Gauteng Department of Economic Development (GDED)

SME Green Support Incentive Program

ENERGY CONSUMPTION ASSESSMENT FOR ECO CARE

176 Vanadium Street, Zone 15 Industrial Park,Ga-Rankuwa, 0208

10 May 2022

REPORT

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

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

This project report is to remain confidential between the NCPC-SA/CSIR and Unconventional Waste Solutions and may not be revealed in any way to a third party without the prior written permission of the NCPC-SA/CSIR.

the dtic
Department:
Trade, Industry and Competition
REPUBLIC OF SOUTH AFRICA

ACKNOWLEDGEMENTS

This Energy Efficient Assessment (EEA) Report was adopted from the Resource Efficiency Report prepared on behalf of the National Cleaner Production Centre of South Africa by **NCPC Energy Team**.

DOCUMENT CONTROL

Degree of Confidentiality:	Client Confidential	
Title:	Energy Efficient Assessment of Eco Care.	
Author(s):	NCPC Energy Team	
Project Leader:	Mashudu Madzivhandila	
Date of Issue:	10 May 2022	
No of Pages:	23	
Issuing Organisation: CSIR Energy Centre Pretoria	Telephone: (012) 841 7258	
Contract Name:	Energy Efficient Assessment of Eco Care	
Project Number:	ENCP 019	
Keywords:	Energy consumption, Renewable Energy, Energy Management	
Issue Number:	01	
Copy Number	01	
APPROVED BY:		
Responsibility	**Name**	**Signature**
Author	NCPC Energy Team	
Review (NCPC-SA)	Mashudu Madzivhandila	
RECEIVED BY:		
Responsibility	**Name**	**Signature**
NCPC-SA	Victor Manavhela	

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

An Energy Assessment was conducted at Eco Care based in Ga-Rankuwa, Pretoria. This was done to evaluate the company's operation by assessing how much energy they utilize on their site and assist in cost reduction of the consumed energy. The annual Electricity consumption per year is R115 134 with a 80 576 kWh consumption and the production data was not recorded.

Identified energy efficiency opportunities were identified as follows:

- An estimated 3% reduction in electrical energy usage through the installation of LED and 4 % of costs (2 895 kWh and R4 140 per annum) – excluding Solar PV
- Opportunity for approximately 20% of electrical energy to be sourced from an alternate energy source (saving of 16 000 kWh and R 23 000)
- Estimated Carbon Dioxide reduction of 19.77 tonnes identified
- Overall identified investment cost of R 226 000
- Overall Payback period is 10.6 years

A summary of the material to be purchased is contained below:

Table 1: Solar Panel and Lighting Raw Material

Solar Equipment	**Quantity**	**Unit**	**Rate**		**Amount**	
EE Lighting Fixture	50	Unit	100	ZAR	5 000	ZAR
Sunsynk Sun 12kW Three Phase LV Hybrid Inverter	20	Unit	2 938.93	ZAR	58 778.60	ZAR
Freedom Won Lite Home 10/8 LiFePO4 Battery N	1	Unit	47429.14	ZAR	47 429.14	ZAR
CANBUS Cable for Freedom Won and Sunsynk or Goodwe combination	1	Unit	58 652.22	ZAR	58 652.22	ZAR
Three Phase Earth-Neutral Bridge Box For Inverters Up To 12kWac	1	Unit	318.55	ZAR	318.55	ZAR
70mm2 Battery Cable (H01N2-D) 2m – PAIR	1	Unit	1 765.79	ZAR	1 765.79	ZAR
600V Protection Box 2 Inputs 2 Outputs 16A Isolator Type I_II SPD	1	Unit	948.78	ZAR	948.78	ZAR
4mm2 single-core DC cable 50m - Black & Red	1	Unit	6 554.17	ZAR	6 554.17	ZAR
MC4-Evo2 1500V DC Connector Twin Pack 0086/0087 (Kit 1)	1	Unit	1 366.37	ZAR	1 366.37	ZAR
MC4 Pre terminated cable 2m (1 Pack)	10	Unit	164.82	ZAR	1 648.20	ZAR
KETO 1 BaCery Disconnector with 250A Fuses	4	Unit	138.05	ZAR	552.20	ZAR
10 Panel Mounting Kit - IBR Roof c/w earth plate clamp kit & profile splice	1	Unit	1 882.36	ZAR	1 882.36	ZAR
70mm2 by M10 Ring Terminal Lug	2	Unit	4 942.72	ZAR	9 885.44	ZAR
BaCery Hazard label Li-ion (230mm * 90mm)	1	Unit	468.79	ZAR	468.79	ZAR

BaCery Hazard label Li-ion (230mm * 90mm)	6	Unit	39.28	ZAR	235.68	ZAR
PV on Roof and Hazard Labels Pack	1	Unit	42.86	ZAR	42.86	ZAR
	1	Unit	135.51		135.51	ZAR
Delivery to Garankuwa	1	Unit	1527.48	ZAR	1527.48	ZAR
				Subtotal	**197 192.14**	**ZAR**
				Vat: 15%	**29 578.82**	**ZAR**
Total				**Total**	**226 020.96**	**ZAR**

TABLE OF CONTENTS

List of tables

List of figures

.

1. INTRODUCTION

Eco Care is an environmental services company in the Green Economy located in Ga-Rankuwa, Pretoria in Gauteng Province. The company's main business activities are environmental consultancy and waste management, and it includes coming up with alternative and innovative ways to tackle the waste disposal burden. They do that by diverting waste from overburdened landfill sites in our municipalities thus achieving social impact in communities by poverty eradication and green job creation. The waste is collected, packaged, and transported to the local South African market.

The company has five employees working 8 hours shift; The company uses electricity supplied by City of Tshwane Municipality and has no other sources of energy.

The Energy Assessment commenced on 10 May 2022 and a brief introduction meeting ensued with the establishment owner Ms Lerato Makube, followed by the assessment continuing for the rest of the day (on-site).

The assessment at Eco Care 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 instal alternative sources of energy to mitigate the high cost of energy and green their operations through reduced carbon emissions. The NCPC-SA is responsible for conducting the on-site assessment and the whole project life cycle at the Unconventional Waste Solution.

This project forms part of the National Cleaner Production Centre's Resource Efficiency and Cleaner Production Program.

1. COMPANY INFORMATION

Table 2:Company Information

Assessment Type	Review of Energy Efficiency and Renewable Energy opportunities
Assessment Period	May 2022
Company Name	Eco Care
Physical Address	176 Vanadium Street, Zone 15 Industrial Park,Ga-Rankuwa, 0208
Phone	082 424 5502
Trading Since (year)	2015
No. of Full time Employees	6
Industrial Processes	Waste Management
Company Contact Person:	
Name:	Lerato Makube
Designation:	CEO
Mobile: **E-mail:**	+27 82 424 5502 lerato@ecocare.africa

2. PLANT PROFILE

Eco Care (Pty) Ltd, as the name suggests, has abandoned the dump-and-burn conventional way of dealing with waste. Instead, they have joined the growing industry of repurposing waste into a driving force for positive social and environmental positive impact. The company is situated in the industrial zone of Germiston, not very far from residential areas, a strategic location to fulfil their purpose.

The company operates in a set of connected buildings, which include offices, warehouse, a storeroom, and a residential house. The buildings have different roof structures, which include two gable, some flat (with one a concrete slab) and one pyramid roof structure. Of this available roof surface, two buildings have gable roof structures (one much larger than the other) and one building has a pyramid roof structure.

Using the online PVWatts® Calculator, the total available roof surface can be estimated to be approximately 475 m2, with the potential system direct current (DC) generation capacity of 71.3 kW. The buildings are built with the orientation of about 45˚ west of north. The roof surfaces that can harvest most solar energy than others are those facing closest to the north. Such roof surfaces include the portions of the gable and pyramid roof structures as shown and marked by Figure 1b. These roof surfaces face at an azimuth angle of 315˚ with an approximate are of 80 m2 and a potential system direct current (DC) generation capacity of 12.1 kW.

Currently, the company get its electricity from the Municipality and they pay handsomely. Since the business operates only during the day, the following discussion in this report seeks to lower the electricity bill and investigate whether a grid tied PV system could be ideal and more practical to supplement power supplied by City Tshwane with a PV system.

1.1 Site Solar Energy Resources

Eco Care is in Gauteng. The Gauteng Global Irradiation will be used to determine the annual energy yields. The SMA Sunny Design website estimates Gauteng's global annual irradiation at 2046.98 kWh/m²year. The daily global irradiation for each month of the year is reflected in Figure 1 below.

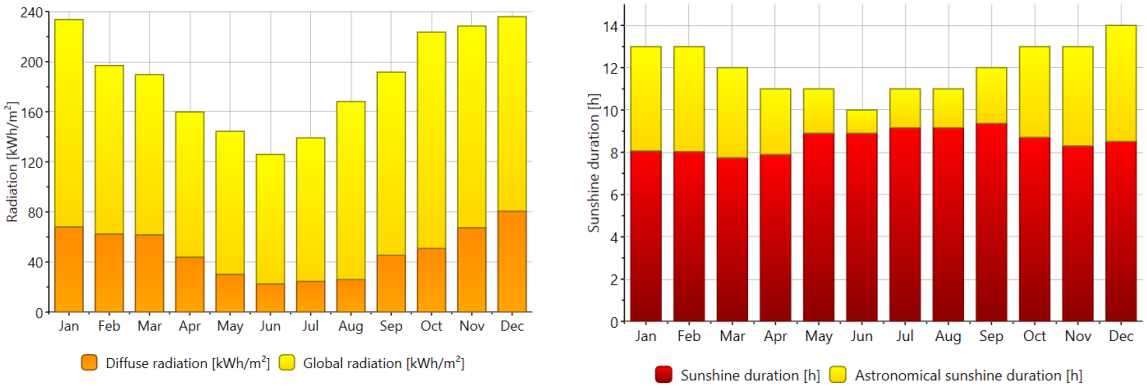


Figure 1:Global radiation data

The global irradiation data for Gauteng is shown above. The months with the lowest Irradiation data are June and July and the highest are November, December, and January. For the Unconventional waste site to be suitable for using solar energy as an alternative source of energy and for the PV system installations, the lowest solar radiation must be sufficient to generate enough energy for production.

2. PROJECT METHODOLOGY

Table 3:Project methodology

Step	Action Plan	Purpose and results
1	Plan and organise (walk through audit and informal Interview)	Resource planning, Organise instruments and time frame, Macro data collection, Familiarisation of process and plant activities
2	Conduct brief meetings with stakeholders	Building up cooperation, awareness creation and issuing a questionnaire
3	Primary data gathering, a Process flow diagram	Historical data analysis and baseline data collection.
4	Conduct detailed trials for different solar panels, inverters, and batteries	Trials on new products available on the market
5	Identification and development of potential value addition products	Conceive, develop, and refine ideas. Review previously suggested ideas and contact vendors for new/efficient technologies.
6	Cost-benefit Analysis	Assess technical feasibility, economic feasibility and prioritisation of the most promising projects. Prioritise by short, medium and long-term measures.
7	Reporting and Presentation to top management	Documentation and report presentation to top management
8	Implementation and follow-up	Assist and implement recommendation

3. PRODUCTION PROCESS FLOW CHART

The production process begins when they receive recyclables materials from their external suppliers. These materials come in a scattered form. The material is then inserted inside a balling machine where it is compressed to produce a large pallet. The reason of balling this material is to compact as much material as possible, making sure that the material is not filled with air. The baled material is then wrapped with a string or a shrink wrap and then stored and later transported to the customers for further processing.

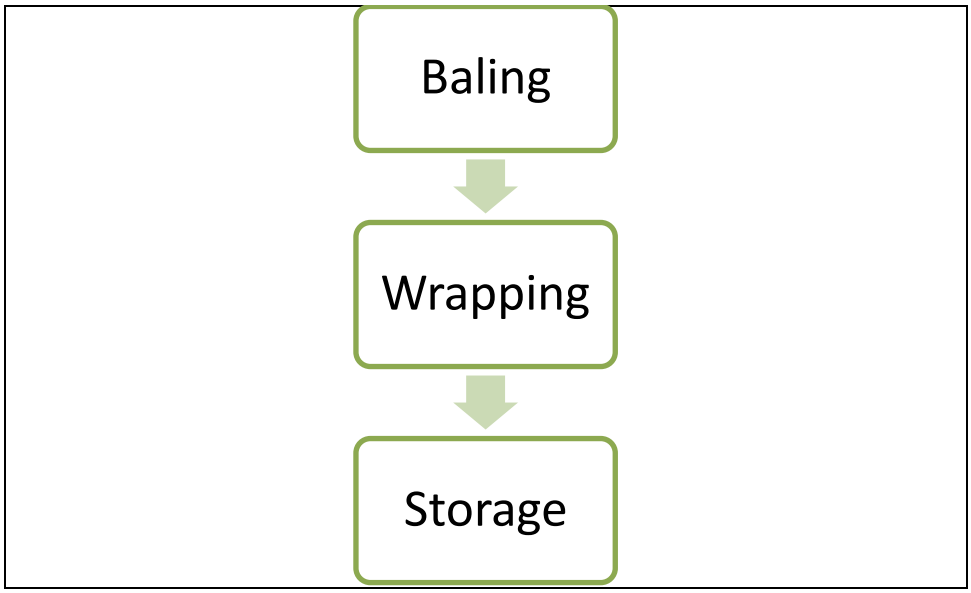


Figure 2: Process flow

4. ENERGY CONSUMPTION

Electricity consumption data was provided by the company. The data is a 12 months data. Unfortunately, there were no recordings of how much production is being done as the production is simply based on the amount of received recyclable materials and they don't account how much each baled product is done.

a. Electricity

The following table shows figures of how much electricity is being utilised on site. The electricity is also supported by the energy balance which highlights where their energy is going into in terms of consumption. The month where they utilized electricity the most would be the month of October as there were a pile up of recyclable materials that they receive from their clients and also the demand of baled materials was high. And, their consumption various from month to month because they are based on what they receive on site.

Table 4:Electricity consumption

Months	Electricity(kWh)	Cost/Month	Cost/kWh (Rands)
Jan-21	4,813	R 6,877.30	R 1.43
Feb-21	4,188	R 5,984.00	R 1.43
Mar-21	3,910	R 5,587.00	R 1.43
Apr-21	4,172	R 5,961.00	R 1.43
May-21	6,622	R 9,462.18	R 1.43
Jun-21	7,339	R 10,486.70	R 1.43
Jul-21	7,746	R 11,068.00	R 1.43
Aug-21	3,312	R 4,732.50	R 1.43
Sep-21	7,006	R 10,010.87	R 1.43
Oct-21	10,967	R 15,670.75	R 1.43
Nov-21	10,328	R 14,757.68	R 1.43
Dec-21	10,173	R 14,536.00	R 1.43
Total	**80,576.00**	**R 115,133.98**	
Average	**6,714.67**	**R 9,594.50**	

b. Baseline Establishment

A baseline could not be done because there are no production figures available.

c. Identification of Significant Energy Users

An energy balance was done on site accounting everything that utilises electricity on site. The total on the balance would tie up with the total from their electricity balance. It is purely based

on estimates and simply highlights where the electricity on site is going to. This aids in establishing the Significant energy users on the site.

Table 5 highlights the energy balance and identifies the significant energy users. The biggest energy users on the site are the balling machine and the weighbridge which marks the heart of the business. The machine operates daily for 8 hours a day, and it is the one equipment that enables the company to be sustained. The second user is the geyser which is on every day and is used by the staff after every shift. The third users would be the lighting systems for offices and the warehouse. The company uses the fluorescent lightings which ranges from 36W to 58W of consumption. The other equipment uses less energy as they have a very low utilization ration as per the energy balance.

Table 5: Installed capacity & estimated energy usage

Equipment	**Estimated kWh/year**	**%Energy Consumed**
Balling Machine	49,088	61%
Weighbridge	18,348.00	22.77%
Geyser	6,235.20	7.74%
Lighting	5,903.04	7%
Fridge	381	0.01%
Microwave	7.80	0.01%
Desktop	208.000	0.26%
Printer	156.000	0.19%
CCTV	249.60	0.31%
Total	**80,577**	**100%**

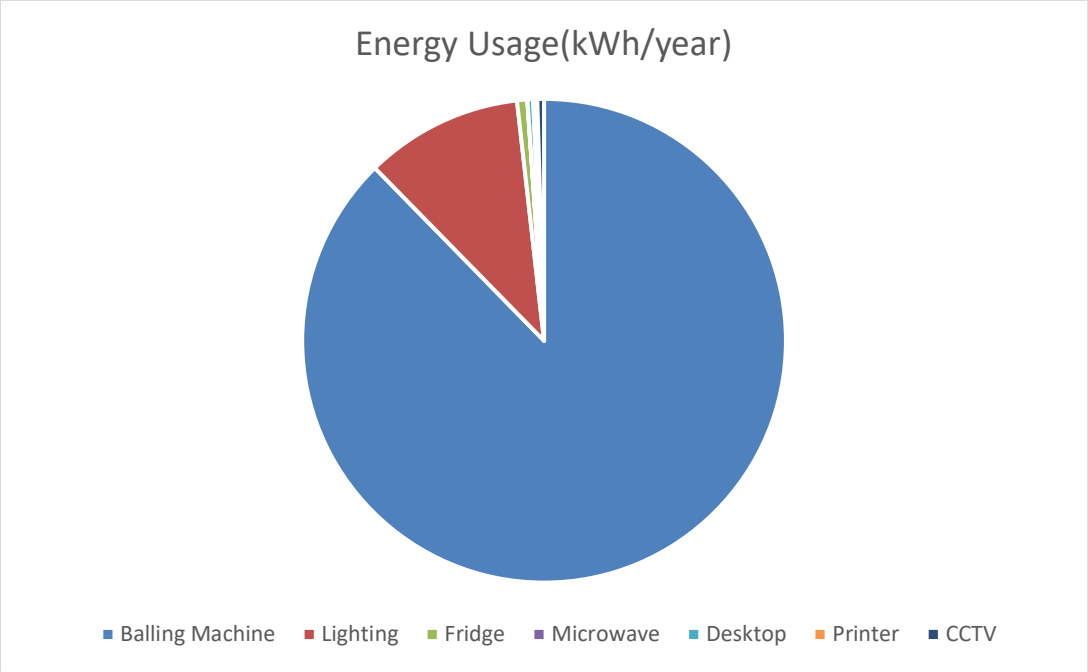


Figure 3: Significant Energy User Breakdown

5. DETAILED ASSESSMENT FINDINGS AND RECOMMENDATIONS

a. Installation of LED Lighting system

Rationale

Lighting is a significant component of electricity consumption in the residential and commercial sectors that in South Africa together consume around 50% of the company's electricity. The replacement of lights with highly energy efficient ones is one of the simplest and most cost-effective measures to reduce electricity consumption and related greenhouse gas emissions. The replacement of fluorescent lights with LED lights reduces the electricity consumption by around 50% to 70%.

Comment

The company currently uses the old fluorescent lightings that consumes 58W Based on the energy balance, the company uses 5790.72 kWh of energy per year for lighting.

Recommendations

Installation of LED Lighting system to the existing fluorescent fixtures.

Indicative Cost benefits

Total Electricity per year: 5790.72 kWh

Total Electricity saved per year: 2 895 kWh

Total Cost savings: R4 140

Investment Cost: R 5000

Payback period: 1 year

b. Installation of Solar PV

Rationale

Error! Reference source not found. shows the roof space that the company, Ecocare has, on which a solar system can be installed. The figure also shows the maximum solar system installation capacity.

Figure 4:The roof space of Ecocare and its maximum as well as the maximum solar system installation capacity

Potential Issues

The size of the space indicates the potential or the limitations it has for harvesting solar energy. The buildings have few sections that face north-west, which is the area that is recommended for PV installation is the north-west facing. The other face that has a potential is the north-east facing space. **Error! Reference source not found.** shows the recommended Installation capacity before sizing.

Indicative Cost Benefit

The company operates from 08h00 to 17h00, and while this places them in a position to exploit solar energy to generate electricity for their plant operations, the fact that the roof sections are not facing true north, the number or sun hours are reduced. The building consumes an average of 1322.08 kWh of electricity a month.

Based on the estimated 12-month energy consumption of 15941.8 kWh calculated earlier, as well as the projected 1328.48 kWh monthly and the 8.8 kWh daily consumption, it is possible to run the entire plant on renewable energy, considering that about 9 kWh/day of energy and much more, can be supplied from the available roof space.

The following table shows the sizing of the PV system that is recommended for installation on the large roof of Eco Care. While company operates from 8h00 to 17h00, and it can be able to operate with no need for battery bank, the recommendation is a hybrid system to cater for the never-ending load shedding.

Table 6:Solar PV System Sizing and the Corresponding Equipment

Item and Information	Amount	Units
Unconventional Waste Annual Consumption:	15941.8	kWh

Solar Panel name		Canadian Solar:mono	
Solar Panel peak wattage		455	W
Performance Factor		75%	
Number of sun hours		5.63	hours
Daily Energy		1921.238	Wh/day
Daily Energy		1.921238	kWh/day
Annual Energy		701.2517	kWh/year
Estimated Roof space available (rounded figure)		121	m^2
Estimated Roof space required (rounded figure)			m^2
Array Average energy annual Generation		16830.04	kWh/year
Average energy monthly Consumption		1328.48	kWh/month
Average energy daily Consumption		44.28	kWh/day
kW Peak array (kWp)		7.87	kWh/hr
kW Peak array (Wp)		7865.5	Wh/hr
Number of panels		24	panels
Solar Panel Dimensions	length	1050	mm
	height	2110	mm
	Thickness	35	mm
	Area (mm^2)	2215500	mm^2
	Area (m^2)	2.2155	m^2
Sizing an Inverter		12	kW
Battery		7.5	kW
Duration		2.5	hrs
Battery Energy /hour		1.845115	kW
Battery Energy over 2 hours		4.612788	kW

The battery is included to the solar system to enable it to continue supporting production, albeit at a smaller scale.

Figure 7 shows the Canadian Solar panel that is selected for installation.

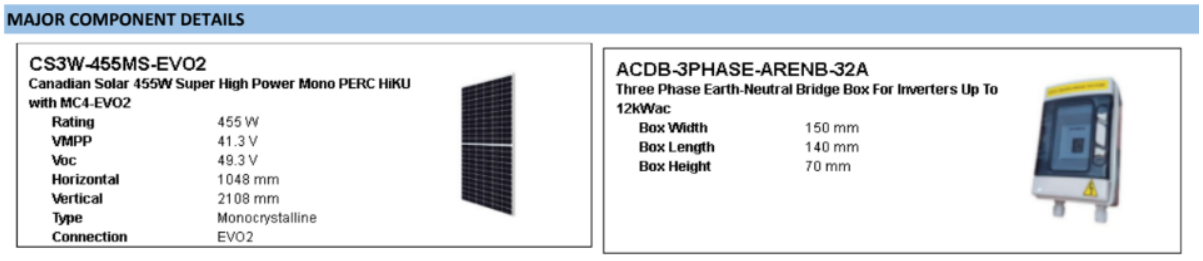


Figure 5. The proposed Canadianc Solar Module, and the three-phase Earth-Neutral Bridge Box for Inverters

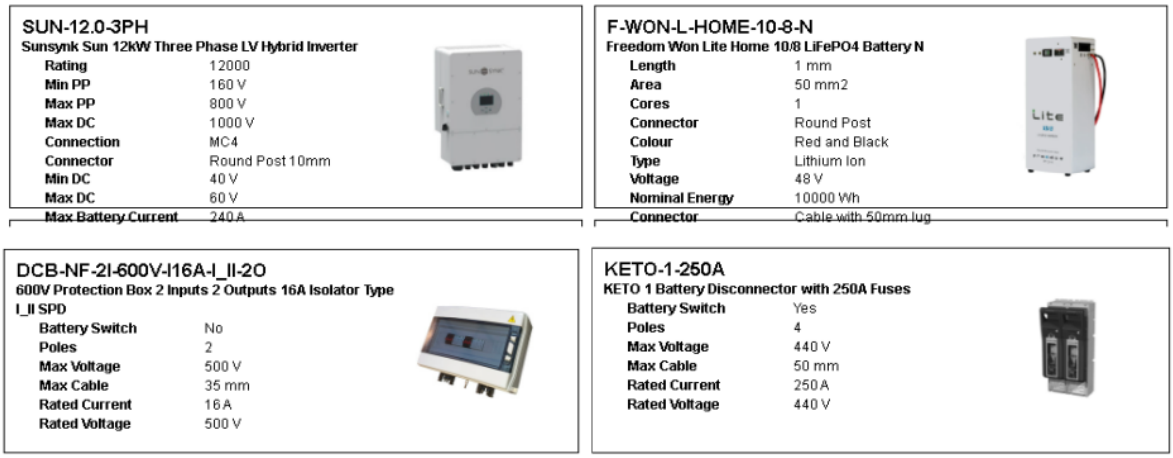


Figure 6 The Sunnysynk Sun 12 kW three-phase LV Hybrid Inverter, and the battery and protection

Table 7 outlines the bill of quantities of this system, as estimated from a quotation obtained from a service provider. This includes solar panels, an inverter, the mounting kit and the battery system. While costing almost covers the greater part of the investment, few items can be reduced in order to cater for installation and avoid making the companies incur any costs.

Table 7: Bill of Quantities for the Eco Care.

Solar Equipment	**Quantity**	**Unit**	**Amount**		
Canadian Solar 455 W Super High Power Mono Perc_Hiku with MC4-EV02	20	Unit	2938.93	58778.60	ZAR
Sunsynk Sun 12kW Three Phase LV Hybrid Inverter	1	Unit	47429.14	47429.14	ZAR
Freedom Won Lite Home 10/8 LiFePO4 Battery N	1	Unit	58652.22	58652.22	ZAR
CANBUS Cable for Freedom Won and Sunsynk or Goodwe combination	1	Unit	318.55	318.55	ZAR
Three Phase Earth-Neutral Bridge Box For Inverters Up To 12kWac	1	Unit	1765.79	1765.79	ZAR
70mm2 Battery Cable (H01N2-D) 2m – PAIR	1	Unit	948.78	948.78	ZAR
600V Protection Box 2 Inputs 2 Outputs 16A Isolator Type I_II SPD	1	Unit	6554.17	6554.17	ZAR
4mm2 single-core DC cable 50m - Black & Red	1	Unit	1366.37	1366.37	ZAR
MC4-Evo2 1500V DC Connector Twin Pack 0086/0087 (Kit 1)	10	Unit	164.82	1648.20	ZAR
MC4 Pre terminated cable 2m (1 Pack)	4	Unit	138.05	552.20	ZAR
KETO 1 BaCery Disconnector with 250A Fuses	1	Unit	1882.36	1882.36	ZAR

10 Panel Mounting Kit - IBR Roof c/w earth plate clamp kit & profile splice	2	Unit	4942.72	9885.44	ZAR
70mm2 by M10 Ring Terminal Lug	1	Unit	468.79	468.79	ZAR
BaCery Hazard label Li-ion (230mm * 90mm)	6	Unit	39.28	235.68	ZAR
BaCery Hazard label Li-ion (230mm * 90mm)	1	Unit	42.86	42.86	ZAR
PV on Roof and Hazard Labels Pack	1	Unit	135.51	135.51	ZAR
Delivery to Garankuwa	1	Unit	1527.48	1527.48	ZAR
				192,192.14	**ZAR**
				28828.82	**ZAR**
Total				**221020.96**	**ZAR**

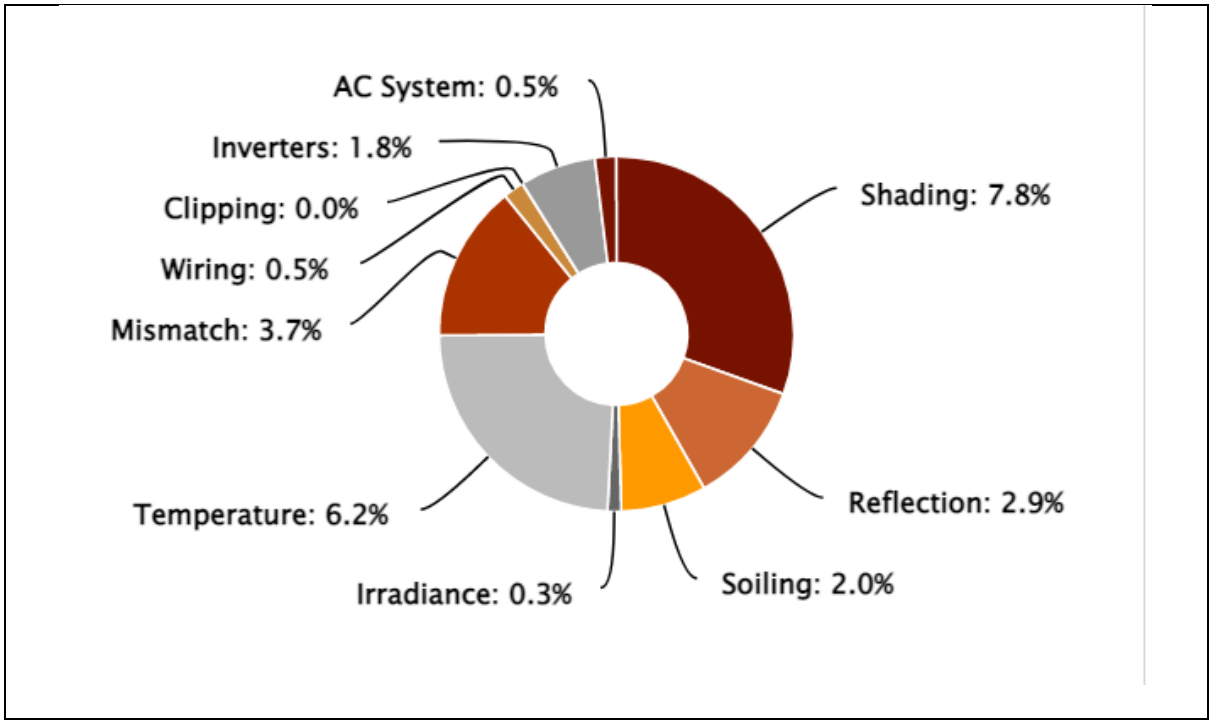
Summary of Electricity and Cost Savings

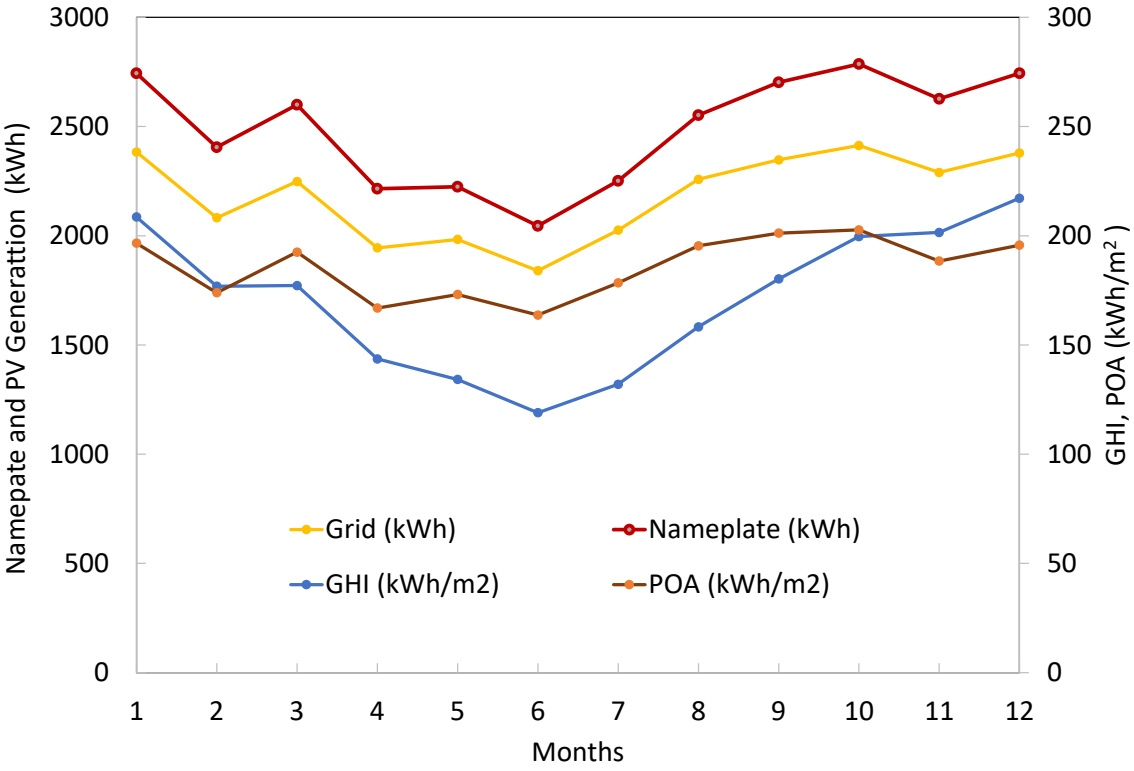
Total Electricity saved per year: 16 000 kWh

Total Cost savings: R 23 000

Investment Cost: R192 192 (excluding labour and VAT)

Payback period: 9.6 years


AC System: 0.5%
Inverters: 1.8%
Clipping: 0.0%
Wiring: 0.5%
Mismatch: 3.7%
Temperature: 6.2%
Irradiance: 0.3%
Soiling: 2.0%
Reflection: 2.9%
Shading: 7.8%


Namepate and PV Generattion (kWh)
GHI, POA (kWh/m2)
Months
Grid (kWh)
Nameplate (kWh)
GHI (kWh/m2)
POA (kWh/m2)
3000
2500
2000
1500
1000
500
0
300
250
200
150
100
50
0
1
2
3
4
5
6
7
8
9
10
11
12

3. IMPLEMENTATION PLAN

The objective of the implementation plan is to provide Eco Care with the confidence that all the energy saving opportunities will be considered when implementing the project, and make sure a to list the tasks is done, activities and processes involved in producing deliverables. It is also to make decison on the allocaton of resources and specifying the project priority levels. This plan will enable the track down of implemented opportunity and the savings they bring about.The two identified opportunities are ranked as high, meaning that they are of high priority and they should be impemented quickly to bring about an energy saving.

Table 8:List of Recommendation

No.	RECP Opportunities	Projected Annual Savings			Investment Cost	Payback Period	Priority Ranking
		Energy(kWh)	Cost	CO^2 emission (tonnes)			
1	EE Lighting	1 548	R 2 900.00	1.62	R 5 000.00	1.7	High
2	Solar PV	15 900	R32 886	15.00	R192 192	12	High
	Total	17 448	R35 786	16.62	R 197 500	13.7	

4. CONCLUSION

Eco Care sees the importance of being energy efficient in their operations. Due to being charged high amounts of access charge, implementation of Energy Efficiency projects is of high importance. And the company is in the process of enlarging its facility by addition of other operations. They will be able to adopt what has been done on the current operations and implement this on the new facility. Because of the Energy Audit, they have seen the importance of understanding more about Energy and would like to do courses at the NCPC to know and understand more on this topic.