NCPC
NATIONAL CLEANER PRODUCTION CENTRE
SOUTH AFRICA

Green Support Incentive Programme for Small & Medium Scale Enterprises in Gauteng Province

Baseline report

Kuishi Kijani (Pty) Ltd

Pretoria North

Date: 16 May 2022

Prepared by: Ariel Energy Solutions

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Department:
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REPUBLIC OF SOUTH AFRICA

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This report was prepared on behalf of the National Cleaner Production Centre South Africa by Ariel Energy Solutions, and the NCPC-SA wishes to acknowledge the work undertaken by Farai Mambwere.

I, **Farai Mambwere,** in my capacity as the technical consultant, hereby confirm that I have assessed **Kuishi Kijani** and have analysed and compiled this **Baseline & Solar PV Feasibility study**. I confirm that all the report findings and representative reflection of the current status of **Kuishi Kijani Pty Ltd.**

EXECUTIVE SUMMARY

The report serves as a baseline and Solar PV feasibility study for the Kuishi Kijani (Pty) Ltd hatchery in Pretoria Rural. The report addresses potential Solar PV generation from available roof space and the amount of energy saved or alternatively a carport-like structure. 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 10kWp solar panels with a 10.kWh battery storage. The annual energy consumption for the site is 12,000kWh at a cost of R28,315. The system should potentially supply all the energy requirements of the facility.

Table 1: Summary of potential solar energy savings and cost

Facility	Capacity (kWp)	Energy Yield (kWh)	No of Modules	Energy Revenue	Capital Cost	TCO2	Payback
Facility	10	12,000	24	R29,042	R230,000	12.51	8

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

Table 2: Raw materials summary

PRODUCT DESCRIPTION	QUANTITY	Item cost in Rand	Total Cost
SOLAR COMPONENTS			
Mecer Solar 330W PV Module (SOL-P-C-330)	24	R3,315.00	R79,560.00
Dc Combiners / Surge Arrestors / Panel fusing	1	R11,950.00	R11,950.00
Cabling & connectors	24	R31.19	R748.56
Consumables, trunking / cable securing	2	R5,293.75	R10,587.50
Sub-total Solar Components			R102,846.06
INVERTER & AC COMPONENTS			
Victron Energy MultiPlus 12/800/35-16 230V Sine Wave Inver	1	R9,057.14	R9,057.14
3 Phase Board / Cabling % Isolators	1	R11,001.25	R11,001.25
Sub-total			R20,058.39
Battery Back Up			
Freedom Won Lite 10/8 LiFePO4 Battery	1	R58,173.91	R58,173.91
Accessories	1	R4,933.13	R4,933.13
Sub-total			R63,107.04
INSTALLATION & COMMISSIONING (LABOUR)			
Installation of Pv Mounting Rails and Panels	24	R950.00	R22,800.00
Applications / COC	1	R15,000.00	R15,000.00
Miscellaneous	1	R6,188.51	R6,188.51
Sub-total			R43,988.51
Total for the supply and installation of Grid-tied PV system inxcluding VAT			R230,000.00

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.

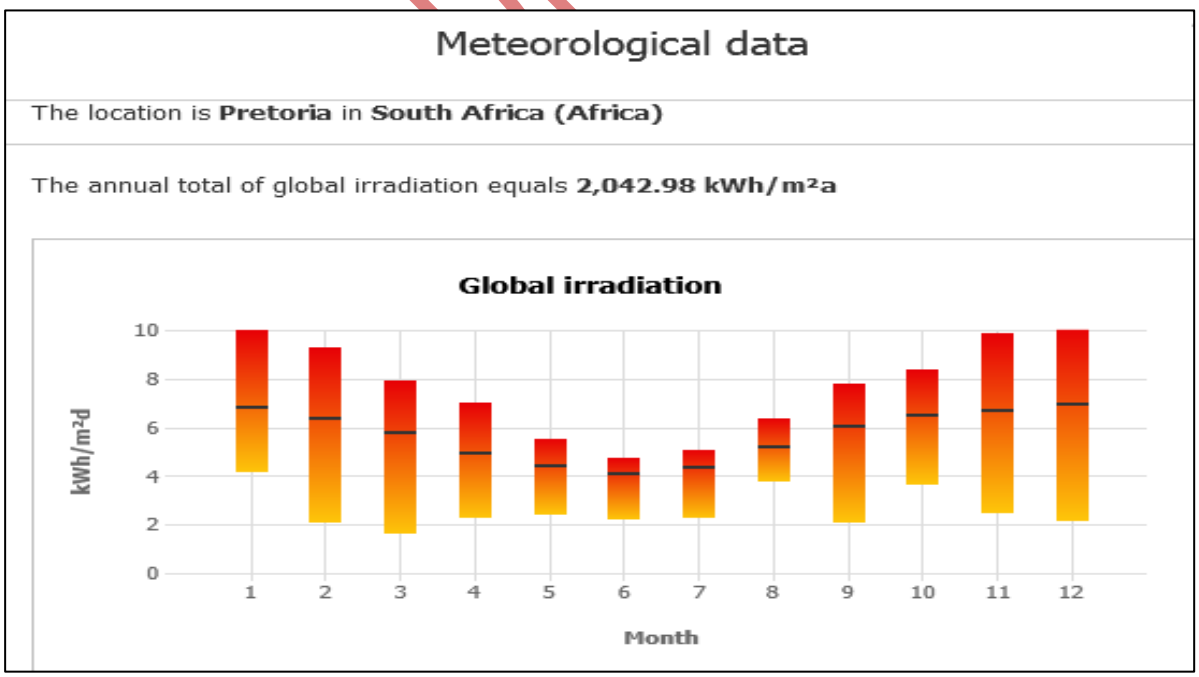
The programme aims to provide financial support for renewable energy implementation in small and medium scale enterprises (SMEs) affected by the economic downturn. The proposed interventions are evaluated for feasibility in terms of estimated investment costs and project financial metrics are applied 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, 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 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).

3 COMPANY INFORMATION

Kuishi Kijani (Pty) Ltd, established in 2019, is a faming operation which is in the hatching and broiler chickens business. Kuishi Kijani is located at Plot No 177, Vastfontein, Olyfboom Street, Pretoria North Rural in the Gauteng Province of South Africa.

The farm receives fertilised eggs from other farmers hatch them and sell day-old chicks to other poultry farmers and and raises broiler chickens at the farm for sale to local community. Kuishi employs two (2) permanent staff, one (1) casual as well as the owner manager, brining the total staff complement to four. Generally this is a 24 hour operation with 2 shifts.

3.1 Contact details

Table 5: Company information

Company name	Kuishi Kijani (Pty) Ltd Pty (Ltd)
Address	Plot No 177, Vastfontein, Olyfboom Street, Pretoria North Rural.
Phone, Fax	072 753 2466
e-mail	moseskebalepile@gmail.com
Website	---
Trading since (year)	2019
No. of Employees	4
Contact person:	
Name	Mr Moses Kebalepile
Position	Owner / Manager
Phone & mobile numbers	072 753 2466

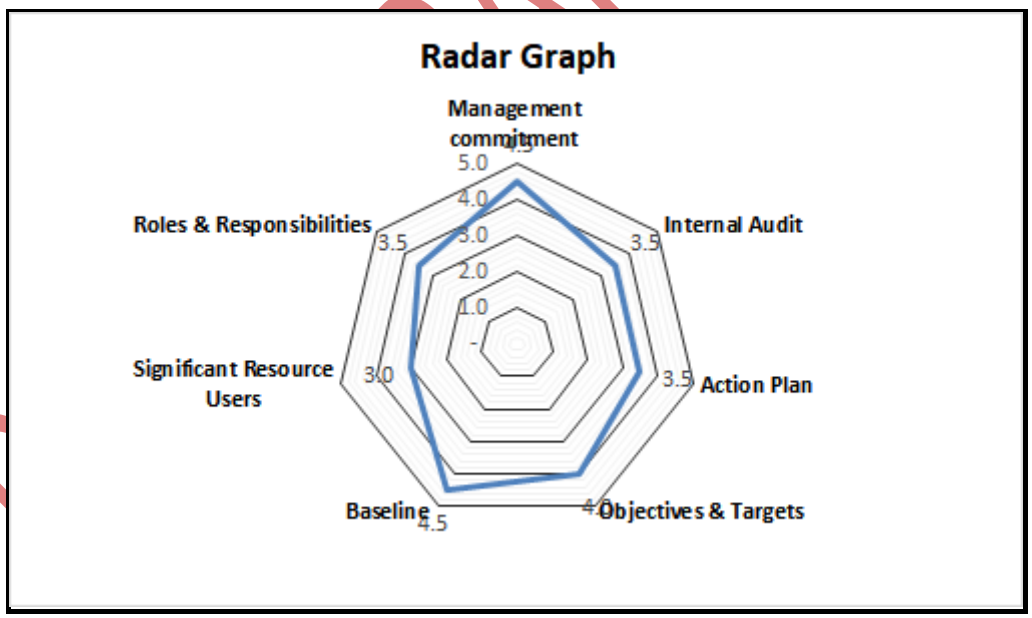
4 INITIAL ENVIRONMENTAL ASSESSMENT

The first phase of the project was a Preliminary Energy Assessment of the hatchery, brooder and broiler house, including the assessment of the historical production and energy usage figures. During the walkthrough of the plant, the facility's energy usage patterns, operating practices noted.

Table 4: Smiley Diagram

	GOOD	FAIR	POOR
Storm Water			☹
Waste Separation		😐	
Wastewater			☹
Solid Waste		😐	
Air Quality	😐		
Noise	😐		
Hazardous Materials (including intermediates and by-products)	😐		

Graph 1: Radar Graph



A simple scale of 1 to 5 was used to assign a weighting value to the observations. There is not much scientific analysis put into this weight but simply gauging by the available information and from discussing with the owner. Based on that, the assessment therefore focuses on systems with opportunities to reduce energy consumption and renewable energy potential. The table below is an attempt to indicate how this weighting was arrived at.

Table 5: Environmental Assessment – Weighting Values

Measurement Aspect	Weight	Remarks (as this relates to energy efficiency / renewable energy)
Management commitment	4.5	The management is totally committed to the project.
Internal Audit	3.5	There is internal accounting of energy usage, main through accurate records and installation of LED lighting
Action Plan	3.5	These relate main to expansion plans of the farm
Objectives & Targets	4.0	Not in detail, but lighting upgrade which is almost 100% complete
Baseline	4.5	Information is adequate, but the diesel usage is based on estimated monthly usage
Significant Resource Users	3.0	Infrared lights for the brooders.
Roles & Responsibilities	3.5	The owner and team responsible for all operations

Both the brooders and broiler house require temperature regulations and the main drawback is the poor insulation of the brooders and broiler house. It is recommended that a separate and detailed analysis of the insulation of these houses be done after this Solar PV system installation.

5 IN-PLANT ASSESSMENT PHASE

5.1 Pre-assessment Phase (preparation phase)

When designing a solar PV system, the correct electricity tariff rate should be used. In the case of Kuishi Kijani, the facility is on a City of Tswhane Annexure D.1, Supply of Electricity,Part 1: Energy, Demand and Fixed Demand Charges (Excluding VAT), with effect from 1 July 2021 until 30 June 2022

The application tariff under this is

- **Section 3.** Agricultural Holdings and Farm Land: Conventional or Prepaid.
- **Section 3.1** R2.2402/kWh
- **Section 3.2** R0.1199/kWh (credit reverse tariff is pre-approved customers feeds back to the grid).

Solar energy is only available between 8 am and 5pm during the day, the peak sunshine hours being between 9am and 3pm. The rate of R2.4202/kWh was used to calculate an effective electricity rate applicable to the consumption of solar energy

Table 6 Electrical Tariff Structure

5.2 Energy Consumption Trends

The KUISHI KIJANI (PTY) LTD facility 5,124kWh from March 2021 to April 2022. In addition, approaximately 600L of diesel was used for the back up diesel generator.

Table 7: Energy Consumption and Costs Trends

Electricity: Prepaid Receipts - City of Tshwane							Diesel		Total
Date	**Account 1**	**Account 2**	**Account 3**	**Other**	**Total (ZAR)**	**kWh**	**Litres**	**kWh**	**kWh**
May-21	500	-	-	250	750	309.89	50.00	548.00	**857.89**
Jun-21	1,350	-	-	300	1,650	681.76	50.00	548.00	**1,229.76**
Jul-21	450	1,000	-	500	1,950	805.72	50.00	548.00	**1,353.72**
Aug-21	2,000	-	-	-	2,000	826.38	50.00	548.00	**1,374.38**
Sep-21	-	450	-	-	450	185.94	50.00	548.00	**733.94**
Oct-21	1,000	-	-	-	1,000	413.19	50.00	548.00	**961.19**
Nov-21	-	-	-	1,000	1,000	413.19	50.00	548.00	**961.19**
Dec-21	-	-	300	-	300	123.96	50.00	548.00	**671.96**
Jan-22	300	-	500	-	800	330.55	50.00	548.00	**878.55**
Feb-22	-	-	-	-	-	-	50.00	548.00	**548.00**
Mar-22	-	500	-	200	700	289.23	50.00	548.00	**837.23**
Apr-22	1,000	500	-	300	1,800	743.74	50.00	548.00	**1,291.74**
Total					**12,400**	**5,123.54**	**600.00**		**11,699.54**

The conversion from cost to energy units used R2.4202/kWh and from diesel, it is 1Litre is equivalent to 10.96kWh. Note that diesel generators of this type have a conversion efficiency of 15 to 34%. This means that for every 100litres of diesel 40litres resulted in electrical energy. This loss was not accounted for since, usually a factor of at least 20% is added to the previous year energy consumption.

Figure 2 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 drivesr for the facility is chicks and chickens produced (production units) and weather (cold degree days, CDD and heating degree days, HDD). The production units were not used in the baseline because this is primarily estimated units 2000 chicks per week and 1000 chickens every 6 weeks. The regression model cannot be used for uniform or average figures to establish a baseline. For example, is the facility uses 975kWh/month and 4,700 day-old chicks per month, the baseline would be 0.209kWh/chick. Practically, this is not feasible as so many factors affect production.

The main useful driver here is the weather, both HDD and CDD.

5.2.2 Energy Usage

Month	Energy (kWh)	HDD	CDD
May-21	857.89	147.60	39
Jun-21	1,229.76	193.20	20
Jul-21	1,353.72	229.70	14
Aug-21	1,374.38	128.70	52
Sep-21	733.94	39.90	131
Oct-21	961.19	35.40	124
Nov-21	961.19	0.20	213
Dec-21	671.96	2.40	151
Jan-22	878.55	4.00	181
Feb-22	548.00	2.70	164
Mar-22	837.23	16.00	111
Apr-22	1,291.74	77.10	43
Total	11,699.54		

HDD and CDD source

Source:	www.degreedays.net
Accuracy:	Estimates were made to account for missing data: the "% Estimated" column shows how much each figure was affected (0% is best, 100% is worst)

Station:	WONDERBOOM/PRET, ZA (28.22E,25.65S)

5.2.3 Multi-variable Analysis (HDD & CDD)

Regression analysis is a statistical analytical tool used to develop the relationship between energy usage and production. It helps, to understand this correlation, energy usage when there is no production and also establish a baseline future performance measurement. For MECS production is the only driver for energy usage and it is used in this analysis. At times, other parameters such as weather are used for analysis. In this case, the outside weather (hot or cold temperature) does not have an impact on the energy used to make the products. A remoted possibility of the weather driving energy usage would be the use of air conditioners. These aircons are however, very few and limited to offices.

In the regression linear equation, the parameters which are most useful, in simplified terms are;

- R-square value (R^2). This is the measure of confidence between energy usage and the energy drivers. It is generally agreed that this value should be above 0.75
- P-Value. This is the probability that the effect or prediction observed in the sample, or a large data range is acceptable. A large value, >0.1 means the analysis model is not acceptable and a lower p-vale, <0.1 means the model is acceptable.
- Intercept – for this linear energy and production/service relationship, this is the water or energy used when there is no production or service provision. This is also referred to as baseload.

Figure 3: Multivariable regression summary

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.732819104
R Square	0.537023839
Adjusted R Square	0.434140248
Standard Error	208.2206056
Observations	12

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	452610.7405	226305.3702	5.219722916	0.031261789
Residual	9	390202.3853	43355.82059		
Total	11	842813.1258			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	962.8921194	351.0782355	2.742671069	0.022747938	168.6979743	1757.086265	168.6979743	1757.086265
HDD	1.661278155	1.790787758	0.927680093	0.377780962	-2.3897652	5.712321509	-2.3897652	5.712321509
CDD	-1.055799725	2.154545578	-0.4900336	0.63583378	-5.929720437	3.818120988	-5.929720437	3.818120988

The model has 0.72 multiple R value, which is close to the preferred 0.75. The F and P values of more than 0.05. This would make the model and the variables irrelevant. A further analysis using the HDD value is used.

Figure 4: Energy vs HDD

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.72434175							
R Square	0.52467097							
Adjusted R Square	0.477138067							
Standard Error	200.1533276							
Observations	12							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	442199.5803	442199.5803	11.03805863	0.007716706			
Residual	10	400613.5455	40061.35455					
Total	11	842813.1258						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	795.6404424	79.0674291	10.06280907	1.50085E-06	619.4672317	971.8136531	619.4672317	971.8136531
HDD	2.453937963	0.738613483	3.322357391	0.007716706	0.808204566	4.09967136	0.808204566	4.09967136

In this model, the R^2 value is 0.52 and F and P value are below 0.05. These are acceptable figures although the 0.52 figure is below 0.75.

However, the intercept is 795kWh/month is too high. This represents the energy usage when there is no production.

5.3 Remarks

The possible conclusion and recommendations are

- The prepaid electricity figures do not necessarily fall within the same calenda month as the HDD and CDD figures
- The actual production figures not provided, but average figures of 2000 day-old chicks per week and 1000 broiler chickens per cycle. Noting also that in winter, there is no broiler production as the broiler house is not properly insulated.
- The accuracy of diesel figures can be enhanced by installing a larger storage tank, e.g. 1000L. The diesel usage would be measured and recorded on a monthly based.

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 are considered. Electricity consumption data were available with the base year (May 2021 to April 2022), and the only accurate resource for which data was available was electricity. The data for diesel are based on average monthly usage.

Thereafter, estimates are made whole facility based on 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 emissions from fuels used by owner/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 Kuishi Kijani (Pty) Ltd come from diesel generator 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

Kuishi Kijani's carbon footprint will be based on electricity data and diesel. The base year for carbon emissions calculation is from May 2021 to April 2022. Kuishi Kijani 12,000 and the equivalent carbon produced is 12.51tCO_2/year.

6.2 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.

Kuishi Kijani (Pty) Ltd 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. Kuishi Kijani (Pty) Ltd Alberton should record data, as shown in the table below.

7 DETAILED ASSESSMENT

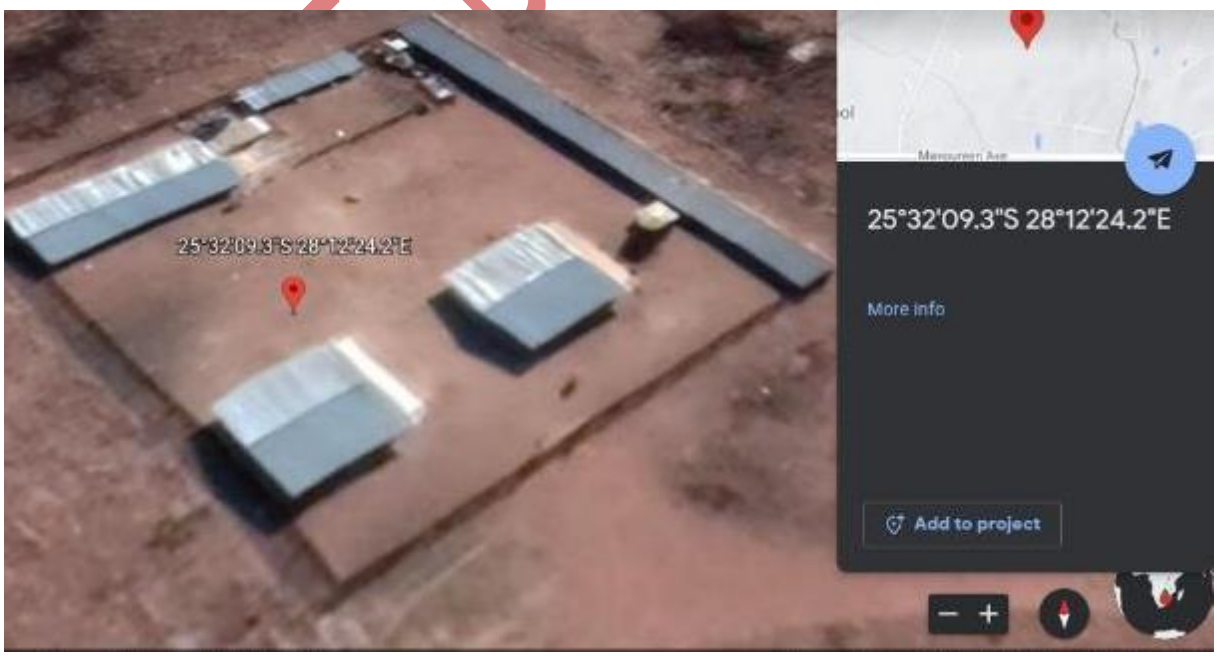
7.1 Equipment Inventory

The inventory of energy users are listed below, as well as the estimated consumption. The highest energy consuming equipment are the infrared lights for the brooders.

Energy End-User	kW	kWh/y	%
Lighting	0.32	914.78	7.8%
Brooders	3.85	5,597.90	47.8%
Borehole Pump	0.75	117.00	1.0%
Melo Chick Hatcher	1.00	2,132.30	18.2%
Setter	1.00	1,776.92	15.2%
Combined incubator/hatcher	1.20	1,064.66	9.1%
Other	1.00	58.50	0.5%
Total	**9.12**	**11,662.06**	**100%**

The maximum daily energy demand for the facility is 31.95kWh, that is 11,662.06Wh/year. The facility has plenty of space that can be installed with solar panels. A northfacing structure is recommended.

Figure 5: Space Availability



7.2 System sizing

7.2.1 Costing

The sizing of the solar PV system is indicated below. A separate Excel Sheet is available.

Table 8: Costing the Solar PV System

1 x 330Wp Solar Module	Size	Performance Factor	Peak Sun Hours	Daily Energy		Annual Energy
	Wp	%	H	Wh	kWh	kWh/y
	330	**75%**	**5.63**	**1,393.43**	**1.39**	**508.60**

Estimated energy produced for Kuishi Kijani			12,000.00	kWh/y
Required solar PV modules			23.59	
Required solar PV modules (rounded figure)			24.00	
Peak power, kWp			7.92	kWp
Module width	1001	mm	1.001	m
Module length	1993	mm	1.993	m
Area for each panel			1.994993	m2
Roof space required (flat surface design)			47.07	m2
Roof space required (rounded figure)			2,090.00	m2
Estimated installation costs (grid-tied system)			12,985.61	R/kWp
Total estimated installaiton costs			102,846.03	Rands
Estimated energy reduction			12,000.00	kWh/y
Demand reduction			7.9	kVA
Energy				
High Demand Season			2.4202	R/kWh
Low Demand Season			2.4202	R/kWh
Total estimated cost savings			29,042.40	ZAR/y
Estimated investment (materials)			102,846.03	ZAR
Total estimated costs			**102,846.03**	**ZAR**

7.2.2 Bill of Quantities

The bill of quantities are shown below. The system will have a Freedom Won Lite 10/8 LiFePO4 battery.

Table 9: Costing the Solar PV System

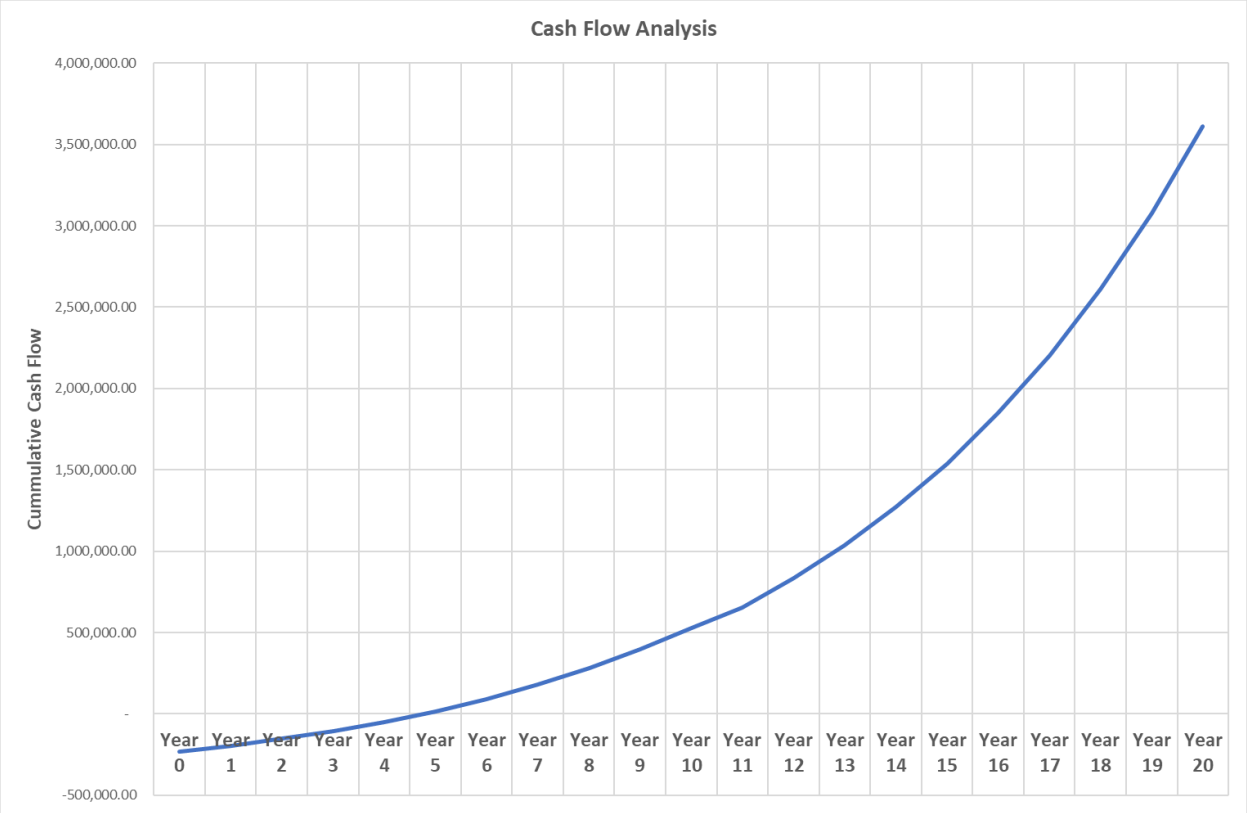
KUISHI KIJANI (PTY) LTD			
PRODUCT DESCRIPTION	**QUANTITY**	**Item cost in Rand**	**Total Cost**
SOLAR COMPONENTS			
Solar Panels -Canadian Solar 330W Super High Power Mono	24	R3,315.00	R79,560.00
Dc Combiners / Surge Arrestors / Panel fusing	1	R11,950.00	R11,950.00
Cabling & connectors	24	R31.19	R748.56
Consumables, trunking / cable securing	2	R5,293.75	R10,587.50
Sub-total Solar Components			R102,846.06
INVERTER & AC COMPONENTS			
Victron Energy MultiPlus 12/800/35-16 230V Sine Wave Inver	1	R9,057.14	R9,057.14
3 Phase Board / Cabling % Isolators	1	R11,001.25	R11,001.25
Sub-total			R20,058.39
Battery Back Up			
Freedom Won Lite 10/8 LiFePO4 Battery	1	R58,173.91	R58,173.91
Accessories	1	R4,933.13	R4,933.13
Sub-total			R63,107.04
INSTALLATION & COMMISSIONING			
Installation of Pv Mounting Rails and Panels	24	R950.00	R22,800.00
Applications / COC	1	R15,000.00	R15,000.00
Miscellaneous	1	R6,188.51	R6,188.51
Sub-total			R43,988.51
Total for the supply and installation of Grid-tied PV system inxcluding VAT			R230,000.00

7.2.3 Cash Flow Analysis

Kuishi Kijani - Grid-Tied PV System with battery back up					
Input Design Parameters					
PV plant size:	10.00	kWp			
Specific cost:	23,000	ZAR/kWp			
Total cost (CAPEX):	230,000	ZAR/kWp			
Solar irradiation:	1,750	kWh/m²/a			
Performance Ratio:	75%				
Specific yield:	1,313	kWh/kWp			
Total yield:	13,125	kWh/a			
Project duration:	20	years			
Equity:	100%	230,000	ZAR		
Debt:	0%	0	ZAR		
Debt interest:	0%				
Discount rate:	7.5%				
OPEX (in % of CAPEX)	3%	6,900	ZAR p.a.		
Inverter replacement after	10	years			
Specific inverter cost:	3000	ZAR/kWp			
Total replacement cost:	30,000	ZAR/kWp			
Panel degradation:	0.50%	p.a.			

Solar PV System Annual Project Values								
Year	CAPEX [ZAR]	OPEX [ZAR]	Expenditure	PV System Energy Yield		Discount factor	Discounted values	
			Total [ZAR]	Annual [kWh]	Cummulative [kWh]		Total Expenditure [ZAR]	Energy Yield [kWh]
0	230,000	-	230,000	0	0	1.00	230,000	
1	0	6,900	6,900	13,125	13,125	0.93	6,419	12,209
2	0	6,900	6,900	13,059	26,184	0.87	5,971	11,301
3	0	6,900	6,900	12,994	39,178	0.80	5,554	10,459
4	0	6,900	6,900	12,928	52,106	0.75	5,167	9,681
5	0	6,900	6,900	12,863	64,969	0.70	4,806	8,959
6	0	6,900	6,900	12,797	77,766	0.65	4,471	8,292
7	0	6,900	6,900	12,731	90,497	0.60	4,159	7,674
8	0	6,900	6,900	12,666	103,163	0.56	3,869	7,102
9	0	6,900	6,900	12,600	115,763	0.52	3,599	6,572
10	0	6,900	6,900	12,534	128,297	0.49	3,348	6,082
11	30,000	6,900	36,900	12,469	140,766	0.45	16,655	5,628
12	0	6,900	6,900	12,403	153,169	0.42	2,897	5,208
13	0	6,900	6,900	12,338	165,506	0.39	2,695	4,819
14	0	6,900	6,900	12,272	177,778	0.36	2,507	4,459
15	0	6,900	6,900	12,206	189,984	0.34	2,332	4,125
16	0	6,900	6,900	12,141	202,125	0.31	2,169	3,817
17	0	6,900	6,900	12,075	214,200	0.29	2,018	3,531
18	0	6,900	6,900	12,009	226,209	0.27	1,877	3,267
19	0	6,900	6,900	11,944	238,153	0.25	1,746	3,023
20	0	6,900	6,900	11,878	250,031	0.24	1,624	2,796
Total							**313,882**	**129,002**
						LCOE:	**2.433**	**ZAR/kWh**

Tariff	2.4202	R/kWh	Cummulative Savings & Expenditure		
Annual Increases	Average Tariff	Energy Cost Savings	Cummulative Energy Cost Savings	Cummulative Exenditure	Net Cash Flow
	R/kWh	ZAR/y	ZAR /y	ZAR//y	ZAR/y
15.0%	2.7832	-	-	230,000.00	230,000.00
15.0%	3.2007	42,009.38	42,009.38	236,900.00	194,890.62
15.0%	3.6808	48,069.23	90,078.61	243,800.00	153,721.39
15.0%	4.2329	55,001.83	145,080.44	250,700.00	105,619.56
15.0%	4.8679	62,932.65	208,013.08	257,600.00	49,586.92
15.0%	5.5981	72,005.17	280,018.25	264,500.00	15,518.25
15.0%	6.4378	82,383.47	362,401.72	271,400.00	91,001.72
15.0%	7.4034	94,255.14	456,656.86	278,300.00	178,356.86
15.0%	8.5140	107,834.68	564,491.54	285,200.00	279,291.54
15.0%	9.7911	123,367.34	687,858.88	292,100.00	395,758.88
15.0%	11.2597	141,133.52	828,992.40	299,000.00	529,992.40
15.0%	12.9487	161,453.80	990,446.20	335,900.00	654,546.20
15.0%	14.8910	184,694.64	1,175,140.84	342,800.00	832,340.84
15.0%	17.1246	211,275.04	1,386,415.88	349,700.00	1,036,715.88
15.0%	19.6933	241,673.92	1,628,089.80	356,600.00	1,271,489.80
15.0%	22.6473	276,438.78	1,904,528.57	363,500.00	1,541,028.57
15.0%	26.0444	316,195.43	2,220,724.00	370,400.00	1,850,324.00
15.0%	29.9511	361,659.20	2,582,383.21	377,300.00	2,205,083.21
15.0%	34.4437	413,647.71	2,996,030.92	384,200.00	2,611,830.92
15.0%	39.6103	473,095.45	3,469,126.37	391,100.00	3,078,026.37
15.0%	45.5518	541,070.42	4,010,196.79	398,000.00	3,612,196.79



The breakeven point is at year 4.5

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 10: Summary of recommendations

Facility	Capacity (kWp)	Energy Yield (kWh)	No of Modules	Energy Revenue	Capital Cost	TCO_2	Payback
Facility	10	12,000	24	R29,042	R230,000	12.51	8

9 CONCLUSION

Kuishi Kijani (Pty) Ltd can install rooftop solar panels on any of the the two (2) buildings and generate much-needed energy from Solar PV. The plot has enough space expand using ground mounted systems.