INDUSTRIAL EFFICIENCY IN SOUTH AFRICA

REPORT

# Gauteng Department of Economic Development (GDED) SME Green Support Incentive Program Technical Report

**FOR**

# Xubera Projects

***(Trading as Rina Guesthouse)***

**TECHNICAL REPORT**

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Department:
Trade, Industry and Competition
REPUBLIC OF SOUTH AFRICA

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**Prepared for:** **Xubera Projects (Trading as Rina Guesthouse)**
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## ACKNOWLEDGEMENTS

This report was prepared on behalf of the National Cleaner Production Centre South Africa by **Mega Unit Consultancy**, and the NCPC-SA wishes to acknowledge the work undertaken by **Molebatsi Ramahudu**

I **Molebatsi Ramahudu** in my capacity as the technical consultant hereby confirm that I have assessed **Xubera projects** and have analysed and compiled this Resource Efficiency & Production Assessment report, and I confirm that all the report findings and representative reflection of the current production status of **Xubera projects.**

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| **Company representative** | Thabani Zondi | | |
| **Regional / Program Manager** | | | |
| **DISTRIBUTION:** | | | |
| **Company** | **Contact Person** | **Copy Number** | |
| **Error! Reference source not found.** | Thabani Zondi | 1 - 3 | |
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**FILENAME, TEMPLATE AND VERSION CONTROL**

## EXECUTIVE SUMMARY

The National Cleaner Production Centre, South Africa (NCPC-SA) and the Gauteng Department of Economic Development (GDED) invited Small and Medium Enterprises (SME's) based in the Gauteng Province to apply for support from the Green Support Programme. The programme aims to provide relief to SME's affected by power interruptions and the economic downturn of the past two years by supplementing a portion of their energy needs with renewable and efficient energy technologies. The programme is aimed at providing financial support for renewable energy implementation at the operations of SMEs affected by the economic downturn of the past two years.

This report serves as a due diligence for a solar Photo Voltaic (PV) system under which the main aim was to determine the alternate supplementary energy source for Xubera Projects as guided by their needs. The study is related to challenges of load shedding that disrupts business operations. This report takes into account the current status and needs of Xubera Projects with regards to electricity usage and business prospects.

The methodology consists of the assessment procedure, literature consultation, and additional online resources. All in all, the status of and capacity of the site's needs is outlined and measures with regards to the solar irradiation (South Africa, Pretoria) are used to estimate possible solar PV output per month with respect to corresponding cost analysis.

### Key Findings and Recommendations

- Xubera Projects has not implemented any cleaner productions interventions.
- The guesthouse uses prepaid electricity, and the estimated annual electricity consumption is based on an energy balance calculated.
- The annual electricity consumption is 19 103 kwh/year, amounting to R37 252,
- The system was designed based on the energy required to run the business with minimal interruptions taking into account the Green Support incentive budget cap of R220 000.
-

The proposed solar PV system will generate 9.78 kWp with a 20-kWh battery storage. The potential energy savings a year is 16 238 kWh equivalent to R31 664 /year. The project requires an investment of R223 856 with a payback period of 7.07years. The $CO_2$ offset from the use of renewable energy (solar PV) is 16.93 tons a year.

## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| $CO_{2e}$ | Carbon dioxide equivalents |
| CP | Cleaner Production |
| Deg. C | Degrees Celsius |
| HRS | Hours |
| IPA | In-Plant Assessment |
| kWp | Kilowatt peak |
| R/W | Rands per Watt |
| GDED | Gauteng Department of Economic Development |
| GHG | Greenhouse Gas |
| MWh | Megawatt Hour |
| PV | Photovoltaic |
| $M^2$ | 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 |
| W | Watts |

**CONTENTS**

# 1. INTRODUCTION

Rina Guesthouse is a 2-star hotel situated in Pretoria area, Gauteng. It offers excellent hospitality to short-stay guests. The guesthouse has 8 spacious and comfortable rooms with modern amenities. The suites come with a kitchenette, living room, bathroom with a shower and bathtub. The Guesthouse has 3 full time employees and has a 24/7 operating model.

The assessment commenced on the 24th of June 2022 with an inception meeting followed by a site walkthrough to identify scope and boundary. During the site walk, observations were made where an electrical equipment register was established. The objective was to identify all the energy inputs with its use and the electrical load according to its discrete function.

This project forms part of the National Cleaner Production Centre's Resource Efficient and Cleaner Production (RECP) Programme, whose objectives are to assist companies in different industry sectors achieve sustainability and competitiveness through resource efficient production practices.

The 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. The NCPC-SA is responsible for conducting the on-site assessment and the whole project life cycle at Xubera projects.

The assessment consisted of evaluating the company's RECP management practices, observing the operations of significant resource users. This report discusses the findings of the assessment as well as providing proposals for resource efficiency interventions that can be implemented at the new factory. The interventions are evaluated for feasibility in terms of estimated investment cost savings and simple payback period.

## 2. PROJECT METHODOLOGY

The adopted methodology is comprised of data collection, analysis, and measures as guided by the cleaner production principles, supported by online resources and literature.

Scope and Boundary

The focus of the assessment is on the entire operations of Xubera projects with the emphasis on electricity usage within the factory and the scope is to conduct a solar PV feasibility study as shown by the methodology below in **Error! Reference source not found.**.


*Figure 1: Overview of the project methodology*

The following steps were followed to conduct a solar PV feasibility study:

- Study the existing factory capacities and its performance to assess its operations.
- Collection of requisite data to analyse and identify areas with potential for conservation of energy.
- Determine the overall electricity usage using the electrical register and calculate electricity consumption per department/section.
- Measurements of operational parameters and calculations of energy balance.
- Design a solar PV system based on the collected data, online resource such as PVGIS software and literature studies.
- Calculations of cost benefit analysis in terms of savings in energy consumption and pay-back period.

## 3. COMPANY INFORMATION


**Company information table**:

| | |
|---|---|
| Company name | Xubera Projects trading as Rina Guesthouse |
| Address | 11 Inez St, Sunnyside, Pretoria, 0002 |
| Phone, Fax | 27 (0) 82 236 1924 |
| e-mail | Xubera.projects@gmail.com |
| Website | - |
| Trading since (year) | 2021 |
| No. of Employees | 3 |
| Company size | Micro-Enterprise |
| Annual turnover in rand value | - |
| Industrial Process used | Tourism Facility |
| **Onsite Project Team:** | |
| Assigned Project Manager and position within the organisation | *These are the people who will be trained on how to operate the solar system including M&E processes* |
| Team members and positions | |
| **Contact person:** | |
| Name | Thabani Zondi |
| Position | Manager |
| Phone & mobile numbers | 27 (0) 82 236 1924 |
| Email address | |

# 4. PRODUCTION PROCESSES

## 4.1. Process Description

The facility is a tourism facility with an average occupancy of 20 guests per month.

## 4.2. Process Flow Chart

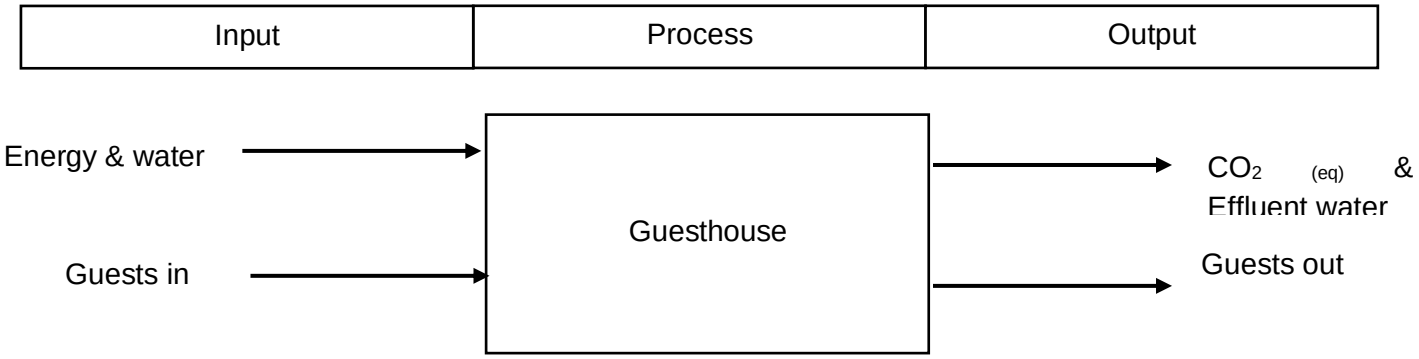


Figure 2: Xubera process flow

## 4.3. Production data

Xubera projects has no records of occupancy data

# 5. CURRENT ENERGY CONSUMPTION DATA

## 5.1. Energy data

Xubera projects purchases electricity units of a range of R2000 – R2500 monthly and does not keep record of monthly receipts.

### 5.1.1. Site energy trend

The figure below shows electricity usage per equipment used in in the guesthouse. This was calculated using an electrical register that was compiled during a site walkthrough. The guesthouse appliances and HVAC system consumes most of the electricity as opposed to others equipment's.

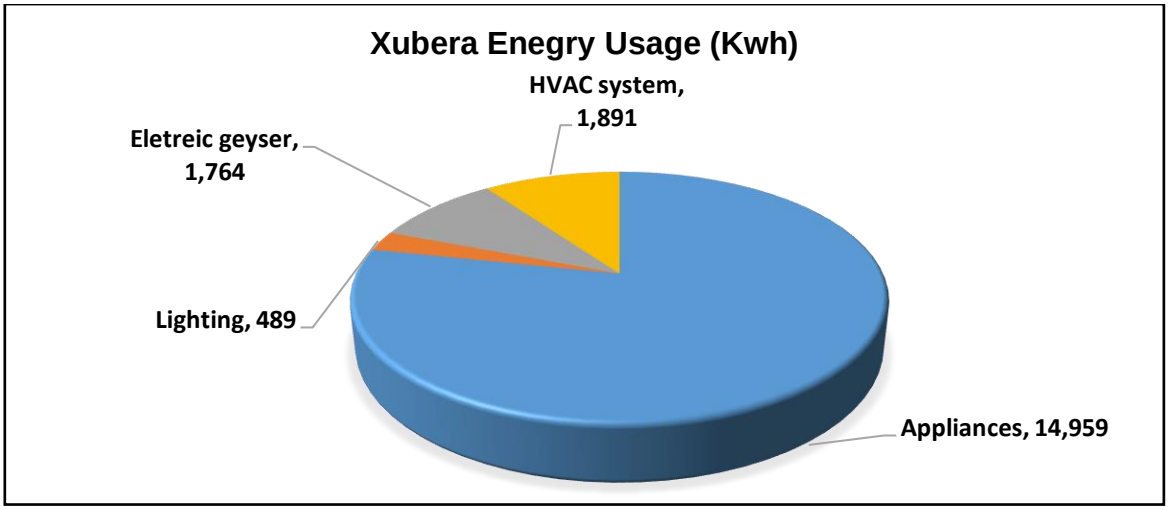


*Figure 3: Energy consumption and energy costs per month*

### 5.2. Baseline Data

A baseline could not be calculated due to the unavailability of monthly electricity and production data.

## 6. RENEWALABLE ENERGY SOLUTION

### 6.1 Description of the renewable energy

As already highlighted, South Africa has some of the highest solar irradiation in the world, with measures amounting to about 263-278W/m$^2$ (Figure 4). This gives an ideal space for large and small solar PV installation. However during winter, the irradiation subsides (Figure 5: 3.9kWh/m$^2$ as compared to summer with a 7kWh/m$^2$) it is still commercially viable to reduce significant amount of energy demand from the national grid.

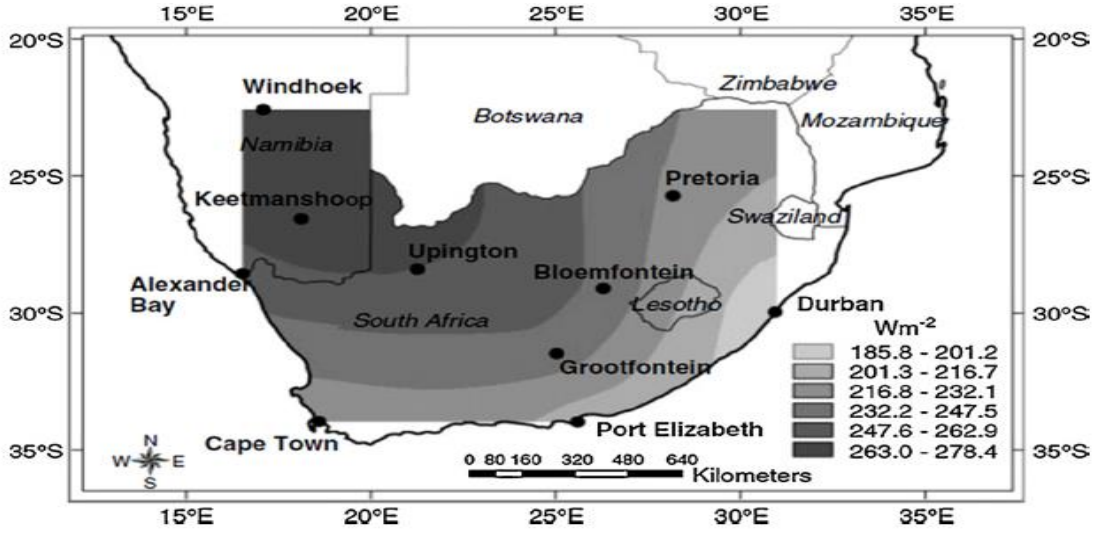


Figure 4: South Africa's solar irradiation capacity per region [1]

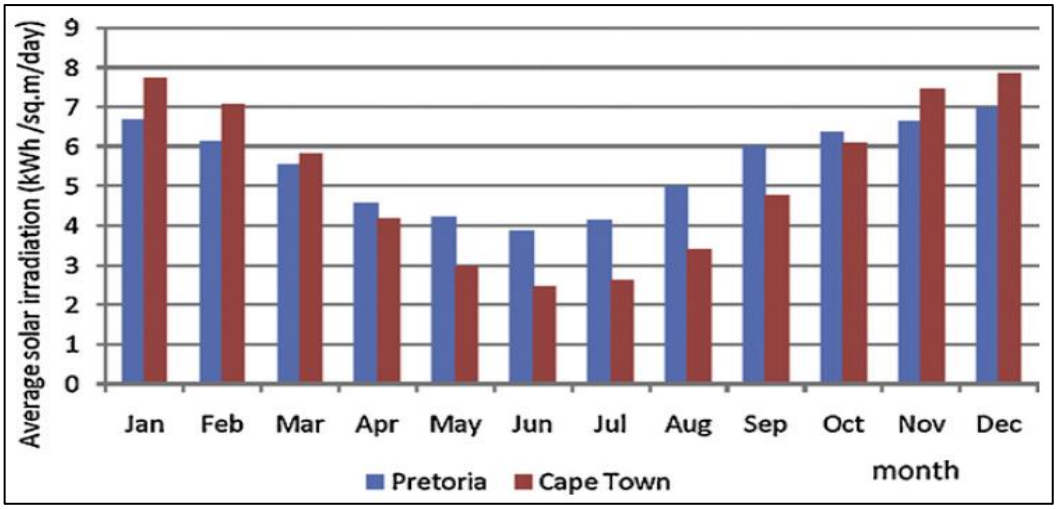


Figure 5: Average monthly solar irradiation in the north and south of South Africa

## 6.2 System Design

This section outlines the sizing of the solar PV system along with related cost measures that determines the financial feasibility (**Error! Reference source not found.**) of the system.

*Table 1: Solar PV system specifications and cost measures*

| | | |
|---|---|---|
| Estimated annual electricity demand (kwh) | 19,103 | kwh |
| Energy costs | 37,252 | Rands |
| Daily load (kwh) | 52 | kwh |
| Specific yield based on PV GIS | 1,661 | kWh/kWp/year |
| PV Generator Size (CANADIAN SOLAR CS3W- 400P) | 400 | Wp |
| KODAK off grid inverter 10kw 48V | 1 | |
| Number of panels (400W/panel) | 24 | modules |
| System production (kWh/annum) | 16,238 | |
| System production (kWh/day) | 44.5 | |
| Battery (kWh/day)/Storage | 20 | |
| Number of batteries (21.3kWh/battery) | 1 | |
| | | |
| Energy costs savings | R31,664 | Rands |
| CO2 equivalence reduced | 16.93 | tCO2/year |
| Investment costs | R223,856 | Rands |
| Payback period | 7.07 | Years |

## 6.3 System configuration

The following table shows the main components and the cost breakdown of the proposed solar PV system.

*Table 2: Solar PV system costs*

| **Main components** | # | Unit Price | Total |
|---|---|---|---|
| PV Generator Size (CANADIAN SOLAR CS3W- 400P) | 24 | R3,200 | R78,201 |
| KODAK OG-1 10kw 48v off grid Hybrid inverter | 1 | R23,304 | R23,304 |
| Pylontech Force Series - Force L1 21.31 | 1 | R55,000 | R55,000 |
| | | | |
| **Balance of system** | | | |
| Cables (DC and AC) | | | R6,000 |
| Mounting system (rails, hooks, clamps etc.) | | | R4,000 |
| Switches and safety devices | | | R2,000 |
| Monitoring system | | | R15,000 |
| Installation costs | | | R20,000 |
| Contingency (10%) | | | R20,350.58 |
| | | | |
| **Total Excl. Vat** | | | R223,856 |

## 6.4 Installation process

The main steps of installing a solar panel system includes: an engineering site visit by the installer, acquiring a permit and documentation from the municipality and other relevant parties. Ordering equipment, solar panel installation and approval from a registered electrical engineer or PV Green card holder. The final installation process will be confirmed by installer and Xubera projects representative.

### 6.5 System Capability and Output – Metering of the Solar System

The projected annual energy cost savings is R31 664 /year, which is 85% of the annual electricity bill. The project investment cost is R223 856 including labour installations with a payback period of 7.07 years

### 6.6 System Operation and maintenance

Sunlight is captured within photovoltaic cells and transported to an inverter where it is converted from direct current DC electricity to usable AC electricity. The figure below shows the projected monthly energy production of solar panels.

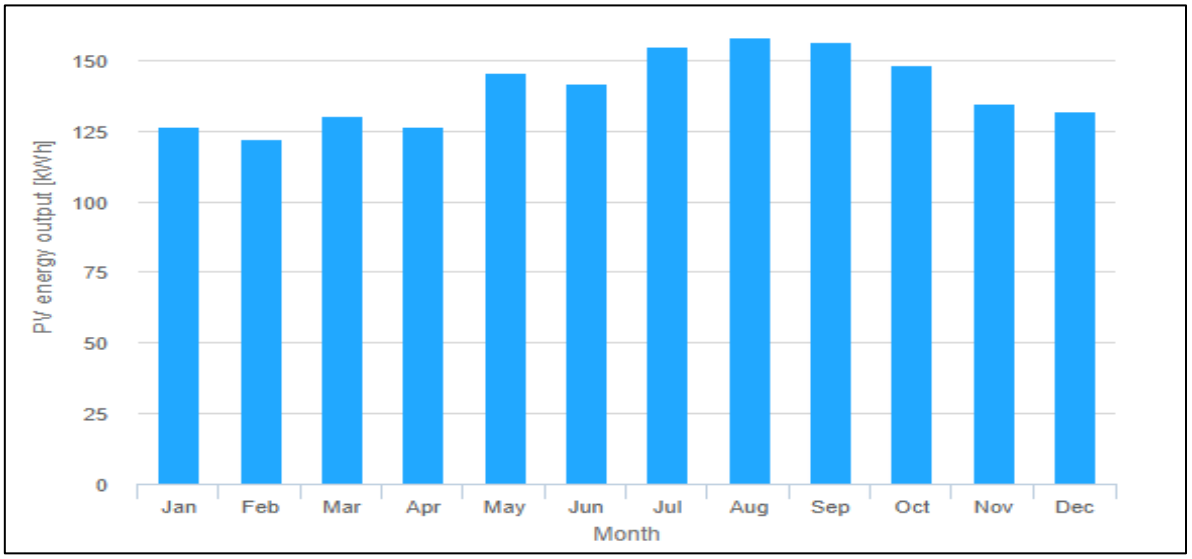


Figure 6: Projected energy yield

Solar panels require minimal maintenance to ensure that they keep working properly and producing the optimal solar energy as shown in figure 7 above. The panels need to be cleaned twice a year to remove dirt and debris. Annual inspection should be done by a professional solar panel inspector and inspect if the solar panels get the optimal amount of sunlight. Maintenance appointments should be scheduled when needed and if Xubera projects notice any problem with solar panels. Problems that can occur is the reduction of energy output resulting an increase in electricity bill.

## 7. CLEANER PRODUCTION RECOMMENDATIONS

The proposed system is called a Hybrid system it runs on solar power and grid electricity. The maximum daily energy demand for the guesthouse is 52 kWh/day, which is 19 103 kWh/year. The projected annual energy produced is 16 238 kWh/year, therefore, the solar system can supply 85% of the guesthouse energy use.

The solar system will have a battery backup of 20kWh lithium battery to power the production in case there's inadequate power supply from the PV modules. The recommendation is considered as a high costs/CAPEX because it has a payback period of more than 2 years.

## 7.1 Evaluation and Feasibility of the Opportunities

The environmental evaluation of the system on an ideal scenario is that the annual electricity generation of 16 238 kWh, will save about 16.93 $CO_{2\ (equivalence)}$. This will add to reduce expenditure on electricity. Figure 8 below shows the financial projections of how the system can be beneficial to the site. In a 10 years period the potential energy costs to the municipality will be R794 258. This happens because of the forever increasing electricity prices from the services provider, with the installation of a solar system, the factory can save about R595 693.

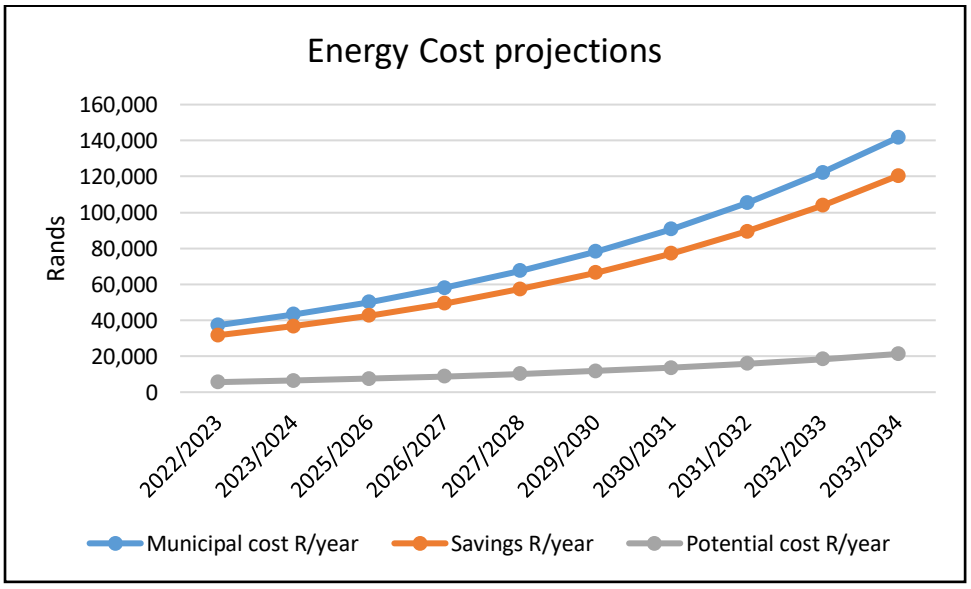


Figure 7: Projected financial performance of the system

## 8. IMPLEMENTATION PLAN

The following steps should be included in developing implementations plan, the project timeline should be re-examined after execution of every step and be adjust should there be a need.

| Implementation steps | Notes | Timeline |
|---|---|---|
| Project planning | Plan to take into account operational schedule, material lead times, permitting and utility inter connection requirements | 1-2 weeks |
| Securing permits | Securing permits takes the longest lead time. | 1 month |
| Schedule review | Schedule should be reviewed with operations staff and Solar system installers. | 1-2 weeks |
| Installation | Installation of solar Pv system | 2-4 weeks |
| Municipality/Engineer sign off | Solar Pv System to be reviewed and signed off | 2-4 weeks |
| On – going performance monitoring | Performance should be monitored against forecast | On – going, post installation |

## 9. CONCLUSION(S)

The site can be able to capitalise on an alternate source of energy in relation to their challenges. Over a period of 10 years the guesthouse will realise a considerable amount of energy savings. This will surely contribute to increased profits that will continue to promote business growth and Gauteng province's economic growth at the SMME level's capacity. At this point of the project, specifics with regards to the type/brand of the system are not highlighted as they will be at hand of the client or later on recommended by the consultant should there be a necessity.

## 10. APPENDICES

Appendix 1: Solar sizing iterations

| | | | |
|---|---|---|---|
| **Climate information** | | | |
| | | | |
| Annual electricity demand (kwh) | 19,103 | kwh | |
| Energy costs | 37,252 | | |
| Annual operation Hrs. | 365 | | |
| Daily load (kwh) | 52 | kwh | |
| Specific yield based on PV GIS | 1,661 | kWh/kWp/year | |
| | 4.55 | kWh/kWp/day | |
| Maximum Global irradiance (G(i)) | 1,146 | W/m2 | |
| **PV generator** | | | |
| PV Generator Size (CANADIAN SOLAR CS3W- 400P ) | 400 | Wp | |
| Module outside Width | 1048 | mm | |
| Module outside Length | 2,108 | mm | |
| Roof length | 16.59 | meter | |
| Roof Width | 10.5 | meter | |
| Available mounting area | 174.195 | m2 | |
| | | | |
| **PV Generator Size - based on Consumption** | | | |
| Generator size /PV capacity needed (in kWp) | 11.50 | kWp | |
| | 9.78 | kWp | |
| **Number of modules** based on generator size | 24 | modules | |
| **Power sizing for inventor** | | | |
| Ppv-DC | 9.78 | kWp | |
| Inverter 20% smaller than PV Generator | 7.82 | < inverter AC > | 11.73 |
| | | | |
| | | | |
| Suitable Inverter AC Output range | **9.20 kw to 13.80 kw** | | |
| **KODAK off grid inverter 10kw 48V** | **R20,304** | | |

| | | | |
|---|---|---|---|
| Inverter Maximum input Voltage: | 500 | V | |
| Inverter MPP range: | 125-425 | V | |
| Inverter Start/Min voltage: | 150 | V | |
| Number of MPPTs: | 2 | | |
| Max input Current per MPPT: | 18 & 9 | A | |
| **Battery Sizing** | | | |
| | | | |
| Capacity | Daily Energy Consumption * Autonomy/DoD * System voltage | | |
| | | | |
| Customer's backup consumption 8 hrs. | | | |
| Autonomy time | 8 | Hrs. | |
| DoD (Depth of Discharge) | 90% | for lithium | |
| System Voltage DC | 48 | V | |
| Battery Capacity | **19.4** | kwh | |
| | | | |
| Battery chosen: Pylontech Force Series - Force L1 | | | |
| Battery Module 6 | | | |
| Battery system capacity: 21.31 kWh | | | |
| No of Batteries in Battery Bank | 1 | | |
| **Cost benefit analysis** | | | |
| Current Energy consumption | 19,103 | | |
| Energy costs | 37,252 | | |
| Potential yield | 16,238 | | |
| Energy savings | 31,664 | | |
| % Savings | 85% | | |
| CO2equivelance (tCO2/year) reduced | 16.93 | | |
| Payback year | 7.07 | | |

Appendix 2: Annual energy trend for solar PV production

| Pretoria irradiation (kWh/m$^2$/month) | | % Irradiation/m$^2$/month | Solar generation kWh/60m$^2$/month |
|---|---|---|---|
| Jan | 6,8 | 10% | 2069 |
| Feb | 6 | 9% | 1826 |
| Mar | 5,5 | 8% | 1673 |
| Apr | 4,5 | 7% | 1369 |
| May | 4,1 | 6% | 1247 |
| Jun | 3,9 | 6% | 1187 |
| Jul | 4,1 | 6% | 1247 |
| Aug | 5 | 8% | 1521 |
| Sep | 6 | 9% | 1826 |
| Oct | 6,2 | 9% | 1886 |
| Nov | 6,7 | 10% | 2039 |
| Dec | 7 | 11% | 2130 |
| Total | 65,8 | 100% | 20020 |

11.

Appendix 3: Detailed financial projections of the system

| | **Municipal consumption kWh/year** | **Solar generation kWh/year** | **Savings kWh/year** | **Incremental R/kWh** | **Municipal cost R/year** | **Savings R/year** | **Potential cost R/year** |
|---|---|---|---|---|---|---|---|
| 2020/2021 | 19,103 | 14,328 | 4,776 | 1.95 | 37,252 | 27,939 | 9313 |
| 2021/2022 | 19,103 | 14,328 | 4,776 | 2.26 | 43,212 | 32,409 | 10803 |
| 2022/2023 | 19,103 | 14,328 | 4,776 | 2.62 | 50,126 | 37,594 | 12531 |
| 2023/2024 | 19,103 | 14,328 | 4,776 | 3.04 | 58,146 | 43,609 | 14536 |
| 2024/2025 | 19,103 | 14,328 | 4,776 | 3.53 | 67,449 | 50,587 | 16862 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2025/2026 | 19,103 | 14,328 | 4,776 | 4.10 | 78,241 | 58,681 | 19560 |
| 2026/2027 | 19,103 | 14,328 | 4,776 | 4.75 | 90,760 | 68,070 | 22690 |
| 2027/2028 | 19,103 | 14,328 | 4,776 | 5.51 | 105,281 | 78,961 | 26320 |
| 2028/2029 | 19,103 | 14,328 | 4,776 | 6.39 | 122,126 | 91,595 | 30532 |
| 2029/2030 | 19,103 | 14,328 | 4,776 | 7.42 | 141,666 | 106,250 | 35417 |
| **Total** | **191,034** | **143,275** | **47,758** | **4** | **794,258** | **595,693** | **198,564** |

## 12. LIST OF TABLES AND FIGURES