supplied by Mogale City Local Municipality and has no other sources of energy.

This assessment report forms part of the Gauteng Department of Economic Development (GDED)'s SMMEs Green Support Incentive Program whose objectives are to assist SMMEs based in Gauteng to install alternative sources of energy to mitigate the high cost of energy and green their operations through reduced carbon emissions. This report presents the relevant findings from the site visit to the plant relating to energy usage and opportunities for energy performance improvements and renewable energy resources that can supplement grid power. The opportunities are evaluated for technical and financial feasibility. Investment cost estimates, energy and cost savings and simple payback periods are presented.

2. COMPANY INFORMATION

Table 2 Company Information

Assessment Type	Review of Energy Efficiency and Renewable Energy opportunities
Assessment Period	April 2022
Company Name	Swagefast (Pty) Ltd
Physical Address	09 Monument Dienspad Street, Olivanna, Krugersdorp, 1739, South Africa
Phone	+27 (0) 11 6684600
Trading Since (year)	1999
No. of Full time Employees	19
Industrial Processes	Iron and Steel
Company Contact Person:	

Name:	Mr Jay Rossouw
Designation:	Managing Director
Telephone: **Mobile:** **E-mail:**	+27 (0) 11 6684600 +27 (0) 73 1747663 jay@swagefast.com

3. PLANT PROFILE

Figure 1 shows the location of the Swagefast (Pty) Ltd factory according to Google Earth's Aerial View. The space occupied by the factory is clearly marked in the figure. The Swagefast factory building is approximately 971m^2 of floor space on two floors. The building houses a warehouse, factory, sales, car park, waste management area, and dispatch processes. The building has large flat roofing, which can be used to mount solar panels for renewable electricity generation. Since the business operates only during the day, a Solar PV system would be ideal and more practical to supplement the power supplied by the local municipality. The integrity of the roof to hold the weight of the panels will have to be investigated before installation.

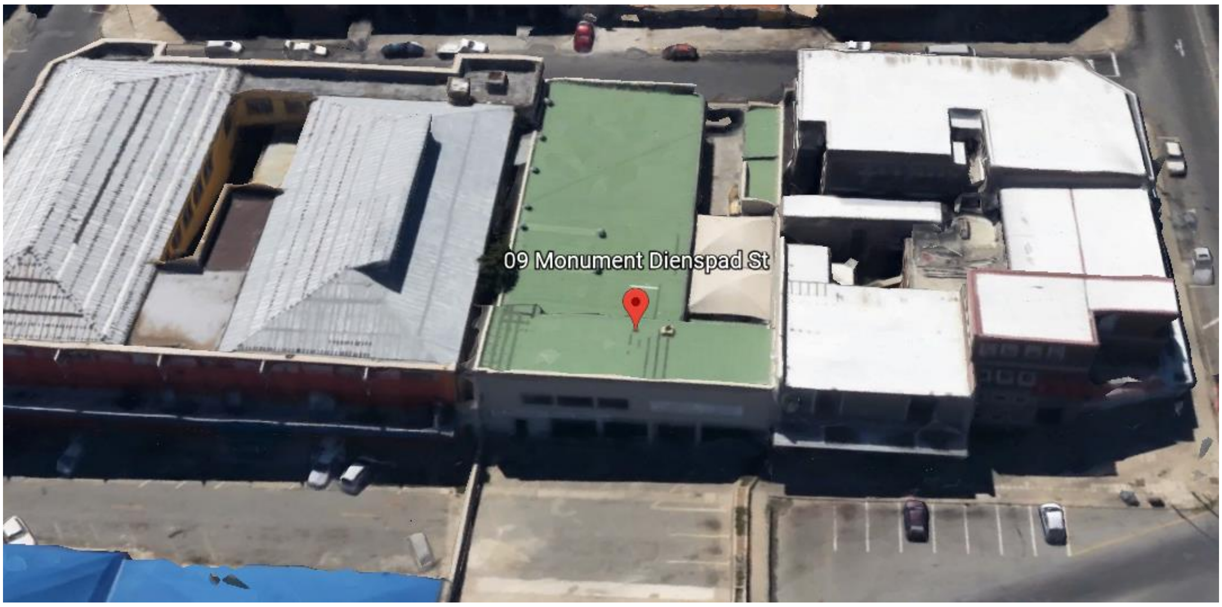

Figure 1 Location of Swagefast factory

3.1 Operational Processes

The facility has 6 main areas, namely, the administration, spare, workshop, store, delivery, and parking areas as shown in

Figure 3. The workshop consumes a large of the factory area. The plant has two main manufacturing processes, namely the development of the new products and the repair of the broken products as shown in Figure 3. The manufacturing process in this plant is quite simple

and it begins with the assembling of equipment according to the design and the size as requested by the client followed by the assembly of the electronic circuit then finally the bolt cutting material is mounted to create the final product. The finished product is subjected to quality checks to ensure compliance with the set quality standards.

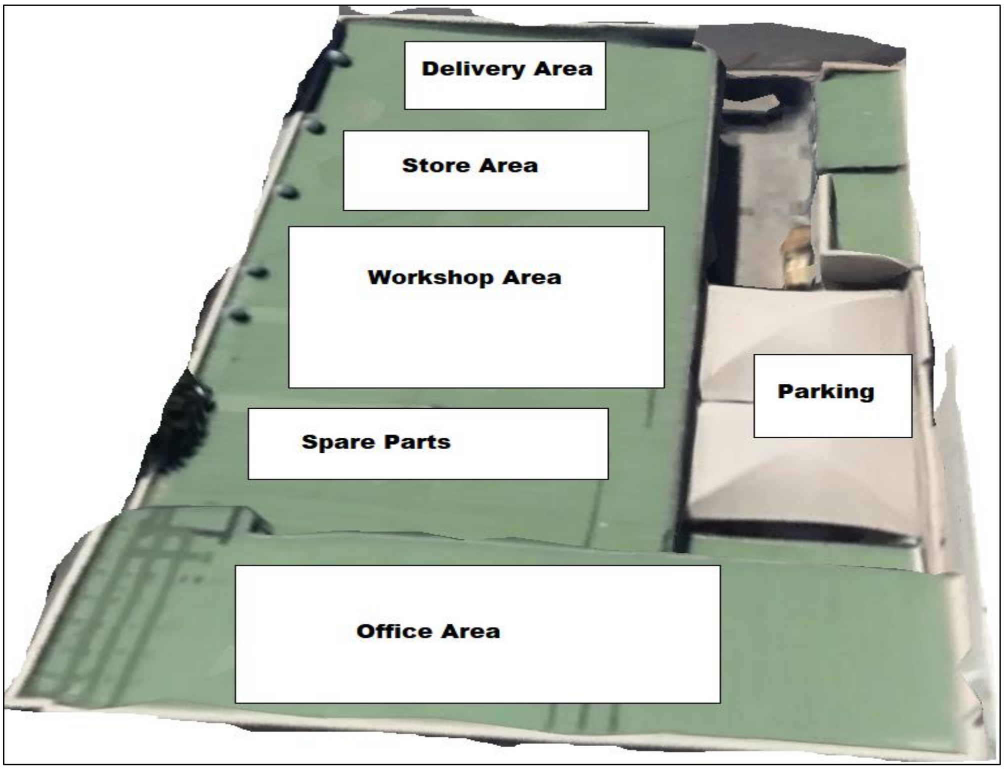

Figure 2 Factory Schematic

Figure 3 Broken Product for a repair

4. ENERGY CONSUMPTION ANALYSIS

In this section, energy consumption data is used to evaluate the environmental performance and operational efficiency of the business. Data collected about management activities can be used to monitor and control overall efficiency, set targets, and calculate monthly or yearly indicators. Data collected about operational activities can be used to evaluate the performance of a specific section of the business. Collection and evaluation of data will most likely reveal operational deficiencies. For instance, in a tourism establishment, high electricity consumption outside occupation times may indicate equipment in operation when not required.

4.1 Electricity

The monthly electricity consumption was captured from the billing information from the Mogale City Local Municipality. Swagefast is billed under the small commercial and industrial tariff structure. This tariff structure is for a connection with a conventional meter, energy consumed per thirty-day period since the previous meter reading is charged per month or part of a month. The monthly electricity consumption is shown in Table and Figure 4. The consumption data was estimated by the municipality for most of the months. The lowest consumption was in February, this could be due to a few numbers of days in the month. The facility has one prepaid electricity meter for the entire establishment. The unit price for electricity increased from August 2021 due to Eskom's tariff change. The company has an annual consumption of 16 283 kWh at a cost of R 45 325.26. It consumes an average of 1 357 kWh monthly at a unit cost of R1.75/kWh.

Table 3. Monthly Electricity Consumption

Months	kWh Consumption	Unit Price R/kWh	Fixed Charges	Total Cost
Mar 21	1 121	1.6145	R1 281.60	R 3 091.45
Apr 21	1 247	1.6145	R1 281.60	R 3 294.88
May 21	1 279	1.6145	R1 281.60	R 3 346.55
Jun 21	1 372	1.6145	R1 281.60	R 3 496.69
Jul 21	1 299	1.6145	R1 281.60	R 3 378.84
Aug 21	1 607	1.85	R1 468.80	R 4 441.75
Sep 21	1 372	1.85	R1 468.80	R 4 007.00
Oct 21	1 517	1.85	R1 468.80	R 4 275.25
Nov 21	1 469	1.85	R1 468.80	R 4 186.45
Dec 21	1 513	1.85	R1 468.80	R 4 267.85
Jan 22	1 499	1.85	R1 468.80	R 4 241.95
Feb 22	988	1.85	R1 468.80	R 3 296.60
AVERAGE	**1 357**	**1.75**	**R 1 390.80**	**R 3 777.11**
TOTAL	**16 283**		**R16 689.60**	**R 45 325.26**

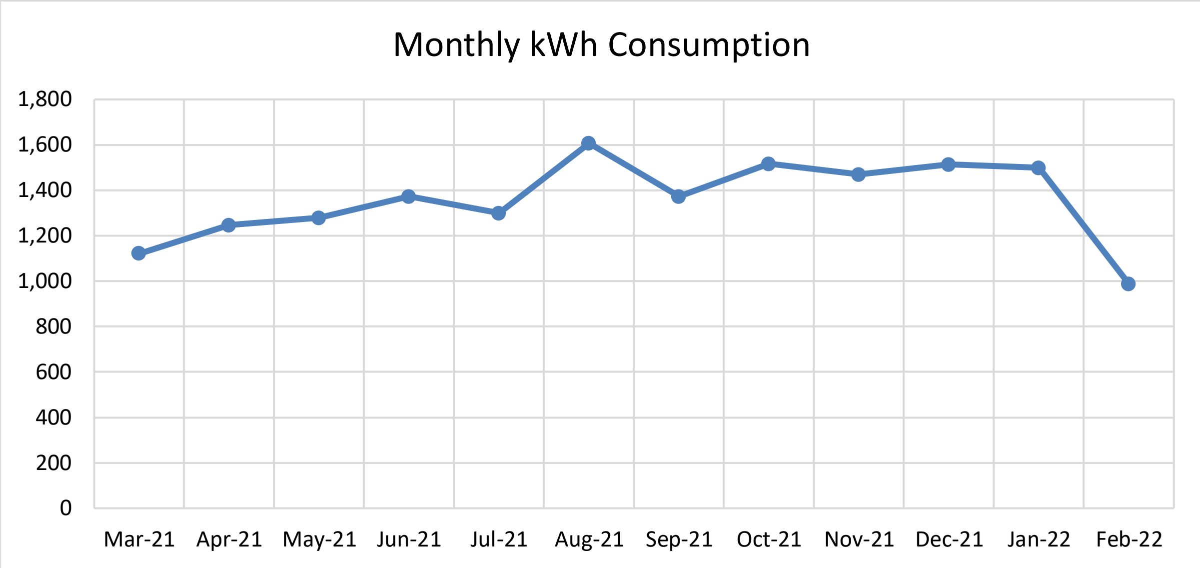

Figure 4 Monthly Electricity Consumption

Figure 5 below shows the relationship between production and energy consumption. There is no collation between the energy consumption and the production throughput, however, this will be discussed further in the next subsection.

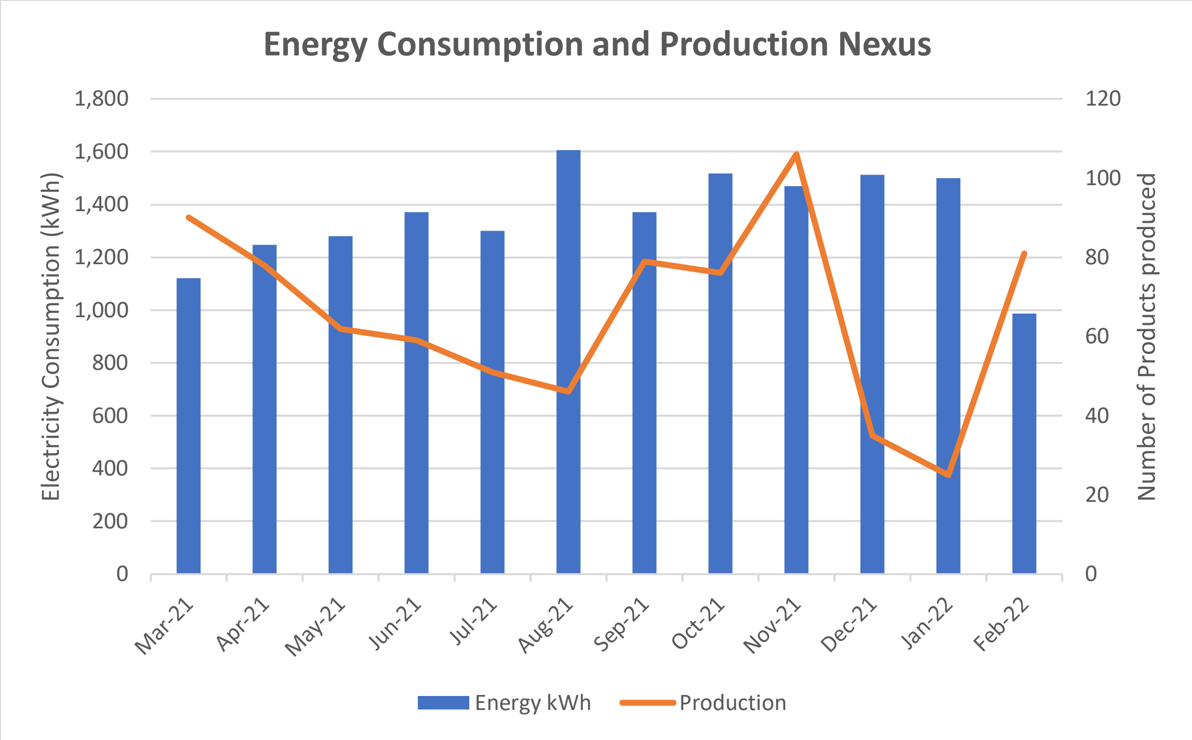

Figure 5 Relationship between energy consumption and production throughput

4.2 Baseline Establishment

This section provides an analysis of the energy consumption data at the factory in order to establish a relationship between consumption and the relevant variables (drivers) that influence this consumption. In an ideal world, the product output volumes would be the primary drivers of energy consumption. However, there is sometimes an added complexity where one or more other factors may influence energy consumption. In this case, the weather was identified as one of the energy drivers. Thus, the relevant variables used in this analysis are the production throughput, Heating Degree Days (HDD 18°C), and Cooling Degree Days (CDD°C) taken from www.degreedays.net, for Johannesburg B/g, ZA (28.00E, 26.15S). The baseline period used is from March 2021 to February 2022.

To do a regression analysis, all variables that can drive the monthly electricity consumption were identified. Three variables were identified:

- Production quantities
- Heating Degree Days (HDD)
- Cooling Degree Days (CDD)

Data was collected for the identified variables as displayed in Table 4.

Table 4 Energy consumption variables

Month	Energy [kWh]	Production	CDD	HDD
Mar 21	1 121	90	79.9	34.3
Apr 21	1 247	78	70.1	50
May 21	1 279	62	21.9	126.3
Jun 21	1 372	59	10.1	183.2
Jul 21	1 299	51	5.3	232.6
Aug 21	1 607	46	28.2	130.9
Sep 21	1 372	79	79.7	54.4
Oct 21	1 517	76	68.8	53.1
Nov 21	1 469	106	103.4	28.5
Dec 21	1 513	35	77.1	26.3
Jan 22	1 499	25	85.1	9.6
Feb 22	988	81	99	11.7

A multi-variable regression was done to determine a model to project energy consumption, shown in Table 5. Including all variables (Production values, HDD, CDD) yielded poor results with an R^2-value of 19% and poor P-values (P>10%) indicating no variables with sufficient influence.

Table 5 Multivariable Regression Analysis Summary of Results

Regression Statistics	
Multiple R	0.446216573
R Square	0.19910923
Adjusted R Square	-0.101224809
Standard Error	189.5781233
Observations	12

ANOVA

	df	*SS*	*MS*	*F*
Regression	3	71479.9979	23826.66597	0.662959253
Residual	8	287518.9188	35939.86485	
Total	11	358998.9167		

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	1524.374055	539.5468639	2.82528573	0.022311545
Production	-3.662161622	3.00385826	-1.219152605	0.257510537
CDD	0.833237116	6.456472268	0.129054549	0.900500088
HDD	0.286107057	2.909008246	0.098352096	0.924072368

Similarly, the regression model with 1 variable was also performed using the lowest P-values from Table namely the production values. The model yielded poor results as shown in Table

, the adjusted R^2 value is 19% indicating that the relationship between energy consumption and production throughput is poor. The adjusted R^2-value should be ideally above 75% to indicate an adequate fit. The model indicates that production throughput is not a significant variable.

Table 6. Single variable Regression Analysis Summary of Results

Regression Statistics	
Multiple R	0.443400551
R Square	0.196604048
Adjusted R Square	0.116264453
Standard Error	169.8288186
Observations	12

ANOVA

	df	*SS*	*MS*	*F*
Regression	1	70580.64041	70580.64041	2.447162549
Residual	10	288418.2763	28841.82763	
Total	11	358998.9167		

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	1579.472307	150.4781267	10.49635812	1.01786E-06
Production	-3.389172182	2.166517614	-1.564340931	0.148803971

4.3 Identification of Significant Energy Users

Significant energy users installed in the factory with their estimated capacities are presented in Table 7 below. Data to determine the installed capacities were obtained from the nameplates of the equipment. Normally, actual demand and energy use are lower because the equipment is not switched on all the time.

Table 7 Installed capacity & estimated energy usage

No	End-Use Equipment & location	Estimated Installed Capacity (kW)	Energy Usage (kWh/yr)	%
1	Lighting	0.33	16057	4%
2	HVAC	4.75	30675	8%
3	Office Equipment	3.41	38461	10%
4	Kitchen Equipment	26.51	34044	9%
5	Security Equipment	16.22	49290	13%
6	Workshop Equipment	62.25	220416	57%
	Total	**113.45**	**388942**	**100%**

The energy usage figures are based on the estimated time the machines are running. These considered operating schedules and demand factors[1]. Diversified HVAC capacities have been derived from design maximum capacities. The diversification has been achieved by factoring for heating and cooling degree days, 95% of mean monthly temperatures, and 95% of monthly temperature ranges. The climatic design conditions adopted are provided by www.degreedays.net. It is assumed that the air-conditioning runs from 08h00 to 17h00 each weekday only. In this factory, it is mainly the workshop equipment that uses more energy.

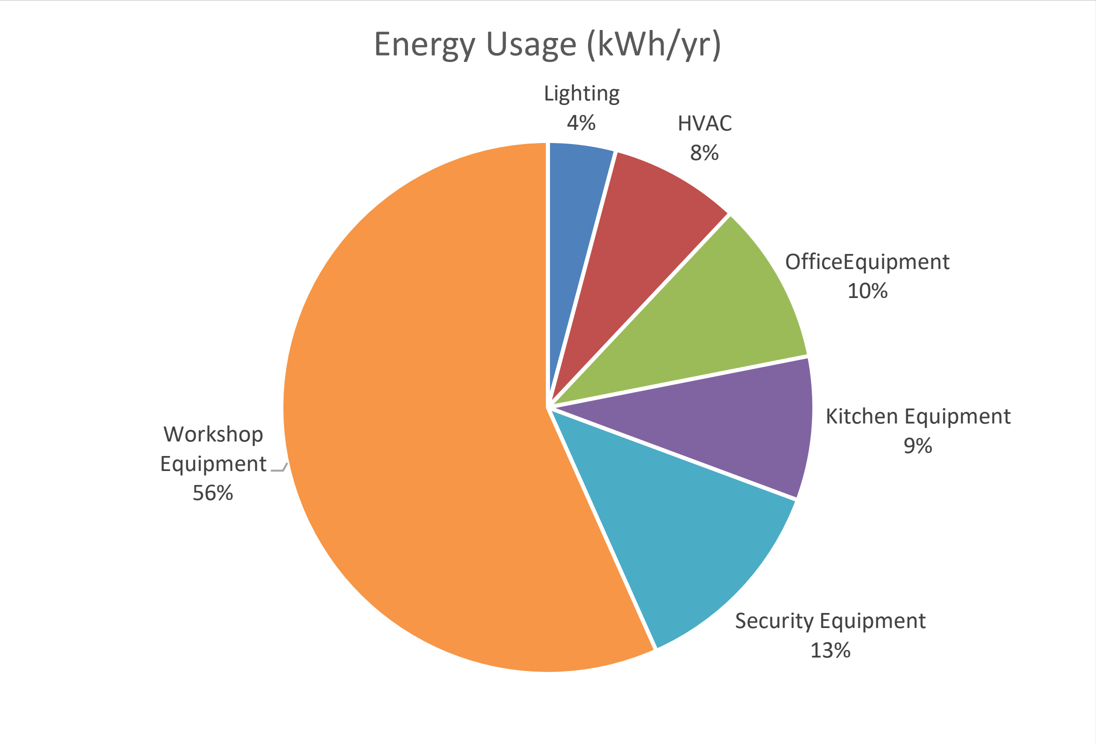

Figure 6 Significant Energy User Breakdown

Since the electricity cost is probably a big component of the operational costs of the business, any reduction would be beneficial in improving the business profitability. The management is aware of the operations or processes that consume more of the available resources. Most lights were retrofitted with energy efficient lighting technologies. The following would be the focus areas that should be examined:

- Identifying equipment which could be switched off when not required.
- Look at the current management protocols to identify where new procedures could be implemented with the staff to enforce switching off unnecessary equipment.

[1] Demand factor is the ratio of the sum of the maximum demand of a system to the total connected load on the system. Demand factor is always less than one

- Implement an Energy Management System and identify a staff member who would become the company's Energy Champion responsible for monitoring and managing energy consumption.

5. DETAILED ASSESSMENT FINDINGS AND RECOMMENDATIONS

5.1 Energy Savings Quick Wins

Based on the information provided and our observation of the factory operations, the following energy saving measures are recommended to improve energy performance. Most of the measures are no cost options while others are low-cost options with very short payback periods.

5.1.1 Operations and maintenance

- Improve operations and maintenance practices by regularly checking and maintaining equipment to ensure that it is functioning efficiently.
- Repair leaking taps and equipment. A dripping hot water tap can leak hundreds of litres per year. This will waste both water and energy.
- Install and maintain insulation around domestic hot water tanks and pipes to reduce energy losses to the surrounding environment.

5.1.2 Lighting

- Open or close blinds to make the best use of natural daylight to reduce lighting during daytime hours.
- Install occupancy sensors in rooms that are frequently unoccupied such as storage rooms, boardrooms, rest rooms, corridors, etc.

5.1.3 Plug Loads: Offices and Kitchen Equipment

- Activate sleep settings on all desk computers, printers, copiers, and other multifunctional office equipment so that they automatically enter a low-powered sleep mode when not in use.
- Sensitise and encourage employees to unplug office equipment not in use, especially over extended periods.

5.1.4 Heating and Cooling

- Regularly change or clean HVAC filters during peak cooling or heating seasons. Dirty filters cost more to use, overwork the equipment, and result in lower indoor air quality.

- Calibrate thermostats to ensure that their ambient temperature readings are correct, and adjust temperature set points for seasonal changes.
- Clean the evaporator and condenser coils on air-conditioners and chillers. Dirty coils can prevent heat transfer, keeping coils clean saves energy.
- Keep doors closed while running air conditioning systems HVAC to prevent wasteful loss of heated or cooled air.

5.1.5 Employee behaviour and education

- Educate staff members about the basic principles of energy management and empower them to reduce energy consumption and switch off equipment when not in use.
- A mechanism must be created for the employees to share their energy saving suggestions with management.
- Energy use information should be displayed on a regular basis in a high-traffic area or as part of the sustainability reporting. Seeing the data and any trends in energy use can inspire employees to contribute to sustained savings.

5.2 Heating Ventilation and Air-Conditioning (HVAC)

The current HVAC systems are listed in Table 8. The facility still uses the old HVAC technology.

Table 8 Summary of HVAC installations

Qty	Description	Capacity (W)
4	12000BTU non-Inverter	1095
5	18000BTU non-Inverter	1650
2	24000BTU non-Inverter	2000

Implementing the following recommendations will reduce the total energy consumption of the air conditioning units installed at the factory:

- Installing the energy efficient split units equipped with inverter technology and running on environmentally friendly refrigerant. This will potentially save about 40% energy compared to conventional units.

- Implement a maintenance programme to ensure that the AC system component like filters is intact and works efficiently. This conserves energy and extends equipment life. AC units should be serviced once per year.

- Reduce energy consumption by keeping windows and doors closed when AC units are in use.

- Check and ensure that AC units are switched off when the factory is closed.

Using efficient energy AC equipped with inverter technology, 40% of energy consumption can be saved.

Therefore,

- Energy Savings 9 712 kWh/y
- Cost Saving: R17 967/y
- Investment: R 120 000 (excluding labour)
- Payback: 7 years
- Carbon dioxide (CO_2) reduction 9 ton/y

5.3 Upgrade Lights to lower wattage LEDs

The current lights are a mix of LEDs and Incandescent bulbs. Table gives a summary of the lighting inventory. It is recommended that all incandescent lights be upgraded to LED lighting technology to reduce energy costs.

Table 9 Summary of lighting fixtures

Qty	Description	Watts/Fixture	Recommendation
Existing Fixtures			
37	LED Downlights	7	Not to be changed
180	LED Tube lights	18	Not to be changed
4	LED Spotlights	200	Not to be changed
12	Incandescent Lights	100	To be changed

It is recommended that the light upgrade be done inhouse as it is not complicated and if done at once, the impact will be greater. The energy savings and CO_2 emission reduction are given below:

- Energy reduction 1 822 kWh/y
- Energy cost reduction R3 371/y
- Investment R1 700
- Payback period 0.5 yrs
- Carbon dioxide (CO_2) reduction 1.7ton/yr

5.4 Water Heating: Heat Pump Option

The provision of hot water mainly for the kitchen and toilets is by electric geysers. There is an option for solar water heaters or heat pumps to be considered for energy savings. The solar water heating option has a requirement for additional plumbing due to the roof height and distance from application areas. Heat pumps are ideal for the water heating application, and it is recommended to install 3 x 3.2kW heat pumps to supply hot water for the change rooms.

The estimated savings are summarised below:

- Electrical energy savings 4,550kWh/y
- Electrical energy cost reduction R10,680/y
- Investment R55,500
- Payback period 5.2 years
- Carbon dioxide CO_2 reduction 4.7 ton/y

5.5 Install a Grid-Tied Solar PV System

Since Swagefast operates only during the day, renewable energy can be generated and be used to supply some, or all the energy required to operate the plant. The space that can be utilised to install solar PV panels system is shown in Figure 7. Based on the estimated 12-month energy consumption of 16 283 kWh calculated earlier, it is possible to run the entire plant on renewable energy. An analysis of the current electricity consumption shows that a PV System of approximately 8kWp size would best fit the consumption patterns, results shown in Table .

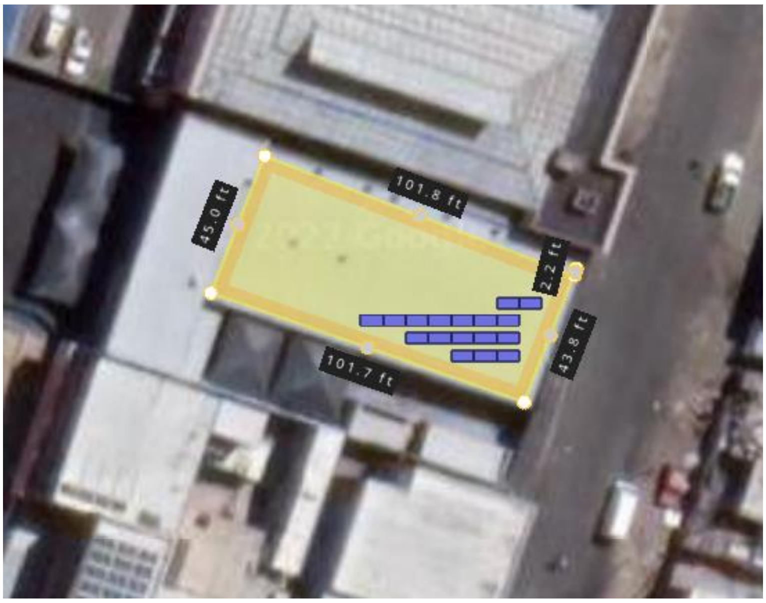

Figure 7 HelioScope Rooftop PV System Design

Table 10 Solar PV System Sizing

SWAGEFAST (PTY) LTD		
ITEM	**REPORT**	**RESULTS**
1	Current Tariff	Fix charge small commercial and industrial
2	Operating hours	24/7/365
3	Estimated Consumption split Day vs Night	60% Day; 40% Night
4	Average Monthly Consumption (kWh)	1 357
5	Average daytime consumption per Month (kWh)	814
6	Blended Tariff (R/kWh)	R1.75
7	Average Monthly Demand (kWh)	1 357
8	Average Monthly Demand Cost (R)	R3 777.11
9	Time of Maximum Demand	Dependent only on monthly kWh consumed
10	Is Tariff Correct & the Best Option?	YES
11	Estimated System Size (kWp)	6
12	Helioscope best fit system size (kWp)	8
13	System Size Comments	Roof mount system

The estimated energy savings and required investments are summarised in Table , based on an 8kW PV system. This is limited by the available north-facing roof.

Table 11 The cost-benefit of the PV system

Blended Rate From Tariff	R 1.75	/kWh
Total Blended Rate	**R 1.7519**	**/kWh**
Average Monthly Daytime consumption	950	kWh
Average Daily consumption	32	kWh
System Size (based on average 5hrs/day production)	**6**	**kWp**
Helioscope Design	8	kWp
Monthly production	1 200	kWh
Annual production	**14 400**	**kWh**
Percentage savings of daytime (kWh) consumption	126.34%	
Value of annual PV production	R 26 640.00	
Average annual (kWh) consumption cost from bill	R 3 777.11	
Average annual total bill	R 45 325.26	
Percentage Savings on Total Bill	**58.78%**	

- Energy savings (alternative energy) 14 400 kWh/y
- Energy cost savings R26 640/y
- Investment cost R296 987
- Payback period 11 years
- Carbon dioxide (CO_2) reduction 14 ton/y

6. IMPLEMENTATION PLAN

No.	Energy saving opportunities	Projected Annual Savings			Investment	Payback	Priority Ranking
		Energy	Cost	CO2 emissions	(R)	(Years)	
		(kWh)	(R/year)	(tons)			
Energy Saving Recommendations							
1	Replacing existing inefficient 12000BTU, 18000BTU, and 24000BTU aircons with equivalent inverter technology.	9712	17 967.20	9.07	120 000.00	6.68	High
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	Total	**30 484**	**56 395.40**	**28.47**	**474 187.00**	**8.4**	

7. CONCLUSION

The general conclusion is that there are energy saving opportunities within Swagefast (Pty) Ltd operations that can reduce energy savings and carbon emissions if implemented. Since Swagefast operates only during the day, renewable energy can be generated and be used to supply some, or all the energy required to operate the plant. Based on the estimated 12-month energy consumption of 16 283 kWh calculated earlier. An estimated 16 084 kWh reduction in electrical energy usage and R 29 755.40 per annum can be achieved through energy efficiency measures. It is possible to run the entire plant on renewable energy, considering that about 14 400 kWh/y energy can be generated from the installation of solar PV using the available roof space. The investment required is estimated at around R296 987 with a payback period of about 8.4 years. This is a good opportunity for the company since electricity is the only energy source consumed on site.