Gauteng Department of Economic Development (GDED)

SME Green Support Incentive Program

ENERGY CONSUMPTION ASSESSMENT FOR B-West Cleaning and Recycling Project,

Plot 58 Aloe Ridge Drive, Walkerville, GAUTENG

06 MAY 2022

REPORT

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

Prepared by: **CSIR** Energy Centre
CSIR Pretoria Campus
Pretoria

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

ACKNOWLEDGEMENTS

This report was prepared on behalf of the National Cleaner Production Centre South Africa by the **CSIR Energy Supply and Demand research group,** and the NCPC-SA wishes to acknowledge the work undertaken by **CSIR Energy Supply and Demand research group.**

I, Paseka Mabina in my capacity as the technical consultant hereby confirm that I have assessed the **B-West Cleaning and Recycling Project** and have analysed and compiled this Resource Efficient Cleaner Production Assessment report, and I confirm that all the report findings are a representative reflection of the current operational status of **B-West Cleaning and Recycling Project.**

DOCUMENT CONTROL

Degree of Confidentiality:	Client Confidential	
Title:	B-West Cleaning and Recycling Project	
Author(s):	Paseka Mabina	
Project Leader:	Mashudu Madzivhandila	
Date of Issue:	06 May 2022	
No of Pages:	18	
Issuing Organisation: CSIR Energy Centre Pretoria	Telephone: (012) 841 7258	
Contract Name:	Energy Efficient Assessment of B-West Cleaning and Recycling Project, Aloe Ridge Drive, Walkerville, Gauteng	
Project Number:		
Keywords:	Energy consumption, Renewable Energy, Energy Management	
Issue Number:	01	
Copy Number	01	
APPROVED BY:		
Responsibility	**Name**	**Signature**
Author	Paseka Mabina	
Review (CSIR-EC)	Dr Peter Mukoma	
Review (NCPC-SA)	Mashudu Madzivhandila	
RECEIVED BY:		
Responsibility	**Name**	**Signature**
NCPC-SA	Victor Manavhela	
Energy Centre	Dr Kittessa Roro	

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 reviewed the energy efficiency of the operations of the B-West Cleaning and Recycling Project, based at Plot 58 Aloe Ridge Drive, Walkerville in Gauteng Province which was conducted in April 2022.

The scope of the review covered energy consumption assessment for all sources used on-site with a focus on solar PV generation options. Relevant recommendations for energy savings have been made. Data obtained from site has been used to draw conclusions on the state of energy consumption and recommendations made for renewable energy options.

A summary of the main energy saving recommendations made in this 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	Cost	CO2 emissions	(R)	(Years)	
		(kWh)	(R/year)	(tons)			
Energy Saving Recommendations							
1	Replacing existing inefficient fluorescent tubes with 5W LED lighting technology	438	1 362.18	0.41	350.00	0.2	High
	Subtotal	**438**	**1 362.18**	**0.41**	**350.00**	**0.2**	
Alternate Energy Source Opportunity							
2	Installing a grid-tied 13 kWp PV system on the rooftop	23 400	72 774.00	16.54	200 475.00	3	High
	Subtotal	**23 400**	**72 774.00**	**16.54**	**200 475.00**	**3**	
	Total	**23 838**	**74 136.18**	**16.95**	**200 825.00**	**3**	

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

List of Figures

List of Tables

.

1. INTRODUCTION

B West Cleaning and Recycling Project is a plastic buy-back centre located in the Aloe Ridge Drive area of Walkerville in Gauteng Province. The company buys waste plastic from waste pickers as well as the community at large. The waste is crushed, wash, processed, and then pelletized. The recycled plastics are re-used to make chairs as well as other plastic products. The company helps with the plastic problem that causes water pollution. The B-West Cleaning and Recycling Project employs 15 staff members and buy stock from more the 20 people daily. The company operates in a good warehouse space 5 days a week from Monday to Friday.

The initial assessment phase of the project commenced on 7 April 2022 with a kick-off meeting and walk-through audit of the plant. The walk-through audit phase of the project focused on conducting a general assessment of the plant to identify energy saving options that will assist the B West Cleaning and Recycling Project to improve energy consumption and reducing waste. The plant consumes electricity supplied by the local municipality and has no other sources of energy.

This review 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 review report presents the relevant findings based on information obtained from the site visit 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. High level investment costs, energy and cost savings, and simple payback periods are presented.

2. COMPANY INFORMATION

Table 2 Company Information

Assessment Type	Review of Renewable Energy opportunities
Assessment Period	April 2022
Company Name	B-West Cleaning and Recycling Project Primary Co-Operative Limited
Physical Address	Plot 58 Aloe Ridge Drive, Walkerville,1961
Phone	(+27) 65 906 8436
Trading Since (year)	2014
No. of Full time Employees	15
Industrial Processes	Recycling
Company Contact Person:	
Name:	Mr Johannes Bocherds
Designation:	Managing Director
Telephone: **Mobile:** **E-mail:**	(+27) 66 551 4758 (+27) 65 906 8436 borcherdsjohan@gmail.com

3. PLANT PROFILE

Error! Reference source not found. shows the location of the factory according to Google Earth's Aerial View. The space occupied by the factory is marked in the figure. The owners of the company are currently renting a warehouse at the farm. The lease agreement started on 01 January 2022. The warehouse 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. This is standard practice for roof mounted solar PV installations since roof designs do not take into account additional weights.

Figure 1 Aerial View of the site

3.1 Operational Processes

After collection, plastic waste is sorted according to different types. Although most types of plastic can be recycled today, the most recycled is polyethylene terephthalate, used to make water bottles, and high-density polyethylene. Other types of plastics including low density polyethylene, polystyrene, and polyvinyl chloride. Acrylic, fiberglass, nylon, and other plastic polymers are difficult to recycle. The process steps are divided into two parts: a pre-treatment process and a thermal decomposition process, as shown in **Error! Reference source not found.**.

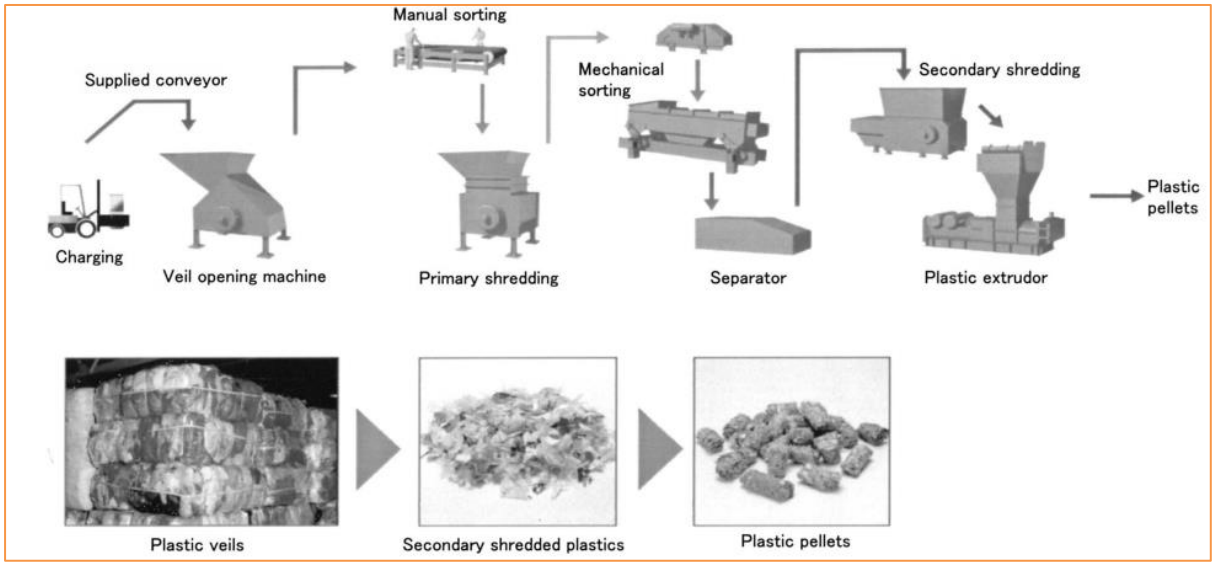

Figure 2 Flow diagram for plastic recycling

3.1.1 Pre-treatment process

After the sorting process, the different types of plastic are separately shredded and washed, to remove contaminant substances such as paper labels, glue, and other residues. Alternatively, a process called agglomeration is used during the pre-treatment stage. It consists of heating the plastic waste just below its melting point to reduce the size, before cutting it into small pieces. The product is an irregular grain, often called crumbs or granules.

3.1.2 Thermal decomposition process

Thermal decomposition is a process used to homogenise plastic pieces with heat. The plastic granules pass through a pipe with a rotating screw, which forces the granules forward into a heated barrel, where the melting occurs. Then, the melted plastic is cooled in a water bath and is later turned into pellets, which are easier to use when making new products.

4. INITIAL BUSINESS OPERATIONAL ASSESSMENT

This chapter demonstrates the initial evaluation of the B-West Cleaning and Recycling Project's business environment performance, as shown in Figure 3, before the on-site assessment is carried out.

Figure 3 Initial business operational assessment

The spider graph above depicts the consultant's view on the following items:

- Accept potential: The owners of the company could see the potential positive impact that GDED can have on reducing their electricity consumption.

- Management commitment: The owners of the company were active participants and keen on ensuring that their establishment uses electricity efficiently.

- Roles and responsibilities: The owners seemed to understand the roles and responsibilities that they uphold in ensuring the smooth and efficient operation of the establishment.

- Significant Resource User (SRU): The owners were aware of the operations or processes that consume the most energy and other resources.

- Baseline: The owners of the recycling plant provided the electricity consumption data they had since they occupied the new facility. In this case, only three (3) months of electricity consumption data was available.

- Resource Performance Indicator (RPI): Submeters are installed in different areas of the establishment.

- Objectives and targets: Due to their high electricity bill, the owners had already set themselves objectives and targets that they must achieve to reduce electricity consumption. However, they don't have any written set targets that can be reviewed periodically.

- Action plan: The company does not have a well detailed plan that outlines the steps needed to achieve any reduction electricity usage.

- Internal audit: No energy assessments were conducted before.

From the above observations, it was evident that the owners of the company are aware of the potential benefits of participating in the GDED.

5. ENERGY CONSUMPTION ANALYSIS

The aim purpose of this section is to analyse energy consumption data and evaluate the operational efficiency of the plant. Data collected about plant activities can be used to monitor and control overall efficiency, set targets, and calculate monthly or yearly indicators. However, for this facility only three months of electricity usage data were available. Therefore, energy consumption analysis will not be performed because of insufficient data points. A minimum of 12 months of electricity usage data is required to perform this task.

5.1 Electricity

The farmer (landlord), the owner of the building where this business operates from has installed submeters to measure the usage of each tenant. The monthly electricity consumption bill is generated by the landlord and submitted to the business every month end for payment. However, there is no information about the tariff structure that the farmer uses to charge the tenants. The three months electricity consumption data is shown in Table 3 and Figure 4. The electricity consumption data points are very scatted. Thus, it is impossible to project or average electricity consumption for 12 months using these three points. The unit price of electricity is also very high. The tenant needs to query the tariff structure used to generate the monthly bill.

Table 3 Monthly Electricity Consumption

Months	kWh Consumption	Unit Price R/kWh	Total Cost
Feb 21	606	3.11	R1 884.66
Mar 21	524	3.11	R1 629.64
Apr 21	5 100	3.11	R15 861.00
AVERAGE	**2 077**		**R6 458.43**
TOTAL	**6 230**		**R19 375.30**

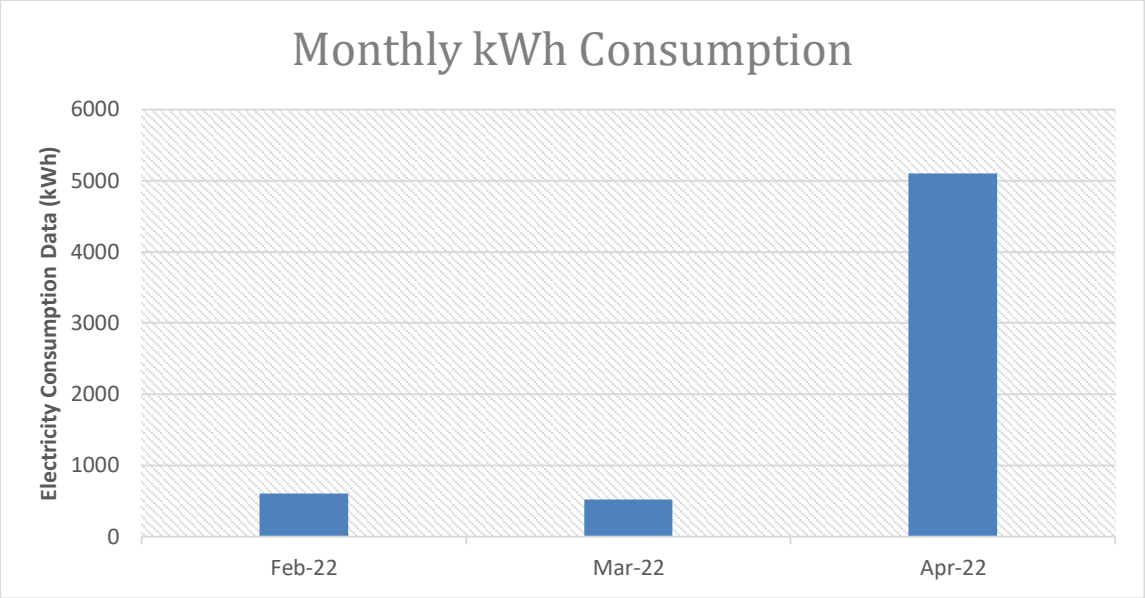

Figure 4 Monthly Electricity Consumption

5.2 Identification of Significant Energy Users

Significant energy users installed in the factory with their estimated capacities are presented in Table 3. 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 4 Installed capacity & estimated energy usage

No	End-Use Equipment	Estimated Installed Capacity (kW)	Energy Usage (kWh/yr.)	%
1	Lighting	0.2	584	0%
2	Granulator machine	5.5	16060	10%
3	Thermal drying machine	7.5	21900	14%
4	Plastic pelletizer extruder machine	30	87600	56%
5	Workshop equipment	10	29200	19%
	Total	**53.2**	**155344**	**100%**

The energy usage figures are based on the estimated time the machines are running in a single shift throughout the year. These considered operating schedules and demand factors[1]. Based on the above load analysis, it has been established that the workshop equipment uses the most energy at about 56%.

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

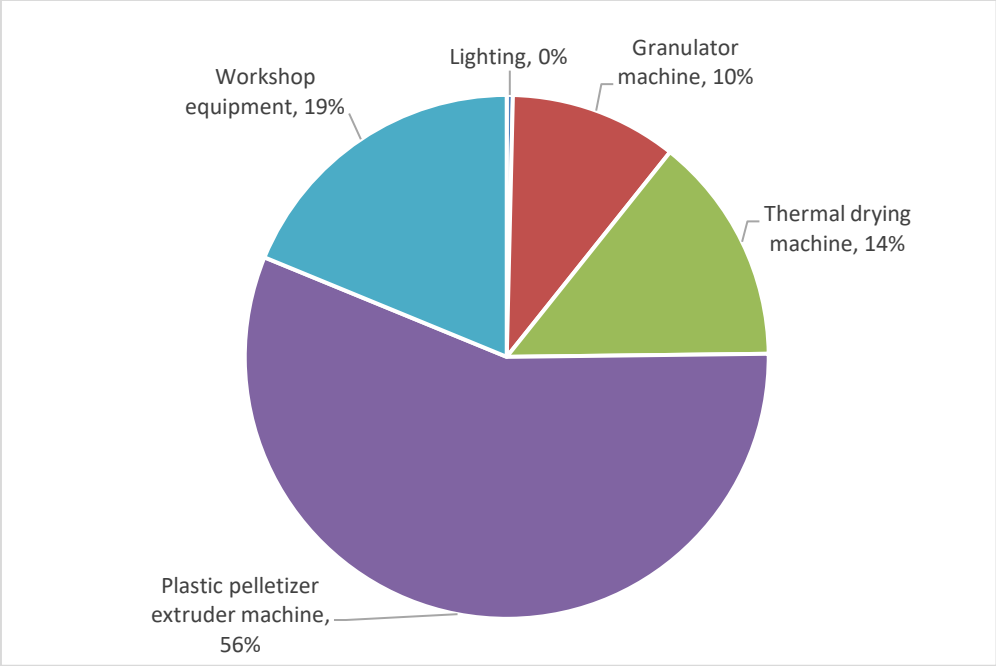

Figure 5 Significant Energy User Breakdown

Since the electricity cost is probably a big component of the operational costs, any reduction would be beneficial in improving the profitability of the business. The management is aware of the operations or processes that consume more energy. 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.

6. DETAILED ASSESSMENT FINDINGS AND RECOMMENDATIONS

6.1 Upgrade Lights to lower wattage LEDs

The current lights are a mix of LEDs and Incandescent bulbs. Table 5 gives a summary of the lighting inventory. It is recommended that all lights be upgraded to LED lighting technology to reduce energy costs.

Table 5 Summary of lighting fixtures

Qty	Description	Watts/Fixture
Existing Fixtures		
4	Fluorescent cube	50

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 438 kWh/y
- Energy cost reduction R1 362.18/y
- Investment R 350.00
- Payback period 0.2 yrs
- Carbon dioxide (CO_2) reduction 0.41 ton/yr

6.2 Install a Grid-Tied Solar PV System

Based on the average 3 months energy consumption of 2 077 kWh and the available space, 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 13kWp size would best fit the consumption patterns, results shown in Table 6. The bill of material is provided in Table 7. However, the system is grid-tied. The cost will exclude the battery storage.

Table 6 Solar PV System Sizing

B-West Cleaning and Recycling Project		
ITEM	**REPORT**	**RESULTS**
1	Current Tariff	Not provided
2	Operating hours	24/7/365
3	Estimated Consumption split Day vs Night	60% Day; 40% Night
4	Average Monthly Consumption (kWh)	2 077 kWh (Estimate)
5	Average daytime consumption per Month (kWh)	1 246 kWh (Estimate)
6	Unit Charge (R/kWh)	R3.11/kWh
7	Average Monthly Demand (kWh)	2 077 kWh???
8	Average Monthly Demand Cost (R)	R6 459.47
9	Time of Maximum Demand	Dependent only on monthly kWh consumed
10	Is Tariff Correct & the Best Option?	Not conclusive – Not sufficient
11	Estimated System Size (kWp)	13 kWp
13	System Size Comments	Roof mount system

Table 7 Bill of Material

Product	Quantity	Price	Amount
PV Modules 405W Tier1 A-Grade Panels (Canadian Solar)	32	R2,550.00	R81,600.00
PV Mounting System Rails, Roofhooks, Mid- and End Clamps	32	R950.00	R30,400.00
Inverter 3-Phase Hybrid Inverter with 11.5kWh Li Battery (5x2.3kWh battery packs) 10 years warranty	1	R175,000.00	R175,000.00
Electrical Components AC and DC Cabling, Surge Protection, Breakers, Fuses, MC4 Connectors, Earthing Rod etc	1	R9,500.00	R9,500.00
Electricity Meter Feed-In Limitation Meter and Current Transformer	1	R4,500.00	R4,500.00
Installation Installation Labor, Transport of Materials, Consumables, Electrical COC	1	R25,500.00	R25,500.00
		Subtotal:	R326,500.00
		VAT (new) 15%:	R48,975.00
		Total:	R375,475.00
		Amount Due (ZAR):	**R375,475.00**

- Energy savings (alternative energy) 23 400 kWh/y
- Energy cost savings R72 774/y
- Investment with R200 475 (**without storage system**)
- Payback period 3 years
- Carbon dioxide (CO_2) reduction 6.54 ton/y

7. 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 fluorescent tubes with 5W LED lighting technology	438	1 362.18	0.41	350.00	0.2	High
	Subtotal	**438**	**1 362.18**	**0.41**	**350.00**	**0.2**	
Alternate Energy Source Opportunity							
2	Installing a grid-tied 13 kWp PV system on the rooftop	23 400	72 774.00	16.54	200 475.00	3	High
	Subtotal	**23 400**	**72 774.00**	**16.54**	**200 475.00**	**3**	
	Total	**23 838**	**74 136.18**	**16.95**	**200 825.00**	**3**	

8. CONCLUSION

The general conclusion is that based on the limited electricity consumption data and business operations, there are not a lot of energy saving opportunities within B-West Cleaning and Recycling Project business that can reduce operational costs and carbon emissions. However, since B-West Cleaning and Recycling Project operate mostly during the day, renewable energy can be generated and be used to supply most, if not all, of the energy required to operate the plant. Based on the average 3 months energy consumption of 2 077 kWh, calculations showed that 23 400 kWh/y energy can be generated from the installation of solar PV using the available roof space. The investment required is estimated at around R 200 825.00 with a payback period of about 3 years. This is a good opportunity for the company since electricity is the only energy source consumed on site. An estimated 438 kWh reduction in electrical energy usage and cost of R 1 362.18 per annum can be achieved through the replacement of the existing inefficient fluorescent tubes with 5W LED lighting technology.