Green Support Incentive Programme for SME in Gauteng

Baseline report

Fermel Pty (Ltd)

Alberton plant

Date: 14/04/2022

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I, **Edmore Manzunzu,** in my capacity as the technical consultant, hereby confirm that I have assessed **Fermel Alberton Plant** and have analysed and compiled this **Baseline and solar feasibility study**. I confirm that all the report findings and representative reflection of the current status of **Fermel Alberton plant.**

Executive Summary

The report serves as a baseline and solar PV feasibility study for the Fermel (Pty) Ltd plant in Alberton. The report addresses potential Solar PV generation from available roof space and the amount of energy saved. The report serves as a baseline against which any problem areas or gaps in Solar PV installation, process technology and environmental authorisations are identified. Future performance goals, objectives, targets and activities can be set based on this baseline report.

IBC, SAM software and Google Earth were used to simulate the number of solar panels that can be installed on the rooftop and the potential solar energy that can be harvested. The Gauteng Global annual radiation is 2 042.98kWh/m^2/year.

The facility can install 6.4kWp solar panels with a 20kWh battery storage. The annual energy consumption for the site is 149,097kWh at a cost of R507,977. The potential energy savings a year is 12,024kWh equivalent to R34,648/year. The project requires an investment of R230,000 with a payback period of 7years. The CO_2 offset from the use of renewable energy (solar PV) is 12.5tons a year.

Table 1: Summary of potential solar energy savings and cost

Building	Capacity (kWp)	Energy Yield (MWh)	No of Modules	Energy Revenue	Capital Cost	TCO2	Payback
Office block	6.4	12.024	20	R34,648	R230,000	12.5	7
Totals		12.024	20	R34,648	R230,000	12.5	7

The summary of raw materials and labour cost are shown below.

Table 2: Raw materials summary

Fermel (Pty) Ltd Solar PV raw materials			
Description	Unit cost	Quantity	Total cost
Solar panels (canadian CS1H-320MS)	3,500	20	70,000
Inverter (SMA SB6.01AV-41)	90,000	1	90,000
Lithium batteries 20kWh (Tri power storage)	35,000	1	35,000
SMA controller, connecting wires,fuses and other electrical accessories	8,000	1	8,000
mounting hooks, brackets	6,000	1	6,000
Solar installation labour charges	21,000	1	21,000
Total			230,000

1 Abbreviations

CO_{2e}	Carbon dioxide equivalents
CP	Cleaner Production
Deg. C	Degrees Celsius
FC	Fraction Capacity
HRS	Hours
IPA	In-Plant Assessment
Kj	Kilojoules
Kl	Kilolitres
R/W	Rands per Watt
GDED	Gauteng Department of Economic Development
GHG	Greenhouse Gas
MWh	MegaWatt Hour
PV	Photovoltaic
MW	MegaWatt
LPM	Litres per minute
M^2	square metres
NCPC-SA	The National Cleaner Production Centre of South Africa
P	Power
QS Assessment	Quick-scan Assessment
R	Rands
SME	Small and Medium Enterprises
GSIP	Green Support Incentive Programme
TE	Transfer efficiency
W	Watts

Contents

2 Introduction

This project is an initiative of the Gauteng Provincial government to aid in the economic recovery of businesses still reeling from the devastating impact of Covid-19, which was followed by the July 2021 civil unrest leading to further economic damage in the province.

The programme aims to provide financial support for renewable energy implementation in SMEs affected by the economic downturn. The interventions are evaluated for feasibility in terms of estimated investment costs and project financial metrics are applied to evaluate project feasibility.

"The Southern African region, and the whole of Africa, has sunshine all year round. The annual 24-hour global solar radiation average is about 220 W/m2 for South Africa, compared with about 150 W/m2 for parts of the USA and about 100 W/m2 for Europe and the United Kingdom. This makes South Africa's local resource one of the highest in the world. Most areas in South Africa average more than 2 500 hours of sunshine per year, and average solar-radiation levels range between 4.5 and 6.5kWh/m2 in one day", www.energy.gov.za.

2.1 Site Solar Energy Resources

The Gauteng Global Irradiation will be used to determine the annual energy yields. SMA Sunny Design website estimates Pretoria's global annual irradiation at **2 046.98kWh/m²year.** The daily global irradiation for each month of the year is reflected in figure 1 below

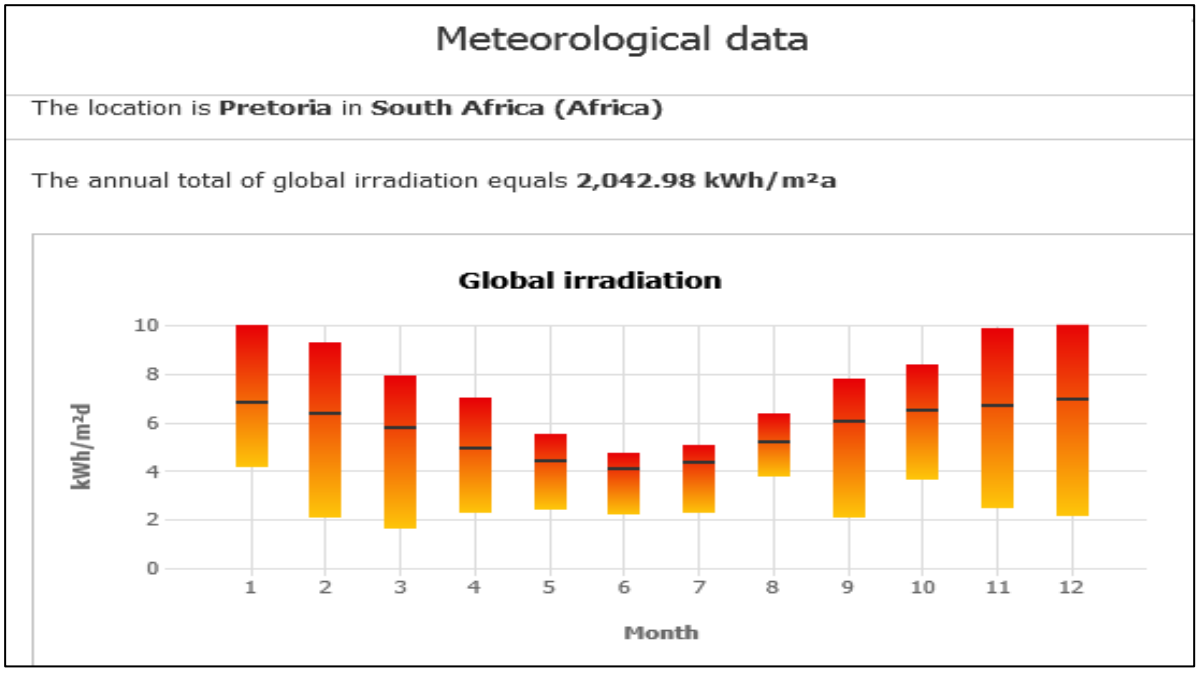


Figure 1: Global radiation data

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.

2.2 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 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

2.3 Design Resources Used

IBC website was used to place modules on top of the different buildings found suitable for this purpose with Google Earth's help for the buildings' location. The software determines the

optimum number of modules that can be placed, hence determining the solar plant's size. Given the operating cost of energy, the software can also determine the annual yields and savings resulting from solar use.

For the purpose of determining the capacities of the installation and energy yields, the following IBC Solar PV module was used: See table 3 below. A spreadsheet model was used to determine both the technical and financial viability of the project.

Table 4 Solar PV module specification

Module Name	*Canadian solar CS1H-320MS HiDM*	
Type of Module	*Mono-Crystalline*	
Power (STC)	*320*	W_p
Efficiency	*20.9*	*%*
Open circuit voltage (Voc)		*V*
Open circuit current (Isc/A)	*9.5*	*Amps*
Module Orientation	*N (6°)*	
Nodule Inclination	*20*	*°*

The design's main aim was to determine the maximum energy that could be harvested from the roof of the buildings and operate the buildings with a hybrid system of solar and grid electricity.

Currently, both the Municipality and Eskom are not obliged to buy green energy from IPP (Independent Power Producers). Eskom only buys from grid-scale suppliers as per declared rounds as announced by the Department of Energy and this is an auction process where energy is bought first from the least cost suppliers until the amount of energy required is fulfilled.

Power X is South Africa's first energy exchange (they have the license to buy and sell green energy and trade). The following are the stipulated in terms of the Power-X purchase contracts:

- Any term can be signed 1 - 20 years

- No minimum supply commitments are required (Power-X will buy whatever the generator produces)
- The generator can be located anywhere in the country in an Eskom or municipal area where Power-X has a System agreement.
- The generator will be paid directly.

The following parameters were used for the economic analysis of the Solar PV plants:

Table 5 Solar PV Economic Analysis Input Variables

Input Variables	**Amount**
Panel Degradation (%)	0.50%
Discount Rate (%)	10.00%
Maintenance (%)	2.00%
Tariff Increase	15.00%

2.4 Design Criteria

The design concept to be used here is a hybrid solar PV system. It is important to note that during load shedding, when the grid is not available, the hybrid connected PV system will be available to supply the premises until the batteries power stored is 20%.

Considering the above points, a distributed design approach was adopted as it offers more benefits from a security point of view (i.e. backup configuration). It also takes advantage of the electrical infrastructure already available (i.e. low voltage electrical panels and smart meters).

It is also important to note that a generator greater than 100 MW requires a licence to operate.

3 Company information

Fermel specialises in the mechanisation of mining equipment, established as a leading innovator and manufacturer of underground mining equipment for both hard-rock and flameproof mining operations. The company operates from 8 00 to 1645 Monday to Friday. The Alberton plant equipment consists of a hydraulic, mechanical fitting workshop, electric and electronic assembly. Fermel is ISO9001 accredited with Lloyds of London (Quality Assurance Management System).

Fermel offers client training (technical skills development and product operating training), repairs and overhaul, Ad hoc field service, component service and exchange programs and comprehensive maintenance programs with guaranteed cost of ownership.

Figure 2: Google map site location

3.1 Contact details

Table 5: Company information

Company name	Fermel Pty (Ltd) Alberton
Address	1 Union Street Roxton Alberton 1401
Phone, Fax	082 886 6164 / 011 724 7820
e-mail	cwehr@Fermel.co.za

Website	https://www.Fermel.co.za/contact/
Trading since (year)	1970
No. of Employees	*20*
Contact person:	
Name	*Corne Wehr*
Position	*Facilities Management team member*
Phone & mobile numbers	*082 886 6164*

4 Initial environmental assessment

Fermel Alberton uses an integrated waste management system that encourages waste segregation at the source. The factory-installed energy-efficient lights and electricity sub-metering in some sections of the plant enabling monitoring of energy consumption in different areas.

Table 6: Rating table

	GOOD	FAIR	POOR
Storm-water	X		
Waste separation	X		
Wastewater	X		
Solid waste	X		

	GOOD	FAIR	POOR
Air quality		X	
Noise	X		
Hazardous materials (including intermediates and by-products)		X	
Energy		X	
Environmental policy	X		

Environmental Questionnaire

This section summarises the plant's current state in terms of wastewater quality, raw materials, air quality, hazardous waste, noise management, and general management of the premises.

Table 7: Environmental questionnaire

Water Quality Management **Stormwater** Do you know where the stormwater drains on your premises are located? X Yes □□No □□N/A Do you have any features or procedures in place to prevent stormwater pollution? X Yes □□No □□N/A Is the stormwater drains around your business free of pollution? (litter, Sand, metal shavings etc.) X Yes □□No □□N/A Do you store all equipment, materials and liquids so that spills or leaks could not enter the stormwater system? X Yes □□No □□N/A Do you regularly clean up the surface areas around your premises? X Yes □□No □□N/A Do you use a broom instead of a hose to sweep and clean up the surface areas around your premises?	**Raw Material** Do you know the composition of your materials? X Yes □□No □□N/A If a supplier was willing to take your waste for reuse, can you guarantee a regular supply? X Yes □□No □□N/A Do you have a licensed waste transporter to transport: General production waste? X Yes □□No □□N/A waste chemicals? X Yes □□No □□N/A liquid wastes? X Yes □□No □□N/A **Air Quality Management** Do you take measures to prevent dust from leaving your premises? X Yes □□ No □□N/A Do you take measures to prevent fumes and vapour (including odorous emissions) from leaving your premises? X Yes □□No □□ N/A

X Yes □□No □□N/A **Wastewater** Do you have a permit from the local water authority (if needed)? X Yes □□No □□N/A Do floor drains in the work area drain to either a storage tank or directly to the sewer? X Yes □□No □□ N/A Do you use a vacuum cleaner (appropriate to the process) to clean up dust and Sand? X Yes □□No □□ N/A **Groundwater** Do you know if your site has groundwater under it? □□Yes x No □□N/A If groundwater is under your site, do you take precautions to prevent pollutants from entering the groundwater? X Yes □□No □□N/A **Noise Management** Do you regularly check and carry out maintenance on noisy equipment? X Yes □□No □□N/A Have you identified the noise source and taken steps to reduce its effects if you have had noise complaints? X Yes □□No □□N/A	**Hazardous Materials** Do you store all hazardous materials (such as resins, catalysts) in a bunded, covered area that will not allow any spilt or leaked materials to enter the stormwater system? X Yes □□No □□N/A Do you have a Dangerous Goods Licence, if needed? X Yes □□No □□N/A Do you have all the relevant material safety data sheets (MSDS) and keep them in an accessible place? X Yes □□No □□N/A Do you have spill fighting equipment and written procedures? X Yes □□No □□N/A **Management of Premises** Have you made any changes to your business for environmental reasons? X Yes □□No □□N/A Do you have an environmental policy or plan? X Yes □□ No □□N/A If you answered no of the questions in this checklist, you could use the information in this package to develop an environmental improvement program that will be good for you, your staff and customers. Now that you have completed this checklist and identified the areas where you can make improvements: • Read through the environmental information sheets. • Get started on an environmental improvement program that will be good for you, your staff and your customers.

Note: N/A stands for “not applicable”.

5 In-Plant Assessment Phase

5.1 Pre-assessment Phase (preparation phase)

It is imperative to use the correct rate when performing the economic analysis of the solar PV feasibility study. Since solar energy is only available between 8 am and 5pm during the day,

the effective rate should be determined for this period. This rate was used to calculate an effective electricity rate applicable to the consumption of solar energy. The effective rate was calculated to be **R3.407,** and this is the rate that will be used to perform the Solar PV system's economic feasibility.

Table 8 Electrical Tariff Structure

City of Ekurhuleni Business tariff TOU		
Demand charge = R204.66/Kva		
Customer service charge =R3,721/month		
An Energy Charge, per kWh		
High Demand Season (June, July, August)		
Peak	Standard	Off-Peak
R3.635	R1.654	R1.19
R0.529	R0.6116	R0.5786
HDS Weighted Average (by hours)		R1.84
Low Demand Season (September to May)		
Peak	Standard	Off-Peak
R5.488	R2.166	R1.523
R0.799	R0.801	R0.738
LDS Weighted Average (by hours)		R2.338
Weighted Average (by no. of months)		R2.18

5.2 Energy Consumption Trends

The FERMEL plant consumed **149.097MWh** from March 2021 to February 2022 and a monthly average of **12.424MWh**.

Table 9: Energy Consumption and Costs Trends

Month	Energy consumed (kWh)	Demand (kVA)	Number of days	Specific energy (kWh/day)	Fixed cost	Demand cost	Energy cost	Total cost
Mar-21	2,117	36	31	68	3,247	3,050	21,474	30,492

Apr-21	0	44	30	0	3,247	3,690	7,889	17,547
May-21	0	44	31	0	3,247	3,690	19,903	29,538
Jun-21	47,913	56	30	1,597	3,247	4,758	15,022	26,085
Jul-21	13,326	62	31	430	3,721	5,245	57,012	69,036
Aug-21	14,694	49	31	474	3,721	4,748	41,831	53,993
Sep-21	13,561	46	30	452	3,721	4,450	51,371	63,236
Oct-21	12,284	44	31	396	3,721	4,253	47,207	58,876
Nov-21	11,462	54	30	382	3,721	5,246	27,441	40,102
Dec-21	12,118	56	31	391	3,721	5,442	25,709	38,566
Jan-22	9,747	54	31	314	3,721	5,166	27,534	40,115
Feb-22	11,875	64	28	424	3,721	6,370	26,607	40,392
Totals	149,097	610			42,755	56,110	368,999	507,977

Figure 3 below shows the energy consumption profile.

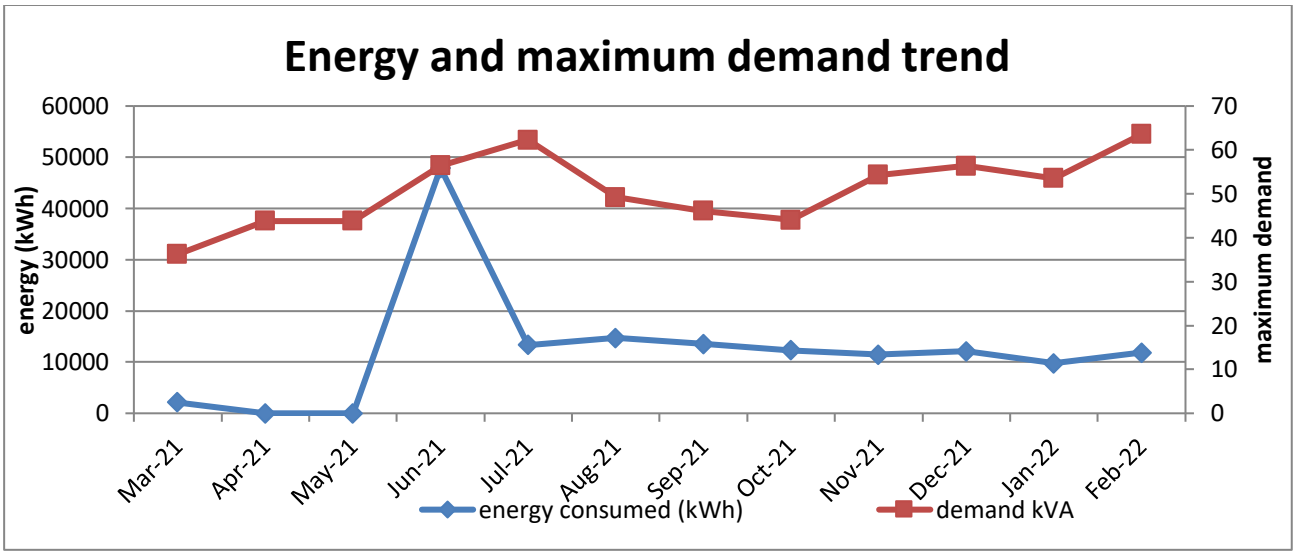


Figure 3 Energy Consumption Profile

The figure above shows the energy consumption trend. Energy consumption was lowest in March, April and May 2021 due to lack of data availability.

5.2.1 Baseline data

The energy driver for the facility is production units (number of cars produced) and weather (CDD and HDD). The table below shows the multivariable regression analysis summary.

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0,46							
R Square	0,21							
Adjusted R Square	0,04							
Standard Error	12148							
Observations	12							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	2	361410078	180705039	1	0,34			
Residual	9	1328149867	147572207					
Total	11	1689559945						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-5885,5	33857,8	-0,2	0,87	-82477	70706	-82477	70706
HDD	135,0	165,9	0,8	0,44	-240	510	-240	510
CDD	127,5	346,7	0,4	0,72	-657	912	-657	912

Figure 4: Multivariable regression summary

The model has an F and P values of more than 0.05; the model and the variables are irrelevant. Although the facility has heating and cooling loads (air conditioners) the regression analysis shows that weather is not a driver of energy consumption at the facility. The R^2 value is less than 75%; therefore, the model cannot be used to predict future energy consumption relative to weather. Production data could be the driver of energy consumption at the facility, during the time of the audit the data was not available.

6 CARBON INVENTORY

6.1 Scope and Boundaries

Activities taking place within a specific area can generate greenhouse gas (GHG) emissions that occur inside the area's boundary and outside the area's boundary. To distinguish between them, the Global Protocol for Community-scale Greenhouse Gas Emission Inventories (GPC) groups emissions into three categories based on where they occur, as summarised in the following table.

Table 9: Scope definitions for GHG inventories

Scope	Definition
Scope 1	GHG emissions from sources located within an area's boundary.
Scope 2	GHG emissions are occurring because of grid-supplied electricity, heat, steam and cooling within a city boundary.
Scope 3	All other GHG emissions that occur outside a boundary result from activities taking place within the limit, e.g. transmission and distribution losses from grid-supplied energy consumption for stationary energy, emissions from transboundary journeys, waste streams generated within the city boundary but landfilled or treated outside the city boundary.

Source: GPC

The scope and boundaries of the carbon inventory are defined for the entire facility. As a minimum, the Carbon emissions from on-site electricity consumption will be considered. Electricity consumption data were available with the base year (March 2021 to February 2022), and the only resource for which data is available is electricity. Thereafter, estimates are made for the plant's common area, based on its estimated contribution to these emissions.

Based on available activity data, the emissions included in the inventory are as follows:

- Scope 2 emissions from grid-supplied electricity.

Emissions excluded from this inventory (due to a lack of activity data) are as follows:

- Scope 1 fugitive emissions from air conditioning and refrigeration leaks:
- Scope 1 emissions from fuels used by employees' vehicles;
- Scope 1 and 3 emissions from fuels used by suppliers and distributors entering the site;
- Scope 3 emissions from business travel of employees and plant trips
- Scope 3 emissions from waste produced on-site but landfilled elsewhere.

The carbon emissions can be direct or indirect emissions, direct emissions for the Fermel Alberton plant come from diesel used by trucks, and indirect emissions are from electricity consumption that is generated using coal. The greenhouse gas emissions factors for South Africa are summarised in the table below.

Table 11: Greenhouse gas emissions factors

SA IEEP Phase II GHG Emission Factors

Fuel	tCO2/GJ	tCO2/MWh
Grid Electricity	0.2896	1.0425
Natural Gas	0.0561	0.2020
LPG	0.0631	0.2272
Diesel	0.0741	0.2668
Residual Oil	0.0774	0.2786
Motor Gasoline	0.0693	0.2495
Kerosene	0.0719	0.2588
Coal Bituminous	0.0946	0.3406
Coal Sub-bituminous	0.0961	0.3460
Coal Anthracite	0.0983	0.3539
Coal Lignite	0.1010	0.3636
Charcoal	0.1120	0.4032
Metallurgical Coke	0.1070	0.3852
Wood fuel	0.1120	0.4032

Fermel Alberton plant's carbon footprint will be based on electricity data only. The base year for carbon emissions calculation is from March 2021 to February 2022. Fermel Alberton consumed 149.097MWh, and the equivalent carbon produced is 155.4tCO_2/year.

6.2 Development of inventory

Fermel Alberton consumed 149.097MWh, as shown in Table 8 above, and the equivalent carbon produced is 155tCO_2/year.

6.3 Carbon management

The setting of IEE objectives, goals, and targets will give the company direction on how to manage the utilities, reduce emissions from the use of energy-efficient technologies, and develop purchasing policies that consider lifecycle costs and efficient use of resources.

Fermel Alberton can improve the way they operate by being proactive through gathering information on resource usage and consumption patterns. The company has an online metering system to manage electricity consumption. Fermel Alberton should record data, as shown in the table below.

Table12: Sample carbon reporting format

Scopes and categories	Metric tons CO_2e
Scope 1: Direct emissions from owned/controlled operations	
Scope 2: Indirect emissions from the use of purchased electricity, steam, heating, and cooling	
Upstream scope three emissions	
Category 1: Purchased goods and services	
Category 2: Capital goods	
Category 3: Fuel- and energy-related activities (not included in scope 1 or scope 2)	
Category 4: Upstream transportation and distribution	
Category 5: Waste generated in operations	
Category 6: Business travel	
Category 7: Employee commuting	
Category 8: Upstream leased assets	
Downstream scope 3 emissions	
Category 9: Downstream transportation and distribution	
Category 10: Processing of sold products	
Category 12: End-of-life treatment of sold products	
Category 13: Downstream leased assets	
Category 14: Franchises	

Category 15: Investments[1]	

A sample of the objectives the company can set are

- Promotion of organisational behavioural change
- Conservation of energy and improving energy efficiency
- Maximise the use of renewable energy sources
- Reducing the carbon footprint of the chillers, trucks and lighting.

7 Detailed design

7.1 Office block

The main constraint in the design is the available budget, therefore, management of the facility suggested that the solar panels to be installed should service the office block, the inverter to be connected to office DB and provide for key equipment. Like computers, servers and printers. The table below summarises the office loads.

Table 10: Office loads power usage

Item	Description	Quantity	Unit kW	Utilization	Power Usage	Continous
1	People in the building	21			kW.hrs	kW.hrs
2	Computers	21	0.20	100%	33.60	33.60
3	Printers	5	0.30	45%	5.40	
4	Fridges	2	0.15	80%	1.92	1.92
5	Hand dryers	4	1.50	15%	7.20	
6	Microwaves	3	1.20	10%	2.88	
7	Kettles	6	2.00	20%	19.20	
8	Aircons	17	0.85	60%	69.36	69.36
9	Heaters	4	1.50	60%	28.80	28.80
10	Lights	41	0.04	100%	11.48	11.48
11	TV	1	0.10	10%	0.08	
12	Telephones	18	0.00	20%	0.09	

13	Server	1	3.00	100%	24.00	24.00
14	UPS	1	0.00		0.00	
15	Laminating Machine	1	0.60	10%	0.48	
16	Binding Machine	1	0.60	10%	0.48	
					kw/hr	
				Total daily	204.97	169.16
	Hours per day					
	kW (Inverter output)			Avail/Inverter	64	
				Inverters	3.2	
				Required	4	
				Power (kW)	25.6	
				Amps	116.458	33A/Inverter

The maximum daily energy demand for the office block is 204.97kWh/day, that is 51,243kWh/year. The facility has plenty of roof space that can be installed with solar panels as shown below.

Figure 5: Roof space available

The suggested design according to the financial constraints the facility can install is shown below.

1 x SMA Sunny Tripower Storage 60		1 x Lithium (20 kWh)	
PV design data			
Total number of PV modules:	20	Line losses (in % of PV energy):	---
Peak power:	6.40 kWp	Unbalanced load:	6.00 kVA
Number of PV inverters:	1	Annual energy consumption:	145 MWh
Nominal AC power of the PV inverters:	6.00 kW	Self-consumption:	10,503 kWh
AC active power:	6.00 kW	Self-consumption quota:	87.4 %
Active power ratio:	93.8 %	Self-sufficiency quota:	7 %
Annual energy yield*:	12,024 kWh	Total nominal capacity:	20.00 kWh
Energy usability factor:	99.7 %	Annual nominal energy throughputs of the battery:	52
Performance ratio*:	85.8 %		
Spec. energy yield*:	1879 kWh/kWp	CO_2 reduction after 20 years:	81 t

Signature

Figure 6: Annual energy generated from solar summary

The projected annual energy produced is 12,024kWh/year, and the yearly building demand is 149,097kWh/year; therefore, the solar system can manage to supply 8% of the facility's energy use. The system size is summarised below.

Energy system

PV system	PV inverter 1 x SMA SB6.0-1AV-41	PV arrays 20 x Canadian Solar Inc. CS1H-320MS HiDM (1000V)
Battery system	Battery inverter 1 x SMA Sunny Tripower Storage 60	Battery 1 x Lithium (20 kWh)
Additional components	Energy management 1 x Sunny Portal	
System size	PV system 6.40 kWp	Battery system 20.00 kWh

Figure 7:Solar system specifications

The solar system will have a battery back-up of 20kWh lithium battery and 20 Canadian solar panels that will generate 6.4kWp. The figure below shows the projected monthly energy production.

Table

Month	Energy yield [kWh]	Self-consumption [kWh]	Grid feed-in [kWh]	Purchased electricity [kWh]
1	1054 (8.8 %)	946	108	11809
2	930 (7.7 %)	836	94	10272
3	1022 (8.5 %)	850	172	11376
4	912 (7.6 %)	801	110	10868
5	953 (7.9 %)	820	132	11935
6	896 (7.5 %)	809	87	10870
7	963 (8.0 %)	847	115	11373
8	1065 (8.9 %)	938	127	11817
9	1073 (8.9 %)	907	166	10239
10	1083 (9.0 %)	940	143	11810
11	1022 (8.5 %)	912	110	11293
12	1053 (8.8 %)	896	156	10796

Figure 8: Monthly energy production trend

The monthly energy produced is less than the monthly demand, therefore the plant cannot be offgrid but a hybrid system of solar and grid electricity. The annual energy cost savings is R34,648/year, which is 8% of the annual electricity bill.

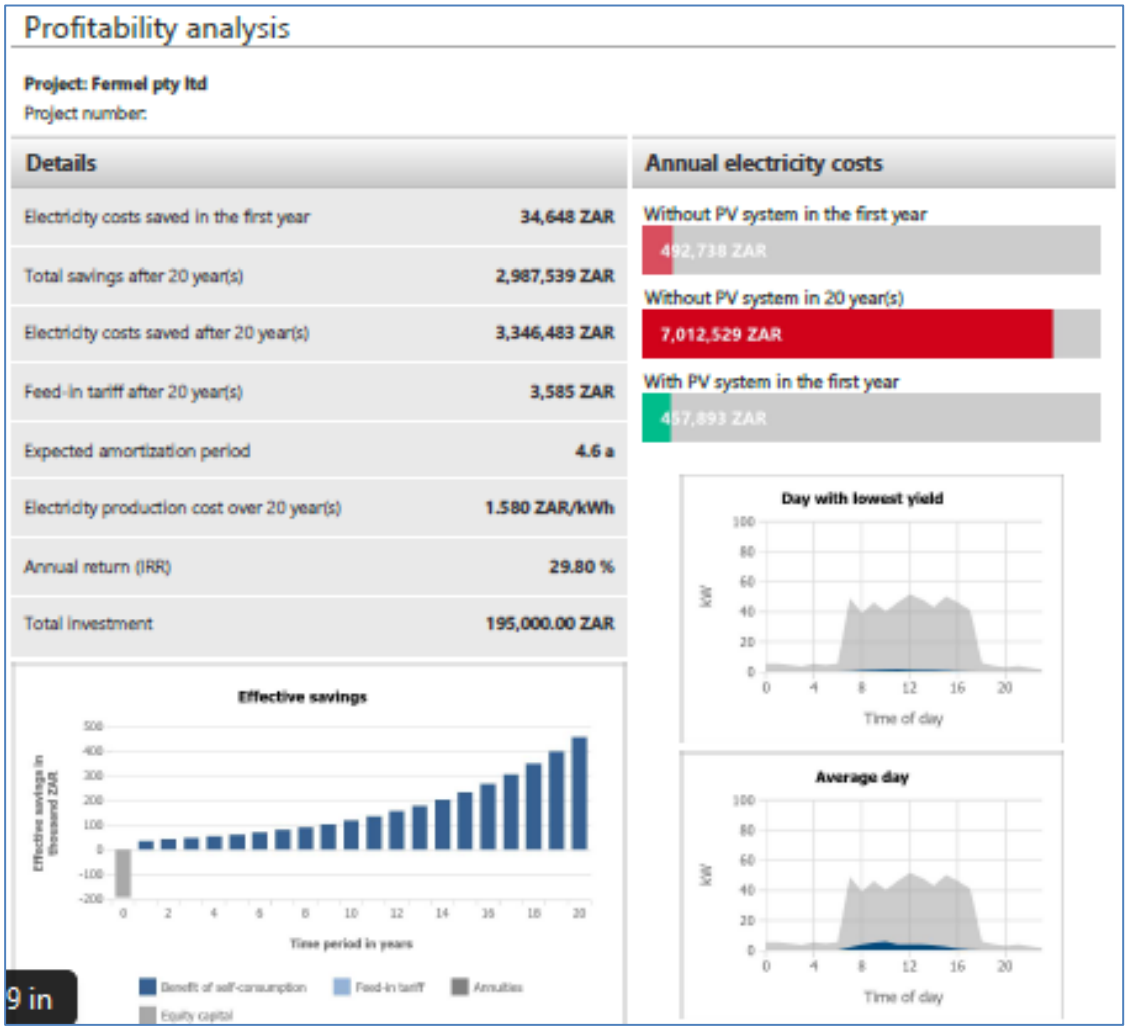
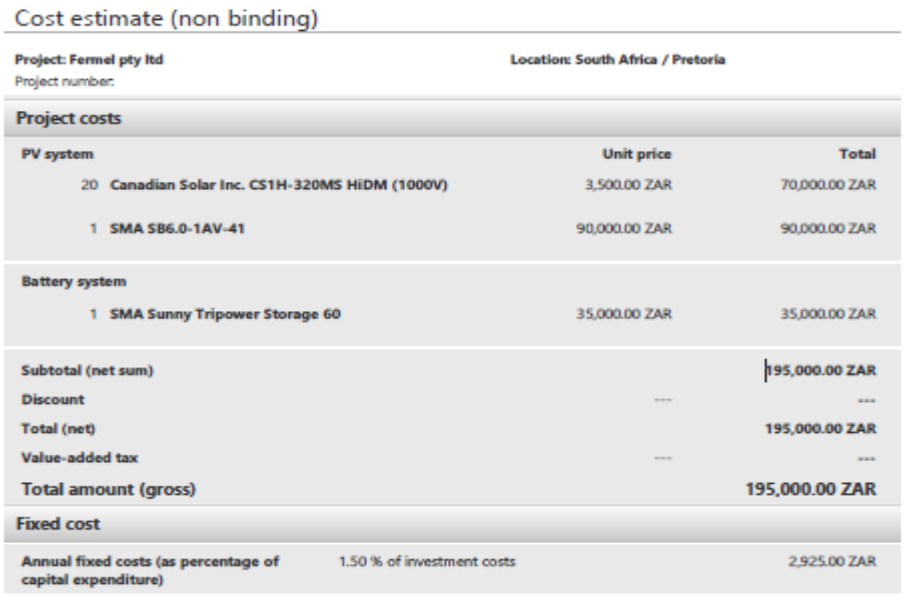


Figure 9: Financial analysis for Hazardous stores solar potential

The project cost R230,000 including labour and accessories. The main components (solar panels, battery storage, inverter) cost R195,000 with a payback period of 7 years as shown in the figure below



Cost estimate (non binding)

Project: Fermel pty ltd — **Location: South Africa / Pretoria**
Project number:

Project costs			
PV system		**Unit price**	**Total**
20	**Canadian Solar Inc. CS1H-320MS HiDM (1000V)**	3,500.00 ZAR	70,000.00 ZAR
1	**SMA SB6.0-1AV-41**	90,000.00 ZAR	90,000.00 ZAR
Battery system			
1	**SMA Sunny Tripower Storage 60**	35,000.00 ZAR	35,000.00 ZAR
Subtotal (net sum)			**195,000.00 ZAR**
Discount		---	---
Total (net)			**195,000.00 ZAR**
Value-added tax		---	---
Total amount (gross)			**195,000.00 ZAR**
Fixed cost			
Annual fixed costs (as percentage of capital expenditure)	1.50 % of investment costs		2,925.00 ZAR

Figure 10: Main components cost breakdown

8 Solar PV feasibility study summary

The table below tabulates the results of the solar PV feasibility assessment. This table indicates both the technical and economic feasibility.

Table 11: Summary of recommendations

Building	Capacity (kWp)	Energy Yield (MWh)	No of Modules	Energy Revenue	Capital Cost	TCO2	Payback
Office block	6.4	12.024	20	R34,648	R230,000	12.5	7
Totals		12.024	20	R34,648	R230,000	12.5	7

9 Conclusion

Fermel Alberton can install rooftop solar panels on most buildings and generate much-needed energy from solar PV. Due to financial constraints, the project can fund a 6.4kWp solar system, with 20kWh battery storage. The system can be extended in future to supply the whole office block and the production plant because the roof space can accommodate more panels. The proposed system should reduce the electricity bill by 8%, and have a battery to power critical equipment during load-shedding.

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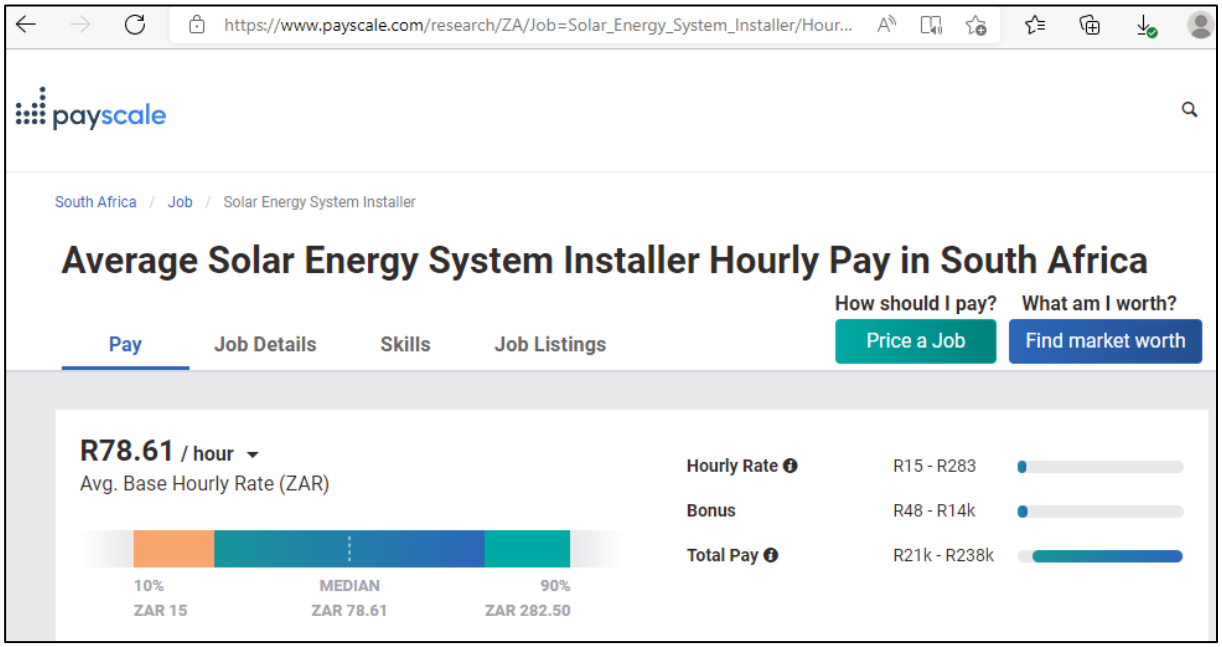
10 Annexures

10.1 Battery specifications

OPzS Solar type	OPzS Solar 910	OPzS Solar 1210	OPzS Solar 1520	OPzS Solar 1830	OPzS Solar 2280	OPzS Solar 3040	OPzS Solar 3800	OPzS Solar 4560
Nominal capacity (120 hr / 20°C)	910Ah	1210Ah	1520Ah	1830Ah	2280Ah	3040Ah	3800Ah	4560Ah
Capacity (10 hr / 20°C)	640Ah	853Ah	1065Ah	1278Ah	1613Ah	2143Ah	2675Ah	3208Ah
Capacity 2 / 5 / 10 hours (% of 10 hr capacity)	60 / 85 / 100 (@ 68°F/20°C, end of discharge 1,8 Volt per cell)							
Capacity 20 / 24 / 48 / 72 hours (% of 120 hr capacity)	77 / 80 / 89 / 95 (@ 68°F/20°C, end of discharge 1,85 Volt per cell)							
Capacity 100 / 120 / 240 hours (% of 120 hr capacity)	99 / 100 / 104 (@ 68°F/20°C, end of discharge 1,85 Volt per cell)							
Self-discharge @ 70°F/20°C	3% per month							
Absorption voltage (V) @ 70°F/20°C	2,35 to 2,50V/cell (28,2 to 30,0V for a 24 Volt battery)							
Float voltage (V) @ 70°F/20°C	2,23 to 2,30V/cell (26,8 to 27,6V for a 24 Volt battery)							
Storage voltage (V) @ 70°F/20°C	2,18 to 2,22V/cell (26,2 to 26,6V for a 24 Volt battery)							
Float design life @ 70°F/20°C	20 years							
Cycle design life @ 80% discharge	1500							
Cycle design life @ 50% discharge	2800							
Cycle design life @ 30% discharge	5200							
Dimensions (lxwxh, mm)	145 x 206 x 711	210 x 191 x 711	210 x 233 x 711	210 x 275 x 711	210 x 275 x 861	212 x 397 x 837	212 x 487 x 837	212 x 576 x 837
Dimensions (lxwxh, inches)	5,7 x 8,1 x 28	8,3 x 7,5 x 28	8,3 x 9,2 x 28	8,3 x 10,8 x 28	8,3 x 10,8 x 33,9	8,4 x15,6 x 32,9	8,4 x 19,2 x 32,9	8,4 x 22,7 x 32,9
Weight without acid (kg / pounds)	35 / 77	46 / 101	57 / 126	66 / 146	88 / 194	115 / 254	145 / 320	170 / 375
Weight with acid (kg / pounds)	50 / 110	65 / 143	80 / 177	93 / 205	119 / 262	160 / 253	200 / 441	240 / 530

10.2 Solar installation hourly rate


https://www.payscale.com/research/ZA/Job=Solar_Energy_System_Installer/Hour...
payscale
South Africa / Job / Solar Energy System Installer
Average Solar Energy System Installer Hourly Pay in South Africa
How should I pay?
What am I worth?
Pay
Job Details
Skills
Job Listings
Price a Job
Find market worth
R78.61 / hour
Avg. Base Hourly Rate (ZAR)
10%
ZAR 15
MEDIAN
ZAR 78.61
90%
ZAR 282.50
Hourly Rate
R15 - R283
Bonus
R48 - R14k
Total Pay
R21k - R238k