ESTABLISHING THE REAL TIME MULTIDIMENSIONAL ENERGY MANAGEMENT SYSTEM ["RMEMS"] [ALSO KNOWN AS AN "ENERGY VAULT"] FOR THE KANNALAND LOCAL MUNICIPALITY AS THE FIRST ONE OF THE 120 IMPLEMENTATION PROJECT SITES IN SOUTH AFRICA

FEASIBILITY STUDY REPORT:

PART B: FEASIBILITY OF INTERVENTIONS

Submission Period: November 2018

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Project No:	1

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1. THE TECHNICAL AND COMMERCIAL PROPOSAL

1.1 Introduction to INOVASURE's Kannaland Local Municipality Case

In developing the framework and content of this comprehensive Feasibility Report for the intended submission to the Development Bank of Southern Africa (DBSA) as the proposed Mandated Lead Arranger for the syndication of the funding for the InovaSure Kannaland Energy Vault Project, as well as the other 119 Energy Vault Projects throughout South Africa, the needs of the Kannaland Municipality are acknowledged.

To best understand the needs of Municipalities, the Kannaland Case is referred to in this feasibility report.

The Needs of the Kannaland Municipality

In the case of the proposed RMEMS development for the Kannaland Local Municipality and other Municipalities to follow, a financial model was adopted that initially was developed for the Kannaland Local Municipality as two phases. The latter mentioned model[1] was developed in line with the original Memorandum of Understanding (MoU) that was entered into between Kannaland Local Municipality and Sun Graft in September 2012, which was in turn transferred to **INOVASURE** (Pty) Ltd for various Project Proposals, all of which were finalised and encapsulated in the submitted final Project Proposal[2] during October 2018 that was approved by the Municipality as an Energy Security Management and Administration

[1] "Feasibility Reports: Financial Model, 04.01a and 04.01b Kannaland phase 1 & phase 2", dated November 2018
[2] The INOVASURE Memorandum of Agreement (MOA) & ESMA Agreement proposal dated 9 October 2018

("ESMA") **Agreement. The original MoU was established in order to deal with energy and water related service deliveries.**

This MoU, as replaced by the ESMA Agreement, made provision for **INOVASURE** to fund, construct, install and operate the proposed and so-called "Energy Vault" that would also later apply to the 119 other implementation sites in South Africa, i.e:

- The Kannaland Local Municipality would own the installed power plant which would be operated by **INOVASURE** for the period of 25 years in terms of the Power Purchase Agreement and the Municipality would assist with the interconnection and **INOVASURE** would carry the cost of the substation and the connection of the substation to the current distribution; and
- The case study of the Kannaland Local Municipality InovaSure Energy Vault Project would be reviewed during the next phases of the implementation and roll-out of the InovaSure ESMA agreements at **Energy Vault** projects in South Africa with funding that would be provided by institutions such as the New Development Bank (NDB) and the DBSA, or in fact any other suitable Development Finance Institution/s.

The Kannaland Local Municipality believes that it has complied with the requirements of the Municipal Supply Chain Management (SCM) Regulation 32 of 2005 (Regulation 32) as according to the Municipal Finance Management Act 56 of 2003 (MFMA) in recommending that any other Municipality could also in due course make use of the services of **INOVASURE** and its various collaborators in the provision of the ***ENERGY SECURITY*** Program.

The General South African landscape

No solution is worthwhile considering unless it can be supported by metrics that adequately provides sustainability, while at the same time rewarding commercial risk. Given time and huge savings on the Government's nuclear solution which is now estimated by the IRP (Integrated Resource Plan of Government), at 6000 kWh at a R1 Trillion cost, Eskom, with the Political Will behind it, could possibly solve the energy problem in South Africa. However, the country does not have time to wait for this to happen, neither should it commit the funds as long as a solution, such as the one provided by INOVASURE, is available.

Based on some 120 installed storage units of 53.5 MWh each across the country, as the base for the model described here, the metrics of the **INOVASURE** project at T_0 (Time Zero) is to "**Generate 2400 MW of power into the grid at peak-times":**

- The total investment over time is estimated to be approximately R120-R150 billion;
- The INOVASURE estimated IRR is of 20% +;
- The estimated energy savings for Eskom will be between 5% and 8% equating to some R 8 billion in investment for Eskom;
- The Carbon footprint reduction will be enormous but initially difficult to quantify. A best guess is 1 130 000 in CERs;
- The Climate change impact measured in terms of reduction of traditional power use will be between 5% and 8%;
- The estimated jobs created in construction will be approximately 40 000 over a 5 to 7 year period;
- The estimated number of permanent jobs created will be approximately 15 000; and
- In the case of the commercial ESMA agreement, the debt considered to be removed from the various Municipalities' balance sheets as part of **LIVESURE's** program will be equal to approximately R10 billion (the approximate current debt) within 3 to 5 years.

INOVASURE's business model

INOVASURE's business model is predicated on COLLABORATION with its customers, in this instance the chosen implementation project for the Local Municipality of Kannaland (comprising Calitzdorp, Ladismith and Zoar) as one of the pilot sites and 119 similar other sites across South Africa.

For purposes of the Business Case, one of **INOVASURE's** first projects in terms of which the feasibility and viability of the **INOVASURE** ***ENERGY SECURITY*** MODEL will be executed by means of the ENERGY VAULT, is the **KANNALAND LOCAL MUNICIPALITY (KLM)** with the following characteristics:

- The Municipality is a Category B, Grade 3 Local Municipality as defined by the Municipal Structures Act no. 117 of 1998;
- It is located in the Garden Route District Municipality area in the Western Cape.

1.2 The Technical and Commercial Proposal – Photo Voltaic Renewable Energy in conjunction with Large Scale Storage

It is technically feasible for Renewable Energy Technologies (RET) to replace the present fossil fuel electricity infrastructure, however; economic barriers remain the primary impediment.

PV is considered a clean, sustainable, renewable energy conversion technology, whilst reducing the adverse anthropogenic impacts of fossil fuel use. The deployment of PV worldwide since 2000 has increased from 0.26GW to 16.1 GW with an annual growth rate of more than 40%, due to technological innovations that have reduced manufacturing costs by 100 times.

It was considered that the tipping point for Solar PV adoption was when the technology would achieve grid parity given that conventional-powered electricity prices are rising whilst PV installed prices are falling. 'Grid parity' refers to the lifetime generation cost of the electricity from PV being comparable with the electricity prices for conventional sources on the grid.

The ESMA Agreement entered into between **INOVASURE** and the Kannaland Local Municipality for a period of 25 years provides for the supply of up to 50MW of power generated using a Photovoltaic Power Plant.

The plan is to begin immediately with 1MW to get the systems up and running in Phase 1, along with the 53MWh battery, and then in Phase 2 to ramp up to 25MW Photo Voltaic capacity (with another 53MWh battery) for export to other Municipalities in the District and in Phase 3 to ramp up to 50MW Photo Voltaic capacity with more capacity planned for further phases for further exports to the other District Municipalities.

The benefits of the production of power with no fuel cost would be evident during the period of 25 years being the expected minimum lifespan of the power plant. It is regarded that the above is an elegant solution for South Africa in addressing the risk of extraordinary increases in energy costs, as well as the high risk of interruptions to the electricity supply, which would cause further pressure on the economic slowdown.

Sun Graft originally approached the Kannaland Local Municipality to explore the possibilities of creating power generation capacity in collaboration with the Municipality. This was quickly recognized as being of strategic and economic importance and the decision to explore the opportunities further, was taken.

1.3 High-Level Business Plan

Objective

The objective of the project is to save off-peak power from the Utility Provider (Eskom) at cheap rates, to store it in large scale batteries (53MWh) and then to deploy the power into the Municipality's Distribution Network during peak-times – so introducing energy "arbitrage". In addition, the objective is to further co-generate electricity from Renewable Energy resources (i.e., solar PV) to provide power to the Kannaland power grid at rates better than that provided by Eskom and to optimise the storage thereof of off-peak by means of also storing it in the large scale batteries for use during peak periods.

The proposed PV facility will during its optimum phase have a generating capacity of 50MW and based on the local solar irradiation resource and the project activity is expected to deliver an annual average of 76 000MWh for deployment to the Utility Scale batteries for storage, or direct injection to the required Network in Distribution or by means of wheeling in Transmission to other Municipalities in the Garden Route District.

The PV project and Battery Storage facility will comprise of the following infrastructure:

- An array of photovoltaic (PV) panels (of up to 3m in height) of up to 50MW (or more);
- A Battery Storage facility of 20MW-53MWh located in the centre of the PV field, which can be doubled for more storage capacity of 40MW – 106MWh;
- A 132 kV substation with high-voltage (HV) yard footprints of approximately 100m x 100m;
- Cabling between the projects components, to be lain underground where practical;
- A new overhead 132kV power line;
- Internal access roads – 5m wide and 8 km long, linking the array with the other infrastructure on the site, as necessary. Existing farm roads will be used as far as possible; and
- Small office and/ or workshop building – 40m x 20m for maintenance and storage

purposes.

Environmental well-being:

INOVASURE conducted a desktop Environmental Impact Assessment (EIA) for the project. The project will have dual environmental benefits of reducing GHG emissions arising from coal-dominated power generation as well as the reduction of air pollution associated with coal-fired power plants such as Sulphur dioxide, nitrogen oxides and particulates.

Social - economic well-being:

The project will contribute to national economic development by increasing the energy supply capacity in the country. Specifically, renewable energy has significant medium and long term commercial potential and can increasingly contribute toward a long-term sustainable energy future in South Africa.

The project will assist in the process of stimulating a green economy in which new domestic industries are created to supply renewable energy facilities and related requirements, resulting in significant greener jobs.

The project will contribute to socio-economic development in two ways:

- Firstly, the creation of 'green' energy within the context of a green economy creates the potential for positive social spin-off effects like greater access to the benefits of the countries natural resources and increased energy; and
- Secondly, the project has the potential to create jobs, both in the construction and operations phases, which is a very important factor in an area of high unemployment. In addition to on-site job creation the project will source materials and equipment locally wherever possible.

Technology to be employed by the project activity

The objective of the project is to store Eskom power off-peak and also to co-generate electricity from Renewable Energy resources (i.e., solar PV) to provide power to the Kannaland electricity grid as well as to neighbouring towns.

The project is intended to have the installed capacity of a total of 50MW PV over the project period. The connection to the Kannaland power grid will be in HV at 132 kV.

Item	Value
Nominal Power	50MWp

Table 1: Proposed Installed Capacity

Use of this technology is limited in South Africa. The technology has been tried and tested internationally. Internationally, solar PV is used in many countries, with the top five in terms of installed capacity being Germany (9.8GW), Spain (3.4GW), Japan (2.6GW), USA (1.7GW) and Italy (1.2GW). Electricity delivered to the South Africa power grid by the project activity will be monitored with electricity meters installed at the 132 kV Substation.

The monitoring system should be web based to allow remote monitoring and supervision. The output of the power plant is 37% of the maximum output.

CO_2 emissions

Due to the fact that Solar Energy is emission-free, the annual emissions reductions of the project are estimated to be on average 73922 tonnes of CO_2e per year over the crediting period. The total emissions reductions of the project will be 1 848 050 tonnes of CO_2e.

Project Alternatives and Feasibility

Alternatives Considered:

As part of the project feasibility assessment, three alternatives were investigated which provide outputs or services comparable to the project activities:

- Construction of a coal/fossil fuel-fired power plant with the same annual electricity generation as the proposed project;
- Construction of a power plant using other renewable sources with equivalent electricity service; and
- Equivalent electricity service provided by the National Grid, a continuation of the current situation.

When considering the project outcomes, the alternatives were as follows:

- ***Alternative One***
  - Construction of a coal/fossil fuel-fired power plant with the same annual electricity

generation as the proposed project.

- Alternative 1 **WAS EXCLUDED** as realistic and credible for the following reasons:
  - Coal as a potential fuel for the plant: South Africa has significant coal reserves. However, these are concentrated in three areas and transportation of coal to the plant site to generate the equivalent amount of electricity would be prohibitively expensive and ultimately impractical.
  - Natural gas as a potential fuel for the plant: There are currently no gas pipelines in South Africa. Sasol, the largest supplier of natural gas in Southern Africa currently has pipelines in South Africa and Mozambique
  - Other potential fossil fuels – diesel and heavy fuel oil: Fuel costs and transportation costs of the volumes required to generate the same amount of electricity as the plant are prohibitively expensive.

- ***Alternative Two***
  - Construction of a power plant using other renewable sources with equivalent electricity service. Alternative 2 was excluded as realistic and credible for the following reasons:
  - Biomass: Biomass volumes are not sufficient to meet the fuel requirements of a renewable energy power plant capable of generating an equivalent amount of electricity as the project.
  - Hydro: There is very little potential to generate hydro-electricity in the region.
  - Wind: Wind is a potential technology that can be used at this site, however site conditions and topography are such that wind cannot generate an equivalent amount of electricity as the proposed project.

- ***Alternative Three***
  - Equivalent electricity service provided by the National Grid, a continuation of the current situation. This alternative proved to be feasible; and
  - Electricity delivered to the Distribution Network by the Solar PV power plant would have otherwise been generated by the operation of grid-connected Eskom's power plants and by the addition of new generation sources.

Consistency with mandatory laws and regulations

South Africa has two Acts that direct t Planning and Development of the country's electricity:

- The Energy Regulatory Act, 2007; and

- The Electricity Act, 2007.

Alternative 3 is in compliance with mandatory Legislation and Regulations. Additional Laws and Regulations relevant to the project include:

- Generation License issued by South Africa Energy Regulatory Authority under the Energy Regulatory Act, 2007;
- Environmental Management Act, 2002
- The Buildings Act,1969
- The Natural Resources Act, 1974
- The Forest Preservation Act, 28/1910
- Noxious Weeds Act # 19 of 1926
- The Flora Protection Act No. 10 of 2001
- The Game Act, 1953 (as Amended in 1993)
- The Wild Bird Protection Act, 1914
- The Factories, Machinery, and Construction Works Act, 1972
- The Occupational Health and Safety Act, 2001
- The Public Health Act, 1969
- The South Africa National Trust Commission Act, 1/1971
- The South Africa Electricity Act 2007
- The South Africa Energy Regulatory Act 2007
- The Public Stream Bank Regulations
- The Air Pollution Control Regulations, 2000
- The Waste Regulations, 2000
- The Environmental, Audit, Assessment and Review Regulations of 2000
- The Litter Regulations, 2012

Investment Analysis

The purpose of this step was to determine whether the project activity was feasible or financially attractive.

The Internal Rate of Return (IRR) of the project was used as the financial indicator for the project. The equity IRR was used to determine the project viability. In order to assess whether the project is economically feasible, the equity IRR was compared to a benchmark IRR of 15%.

1.4 Common Practise and Monitoring

Common Practice

The project would be a newly-built 50MW solar PV power plant in South Africa, therefore activities similar to the Project should be solar PV power plants located in South Africa with an installed capacity in the applicable output range as calculated below. However, no solar PV plants were producing electricity that is supplied to the South Africa power grid. At that stage solar PV plants were limited to personal and micro installations due to the high investment cost.

Monitoring Plan

The following monitoring would be undertaken:

Monitoring Period

A 10 year fixed crediting period was chosen for the project. The monitoring period would run concurrently with the expected crediting period. At the end of each reporting year, monitored data would be aggregated to a monitoring report.

Data Monitored and Sources

The primary parameter to be monitored by the **INOVASURE** plant would be the quantity of net electricity generation supplied to the Distribution Network. This would be determined on the basis of electricity meters installed at each site of the project activity. These meters would continuously monitor the amount of electricity supplied to the grid, store the data in regular intervals, and would allow the project participants to access the readings remotely. The electricity meters would be inspected annually and in case of inaccuracies they would be recalibrated or replaced accordingly.

Electricity meter readings would be confirmed with the records of sold electricity. Data on electricity supply would be regularly transferred to the Chief Engineer's computer and archived. The project owner's internal reports would be the source of data to calculate the GHG emission reductions during the monitoring period.

Should any instrument that was used in the monitoring process fail, it would be fixed or replaced as soon as possible. In case of the breakdown of any of the solar panels, the net amount of electricity generation would decrease, and the total amount of electricity supplied to the grid would also decrease. All accidents that may occur at the solar park would be

recorded whereas only information on major accidents would be included in the monitoring report.

It should be noted that the project activity is expected to be operational in 2019. As such, operation and maintenance procedures for the power plant would be developed, according to current best practices, to meet the plant's scheduled date of operations.

Monitoring Layout

The metering system would be installed between the 132kV substation and the connection to the National grid:

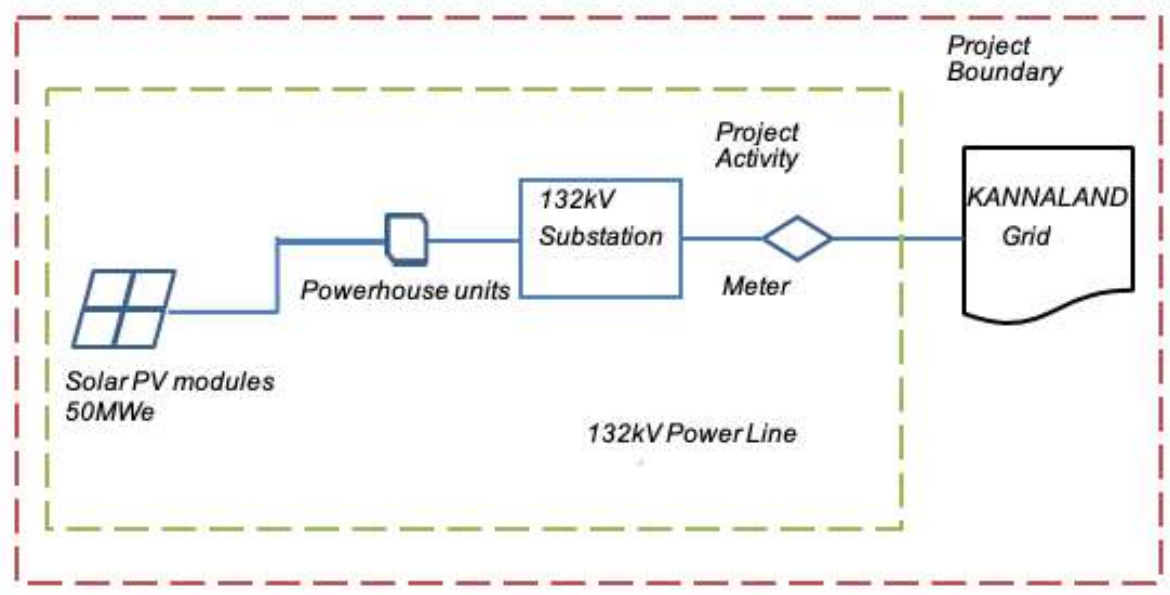


Figure 1: The Monitoring Layout of the Optimum Size Solar Plant

Data Management

All data collected as part of monitoring would be archived electronically and kept at least for 2 years after the end of the crediting period. Data management systems would be used to archive the monitoring data. The meter readings, as well as the relevant information and data source(s), would be archived.

All the relative staff would be trained before operation of the power plant. The training would consists of CDM knowledge, operational regulations, quality control (QC), data monitoring requirements and data management regulations, etc.

The Monitoring Team

The identified project manager would supervise all the monitoring activities. A data handling and reporting manager would be responsible for reading, recording, handling, reporting and archiving relevant data. The QA &QC manager would be responsible for checking data and taking measures to ensure meter precision.

The power plant staff would undergo the necessary training related to operation and maintenance of the solar park and all of the installed equipment. The training would take place at the manufacturer's facility and on site at the power plant. The maintenance personnel of the power plant would be responsible for daily control over the monitoring plan implementation.

The management of **INOVASURE** would be fully responsible for the project implementation and overall control as well as collection of all data required for calculation of GHG emission reductions. All information regarding the accuracy of data would fall under the responsibility of **INOVASURE.** The preliminary version of the monitoring report would be submitted to the specialists of **INOVASURE** for review.

Specialists of Carbon Check would calculate GHG emission reductions with data that would be provided by **INOVASURE** from the meter readings. In case any mistakes would be found in the calculations of GHG emission reductions by **INOVASURE**, the specialists of Carbon Check would correct these calculations accordingly. Specialists of Carbon Check would regularly (at least annually) carry out "test verifications" with a view to ensure that the monitoring plan followed by **INOVASURE** was applied correctly.

The designated on-site engineer(s) and/or other authorized individuals would be responsible for the maintenance and usage of the latest state-of-the-art monitoring equipment. The project would be required to perform additional detailed and independently-audited monitoring of performance, in order to satisfy regulatory and permitting requirements as well as its commercial contracts.

2. INTERVENTION #01: THE SOLAR PV PLANT

2.1 Development of the Solar PV Plant

A solar plant report was prepared for the Kannaland Local Municipality Energy Vault project by Biorex Energy Solutions, one of INOVASURE's collaborators.

Biorex Solutions (Pty) Limited was mandated3 by **INOVASURE** to conduct a pre-feasibility study of a 50MWp Solar PV Plant in the KANNALAND Local Municipality (South Africa), which will be implemented in a Phased manner:

- The Solar PV Plant would be connected to the "Energy Vault" Utility Scale battery storage system;
- The system will be connected to an 11/88 KV (voltage to be confirmed) substation, and provide energy to the Distribution Network;
- The system will be implemented as 1MW and be ramped up to 50MW in phases.

The 2 proposed sites, assumed for utilisation by Biorex in terms of the desktop study, are located 2 km West of the existing Rietfontein Substation, for site 1, and 10 km West of the village of Calitzdorp for site 2.

[3] Biorex Energy Solutions: "Kannaland Energy Vault: Solar PV 50MWp: Pre-Feasibility Report"

- The purpose of the study was to evaluate the energy production potential of the proposed sites, and to have a clear overview of the potential economics of the intended Solar Plant;
- Biorex estimated a generation yield, using the PVGIS Program;
- Biorex elaborated a preliminary Financial Model, using assumptions provided by **INOVASURE**; and
- For the avoidance of doubt, the outcomes of this study do not constitute a firm and binding offer of EPC services, but it takes into account assumptions as accurately as possible, based on actual price negotiations with major equipment suppliers, and is expected to be fine-tuned once the preliminary Feasibility Study is approved.

2.2 The Site Options

Calitzdorp is a town on the Western side of the Little or Klein Karoo in the Western Cape Province of South Africa and lies on South Africa's Route 62.

The farm, on which Calitzdorp stands, was granted to JJ and MC Calitz in 1831. In 1924 a railway line was opened, in 1937 electrification and a new cement road to Oudtshoorn was completed.

The Swartberg (in the North), Rooiberge (to the South) and the Mountains of the Huisrivier Pass (to the West) surrounds Calitzdorp’s challenging landscape with floods, droughts and extreme weather, from very hot to snow clad mountaintops in the winter.

Summers are very hot during the day, mainly a dry heat, up to 40 °C. Wind from the sea every afternoon allows for moderate, cool evenings. Winters have sunny days, very cold nights with occasional frost and snow often falling on the surrounding Swartberg Mountain Range. Rainfall is approximately 200 mm per year, often with the changing of seasons. Prevailing winds are mainly from the south in summer and hot wind from the North in August.

Calitzdorp is a haven for enthusiasts of fishing, bird-watching, 4×4 and other scenic routes, horse-riding and wine tasting.

Calitzdorp is renowned as a centre of the port wine industry in South Africa with several major wine estates famous for their award-winning products. A Port festival takes place in the town in mid-June each year.

Figure 2: Location of Town of Calitzdorp in Kannaland

Figure 3: Location of Town of Calitzdorp within Kannaland

The topography of the region was found to be ideal for the installation of solar power stations mainly thanks to a good level of solar irradiation and low slopes.

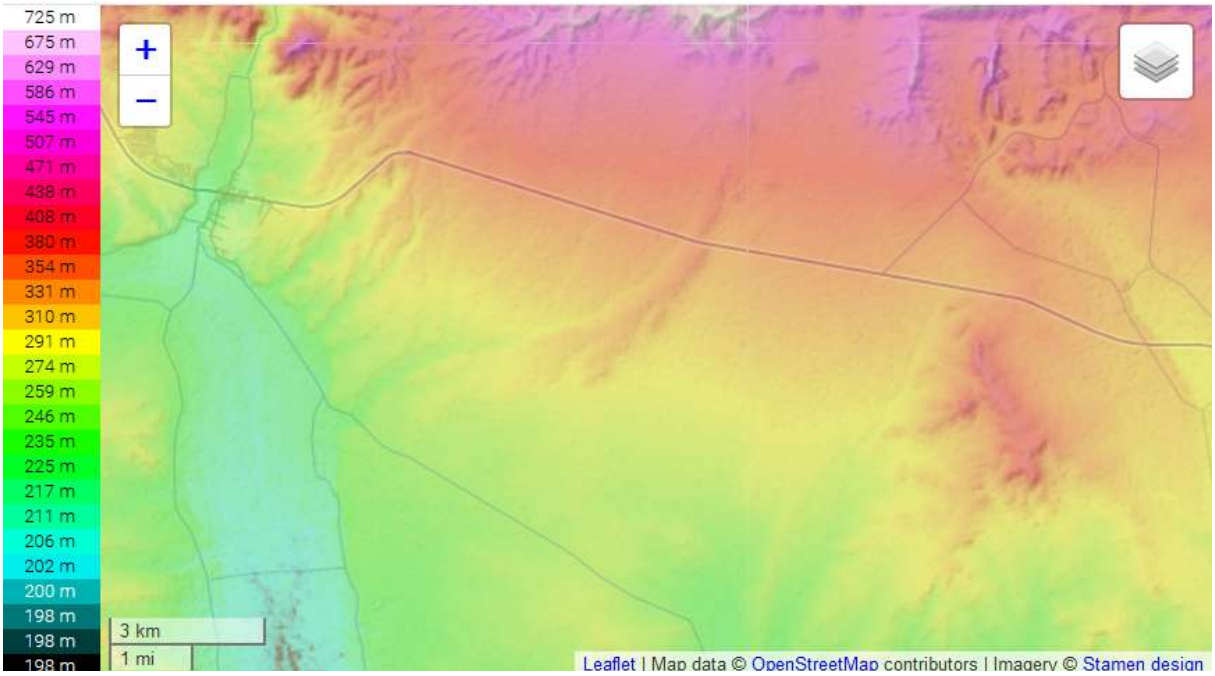


Figure 4: Presence of Hills and Valleys: Topography of the Region

The identification of numerous identified rivers/drainage lines oriented Biorex to identify land suitable avoiding any impact on rivers or identified wet-lands.

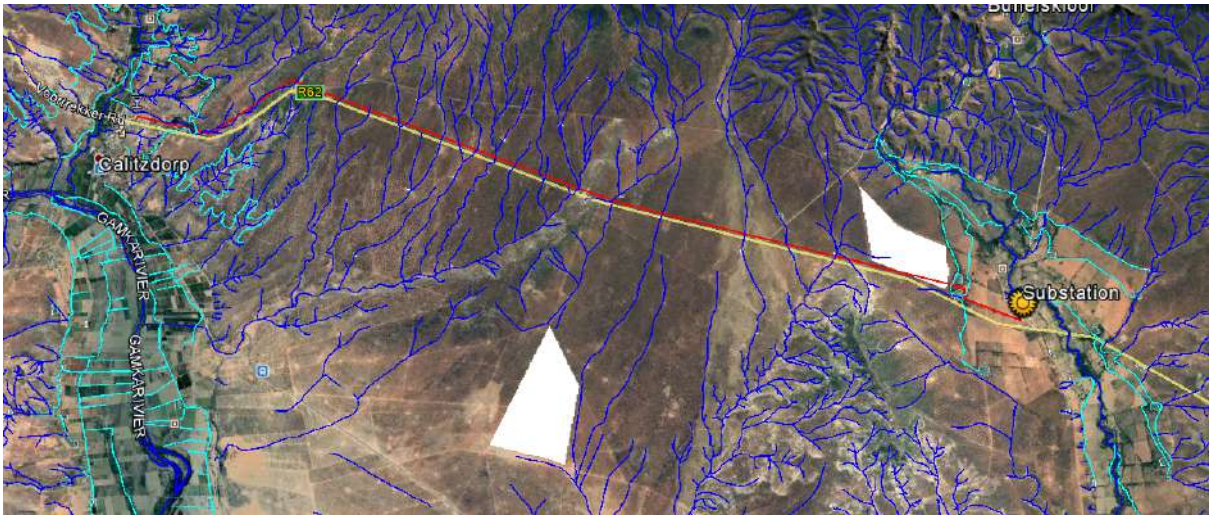


Figure 5 : The Rivers and Wetlands

Biorex identified two potential sites:

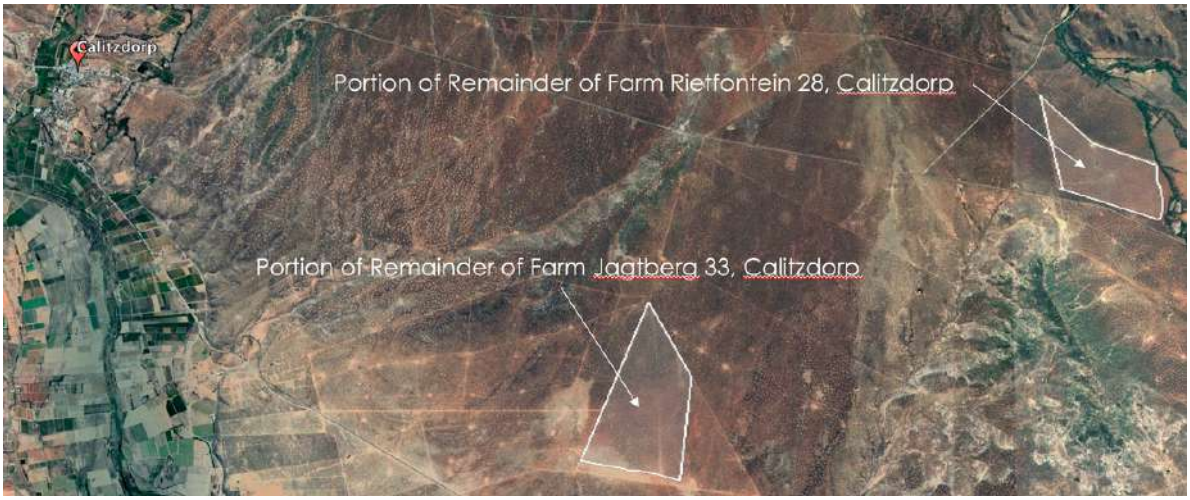


Figure 6 : The two sites identified for the PV Plant

IDENTIFIED SITES:

SITE 1 - RIETFONTEIN RE/28

SITE 2 - JAGTBERG RE/33

Figure 7: Rietfontein RE/28

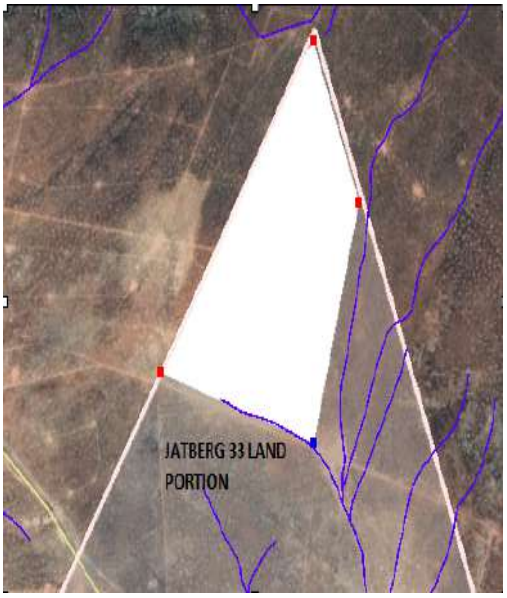


Figure 8: Jagtberg RE/33

RIETFONTEIN IS 5 kms South West of the small village of Bufferlskoof and 15 kms east from Calizdorp and accessible via the R62 AND 1.6 kms away from Rietfontein Substation 16/28.

JAGTBERG is 10 kms west of the village of Calitzdorp, accessible via the R62 and 9 kms away from Rietfontein Substation 16/28.

Figure 9: Photograph of Kannaland Area

This report is a pre-assessment aiming to identify potential sites to erect the 25MWp **INOVASURE** energy vaults (which will be ramped up to 2 x 25MWp for export power) within the Kannaland Municipality borders.

Figure 10: Map of Kannaland Area

2.2.1 Site 1 - Rietfontein

SITE 1 – RIETFONTEIN RE28

33°32'40.57" S / 21°51'16.63" E

INTRODUCTION:

The Proximity of the Rietfontein substation (estimated 40 to 60MVA with 88kV lines) makes the Rietfontein RE/28 a first choice to erect the 50MWp solar field for the 2 vaults. The second reason for the pre-identification of this land is the very low level of wet lands and water presence. The third reason is the fact that this land is made of one large portion instead of being fragmented into multiple small agricultural land.

Following studies made with Cape Farm Mapper software shows that the land is facing North with a neglectable slope (less than 5%) making the land usable for solar application.
PVGiS software used to calculate the irradiation shows good performances below.

PVGIS-5 estimates of solar electricity generation:

Provided inputs:		Simulation outputs	
Latitude/Longitude:	-33.542, 21.849	Slope angle:	1 (opt) °
Horizon:	Calculated	Azimuth angle:	0 (opt) °
Database used:	PVGIS-CMSAF	Yearly PV energy production:	1600 kWh
PV technology:	Crystalline silicon	Yearly in-plane irradiation:	2000 kWh/m²
PV installed:	1 kWp	Year to year variability:	27.40 %
System loss:	10 %	Changes in output due to:	
		Angle of incidence:	-3.5 %
		Spectral effects:	0.4 %
		Temperature and low irradiance:	-8.3 %
		Total loss:	-20 %

Figure 11: Rietfontein PVGIS-5 estimates of solar electricity generation

The only potential substation usable as Point of Connection (PoC) is the RIETFONTEIN 16/28 which seems to be a 40 to 60 MVA fed from a 88kV line (to be confirmed).

It was not possible to find the level of load of this substation.

Research of other PoC on the Calitzdorp side as well as on the Oudtshoorn side has not yet shown any other possibility to connect the vaults power output.

IMPACT ON THE BIOLOGICAL ENVIRONMENT (FAUNA AND FLORA)

The following considerations and assessment are extracted from the Cape Farm Mapper software.

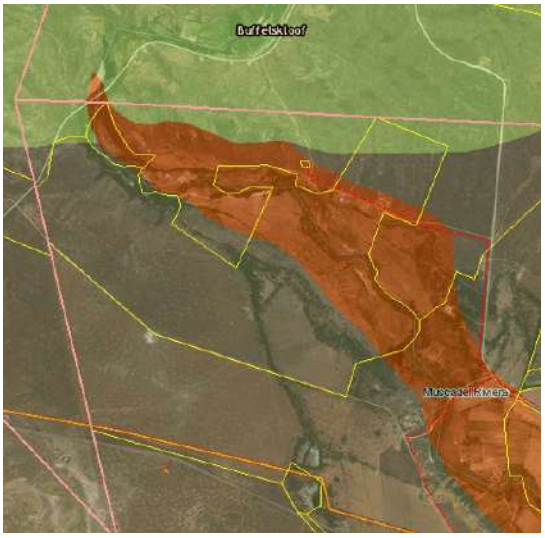


Figure 12: Rietfontein Map of Fauna & Flora

Maintenance activities such as vegetation clearing as well as the amount of disturbance created during construction will leave the site vulnerable to degradation through alien plant invasion and soil erosion. Limited potential ecological impacts resulting from the construction and operation of solar vault as the land is away from the Vlei River. Erection of the solar plant will have a very low impact on possible protected species if any.

On the faunal impacts, the solar plant and energy vault will not produce noise or pollution disturbance that are detrimental to fauna.

Only during the construction can one foresee that sensitive and shy fauna would move away from the area during the construction phase as a result of the noise and human activities. This impact is, however, transient and there is not likely to be any long-term consequences on terrestrial fauna during the operational phase.

POTENTIAL IMPACTS ON HERITAGE RESOURCES

An Integrated Heritage Impact shall be performed by a specialist.

Cape Farm Mapper software describes the environment of the potential sites as an "arid, gently sloping plain". The land is very sparsely vegetated. No structures or ruins were noted.

No basic historic background has been identified. No significant historic or other heritage-related themes have been found so far.

ASSESSMENT OF IMPACTS ON AGRICULTURAL RESOURCES

VEGETATION

The potential land is situated in the Calitzdorp-Buffelkloof area marked by Low Shrub land type of grass. Tree density is less than 5%. The Normalized Difference Vegetation Index (NDVI) is low. Grazing capacity is low.

CLIMATE

This is an arid zone with few perennial rivers. Summers are hot, while winters may cool down to -5°C. Frost occurs from late April through to October, thus rendering is a very short growing season for frost–sensitive crops. Summer rainfall peaks in March, ranging between 0-200mm in this specific area. Unpredictable drought is a feature of the entire zone.

SOILS

Soils associated with arid landscapes and mineral composition presence in this area, are Red-yellow apedal, freely drained soils.

LAND CAPABILITY AND SUITABILITY FOR AGRICULTURE

The potential agricultural capability of the project based on the natural resources identified shows that the site is largely unsuitable for cultivation due to the low annual rainfall.

POTENTIAL IMPACTS ON AGRICULTURAL RESOURCES

Not suitable land for agriculture due to roughness of the soil low rain waterfall and high wind velocity.

The proposed PV Power plants, will have limited impacts on agriculture on site.

WATER AND WETLANDS

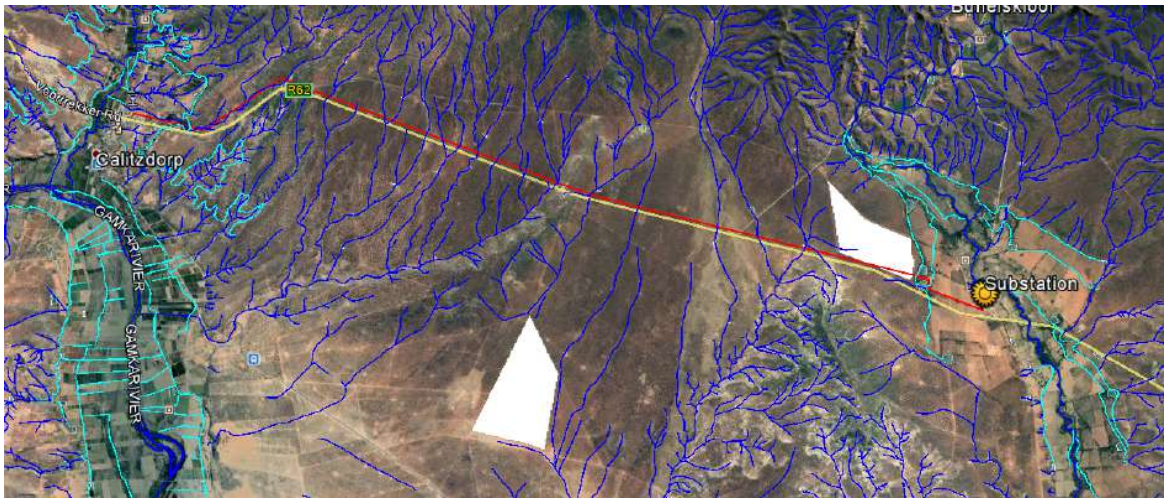


Figure 13: Rietfontein Map of Rivers

Gis specific software identifies rivers all around the identified sites but no rivers (NGI or DWA) are visible on the site (non-perennial rivers).

Figure 14: Rietfontein Map of Wetlands

Two wetlands are identified at the South East portion of the identified land. The Mitigation plan will be to create an exclusion zone between them and the solar field.

ASSESSMENT OF IMPACTS ON VISUAL RESOURCES

KEY LANDMARKS

Based on the 17km zone defined between Calitzdorp and Buffelskloof, the following landmarks have been identified in defining the surrounding areas characteristic landscape:

- Vlei River (in the South);
- Gamka River (at Calitzdorp);
- Existing 88 kv distribution Line along R62;
- Transnet fret/passage line (not electrified).

No degradation of scenic resources is foreseen during the construction and the operation of the Solar plants and InovaSure Energy Vaults.

CONCLUSION SITE 1 – RIETFONTEIN RE/28

A Draft Basic Assessment Report is sufficient to confirm that the potential land identified so far is acceptable to erect two solar plants and energy vaults - including the grid connection.

As Solar specialists, Biorex confirms that the preferred potential site is the RIETFONTEIN RE28 due to the proximity to an existing substation RIETFONTEIN 16/28.

Aside from potential negative impacts, it is submitted that the proposed Photo Voltaic Plant and Energy Vault with its Grid Connection has positive impacts, in that it aligns with national, regional and local strategies to support alternative / renewable energy projects. These include the distribution of much-needed 'clean' electricity into the national grid, provision of local electrical infrastructure for use in long-term, and the provision of employment opportunities during the construction and operation phases for members of local communities.

A detailed Environmental Impact Assessment (EIA) will include the risk mitigation to reduce potential negative impacts to an acceptable level.

2.2.2 Site 2 - Jagtberg

SITE 2 – JAGTBERG RE33
33°32’40.57” S / 21°51’16.63” E

INTRODUCTION:

The Rietfontein substation (estimated 40 to 60MVA with 88kV lines) located 9 kms approx. from this site makes the Jagtberg RE/33 a second option to erect the 50MWp solar field for the 2 Photo Voltaic plants and energy vaults. The second reason for the pre-identification of this land is the very low level of wet lands and water presence. The third reason is the fact that this land is made of one large portion instead of being fragmented into multiple small agricultural land.

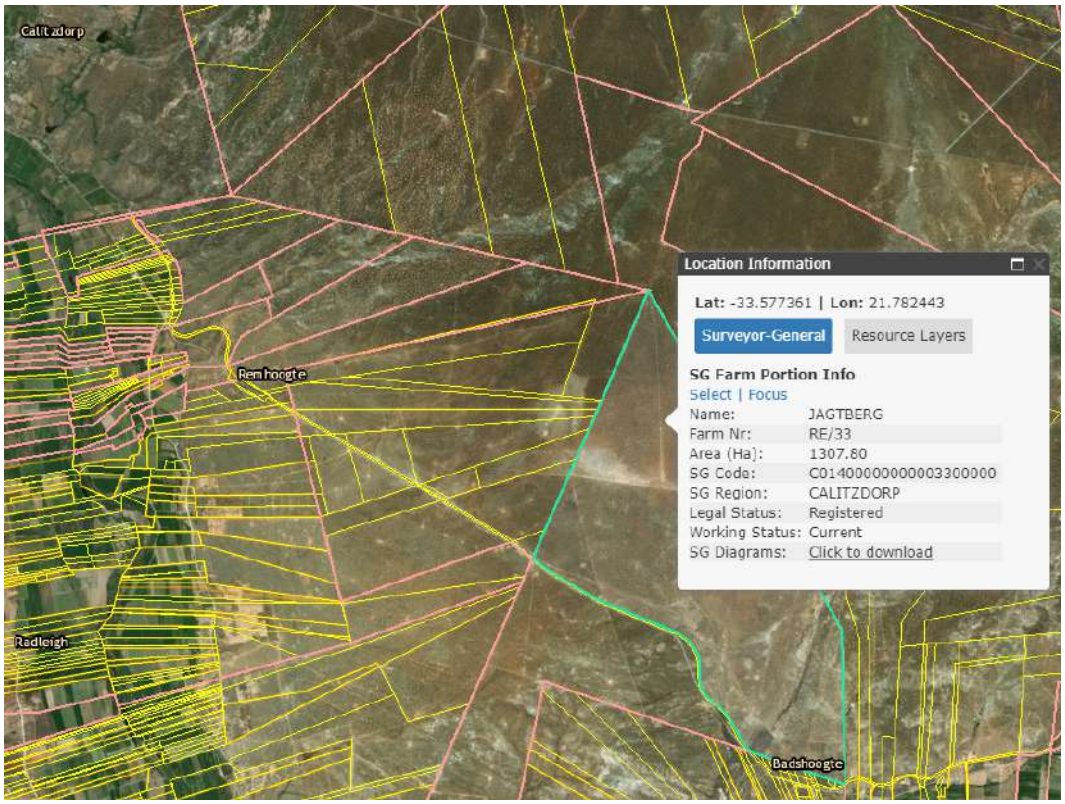


Figure 15: Farm Portions and Parent farm around Jagtberg RE/33

FARM PORTION LIST

Print | Save/View RTF | Email PDF

3 match(es) found for the criteria specified.

Date Requested	2018/10/29 15:52
Deeds Office	CAPE TOWN
Farm Name	JAGTBERG
Farm Number	33
Registration Division	CALITZDORP RD
Portion Number	-

Portion	Owner	Title Deed	Registration Date	Purchase Price (R)
0	MEIRING PHILIPPUS JOHANNES ANTONIE	T10309/1899	1899/12/27	R0.00
1	TRANSNET LTD	T2464/1997	1997/01/14	R0.00

Figure 16: Printout of Title: Jagtberg RE/33 belongs to a single owner - Mr Meiring Philippus - and to the SoE Transnet

Following studies made with Cape Farm Mapper software, it appears that the land is facing North with a neglectable slope (less than 5%) making the land usable for solar application. PVGiS software used to calculate the irradiation shows good performances below.

PVGIS-5 estimates of solar electricity generation:

Provided inputs:		Simulation outputs	
Latitude/Longitude:	-33.572, 21.780	Slope angle:	1 (opt) °
Horizon:	Calculated	Azimuth angle:	0 (opt) °
Database used:	PVGIS-CMSAF	Yearly PV energy production:	1610 kWh
PV technology:	Crystalline silicon	Yearly in-plane irradiation:	2010 kWh/m²
PV installed:	1 kWp	Year to year variability:	24.10 %
System loss:	10 %	Changes in output due to:	
		Angle of incidence:	-3.4 %
		Spectral effects:	0.4 %
		Temperature and low irradiance:	-8.1 %
		Total loss:	-19.8 %

Figure 17: PVGIS-5 estimates of solar electricity generation: Jagtberg RE/33

POWER LINE ALIGNMENT:

The only potential substation usable as Point of Connection (PoC) is the RIETFONTEIN 16/28 which seems to be a 40 to 60 MVA fed from a 88kV line (to be confirmed). It was not possible to find the level of load of this substation. Research of other PoC on the Calitzdorp side as well as on the Oudtshoorn side have not shown any other possibility to connect the Photo Voltaic plants and energy vault's power output.

IMPACT ON THE BIOLOGICAL ENVIRONMENT (FAUNA AND FLORA)

The following considerations and assessment are extracted from the Cape Farm Mapper software:

Not a protected area / belongs to the Gouritz Cluster Biosphere reserve (not critical).

Area not identified as a priority but retains most of the natural character and performs a range of biodiversity and ecological infrastructure functions. Although not prioritized, is still an important part of the natural ecosystem.

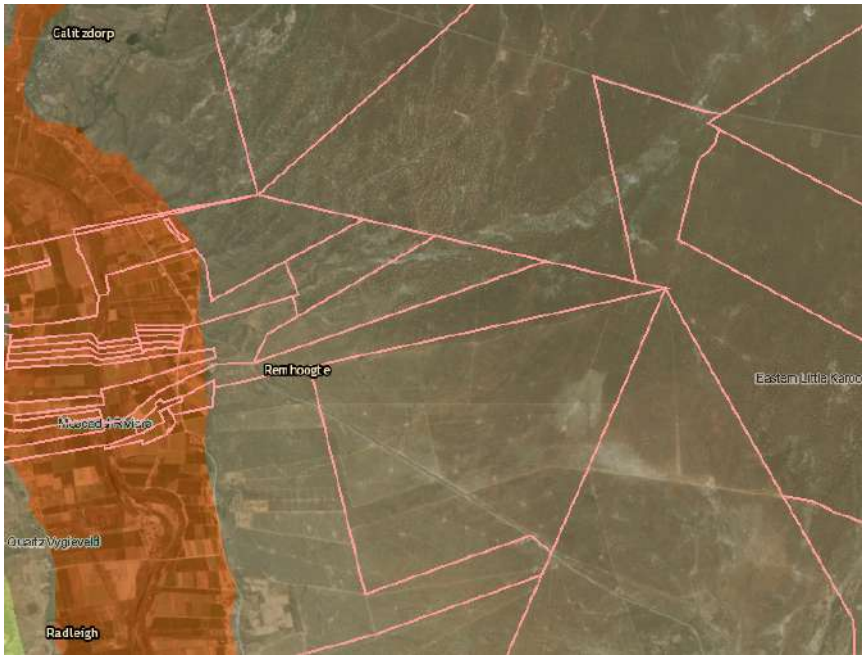


Figure 18: Map of Fauna and Flora: Jagtberg RE/33

Maintenance activities such as vegetation clearing as well as the amount of disturbance created during construction will leave the site vulnerable to degradation through alien plant invasion and soil erosion. Limited potential ecological impacts resulting from the construction and operation of the solar farm and energy vault as the land is away from the Gamka / Nelsrivier. Erection of the solar plant and energy vaults will have a very low impact on possible protected species if any.

On the faunal impacts, the solar plant and energy vaults will not produce noise or pollution disturbance that are detrimental to fauna.

Only during the construction we can foresee that sensitive and shy fauna would move away from the area during the construction phase as a result of the noise and human activities. This impact is, however, transient and there are not likely to be any long-term consequences on terrestrial fauna during the operational phase.

POTENTIAL IMPACTS ON HERITAGE RESOURCES

An Integrated Heritage Impact has yet to be performed by a specialist.

Cape Farm Mapper software describes the environment of the potential sites as an arid, gently sloping plain. The land is very sparsely vegetated. No structures or ruins were noted.

No basic historic background identified. No significant historic or other heritage-related themes found so far.

ASSESSMENT OF IMPACTS ON AGRICULTURAL RESOURCES

VEGETATION

The potential land is situated in the Calitzdorp area marked by Low Shrub land type of grass. Tree density is less than 5%. The Normalized Difference Vegetation Index (NDVI) is low. Grazing capacity is low.

The agricultural land is basically non arable with moderate potential grazing land.

CLIMATE

This is an arid zone with few perennial rivers. Summers are hot, while winters may cool down to -5°C. Frost occurs from late April through to October, thus rendering is a very short growing season for frost–sensitive crops. Summer rainfall peaks in March, ranging between 0-200mm in this specific area. Unpredictable drought is a feature of the entire zone.

SOILS

Soils associated with arid landscapes and mineral composition presence in this area, are Red-yellow apedal, freely drained soils.

Geology: Manly calcrete and hardpan / Uitenhage group.

Soils with limited pedological development i.e soils with minimal development, usually shallow on hard or weathering rock, with or without intermittent diverse soils. Lime generally present in part or most of the landscape.

LAND CAPABILITY AND SUITABILITY FOR AGRICULTURE

The potential agricultural capability based on the natural resources identified shows that the site is largely unsuitable for cultivation due to the low annual rainfall.

POTENTIAL IMPACTS ON AGRICULTURAL RESOURCES

Not suitable land for agriculture due to roughness of the soil and low rain waterfall (Mean Annual rainfall: 220mm) and high wind velocity.

The proposed PV Power plants, will have limited impacts on agriculture on the site.

WATER AND WETLANDS

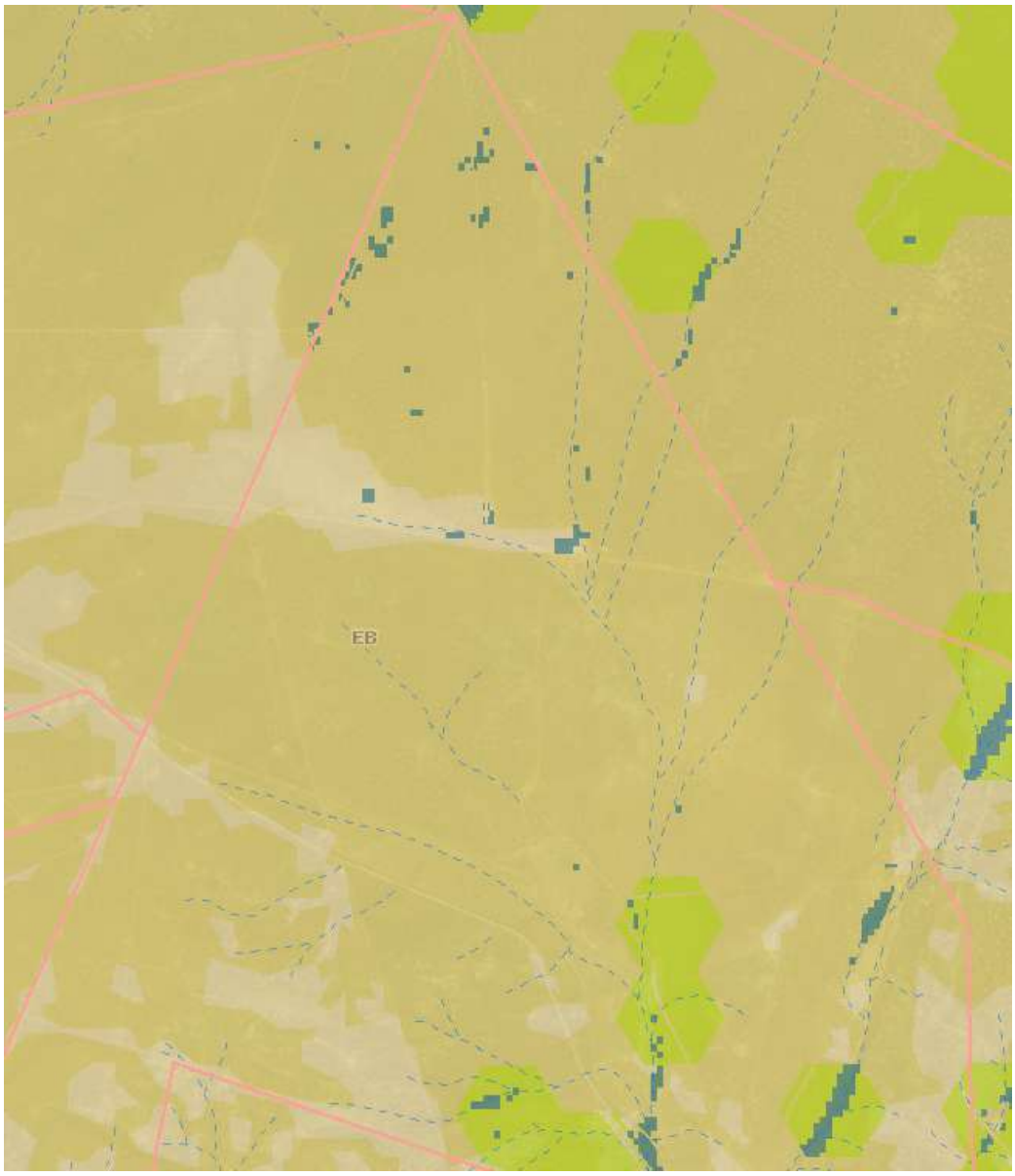


Figure 19: Map of Rivers: Jagtberg RE/33

Department of Water Affairs (DWA) rivers as well as National Geo Spatial Information (NGI) rivers shown on Cape Farm Mapper software. Exclusion zone will be considered.

Rivers (NGI) : Non-perenial rivers

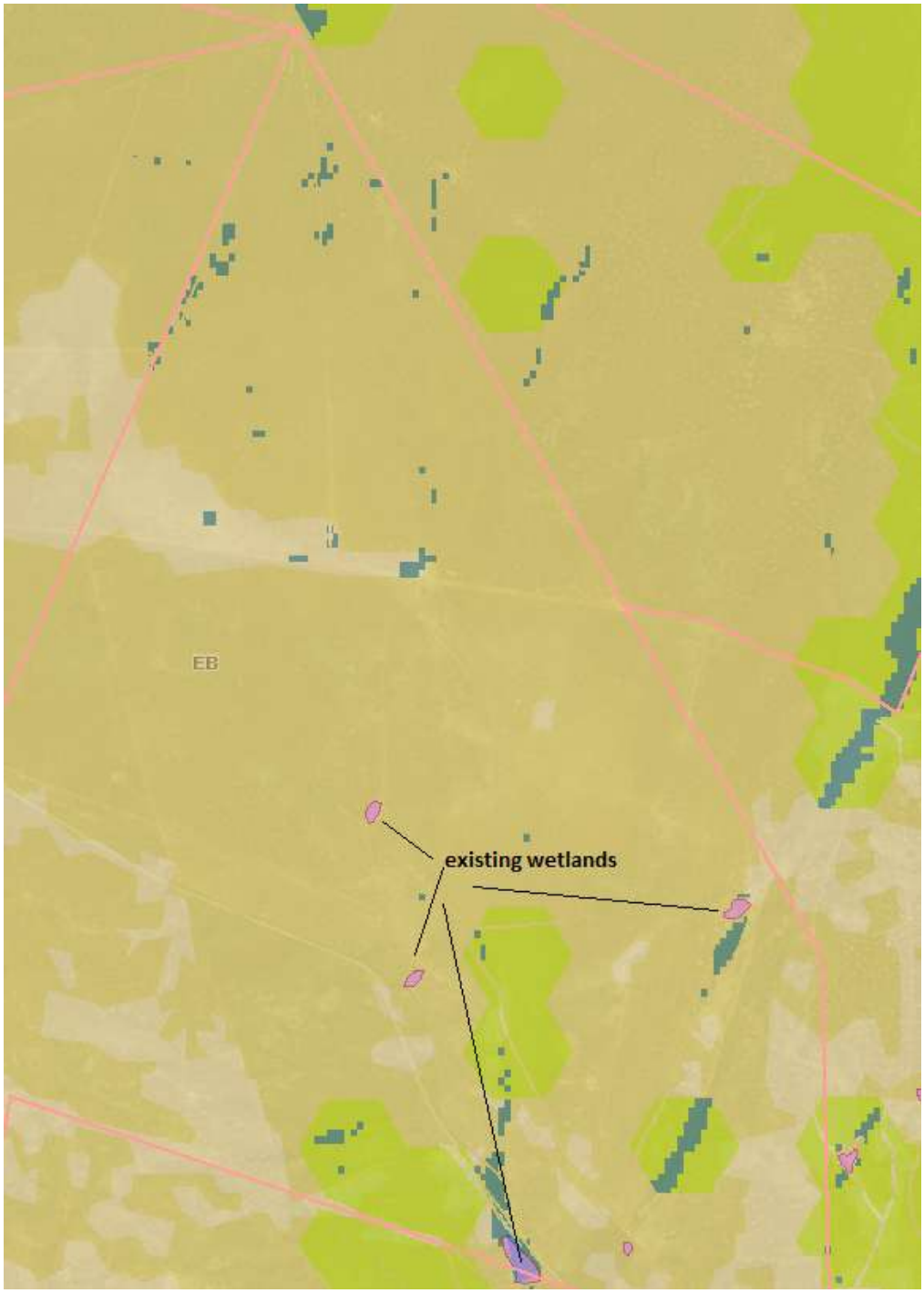


Figure 20: Map of Wetlands: Jagtberg RE/33

Wet lands identified at the south portion of the potential land but far from the construction zone. The mitigation plan will be to create an exclusion zone between them and the solar field. Wetlands: Cat. 1 ESA Aquatic: requires a water use license assessment / presence of 3 artificial wetlands (NFEPA)

ASSESSMENT OF IMPACTS ON VISUAL RESOURCES

KEY LANDMARKS

Based on the 9.8 km approx zone between Calitzdorp and the Jagtberg site the following landmarks have been identified in defining the surrounding areas characteristic landscape:

- Gamka River (at Calitzdorp);
- R62 north of the land;
- Transnet fret/passage line (not electrified) in the south of the land.

No degradation of scenic resources is foreseen during the construction and the operation of the Solar vaults.

CONCLUSION SITE 2 – JAGTBERG RE/33

A Draft Basic Assessment Report is sufficient to confirm that the potential lands identified so far are acceptable to erect a solar power plant and two energy vaults including the grid connection.

As Solar specialists, Biorex confirm that the reserved potential site is the JAGTBERG RE33 due to the long distance to the existing substation REITFONTEIN 16/28.

Aside from potential negative impacts, it is submitted that the proposed Energy Vault with its Grid Connection has positive impacts, in that it aligns with national, regional and local strategies to support alternative / renewable energy projects.

These include the distribution of much-needed 'clean' electricity into the national grid, provision of local electrical infrastructure for use in long-term, and the provision of employment opportunities during the construction and operation phases for members of local communities.

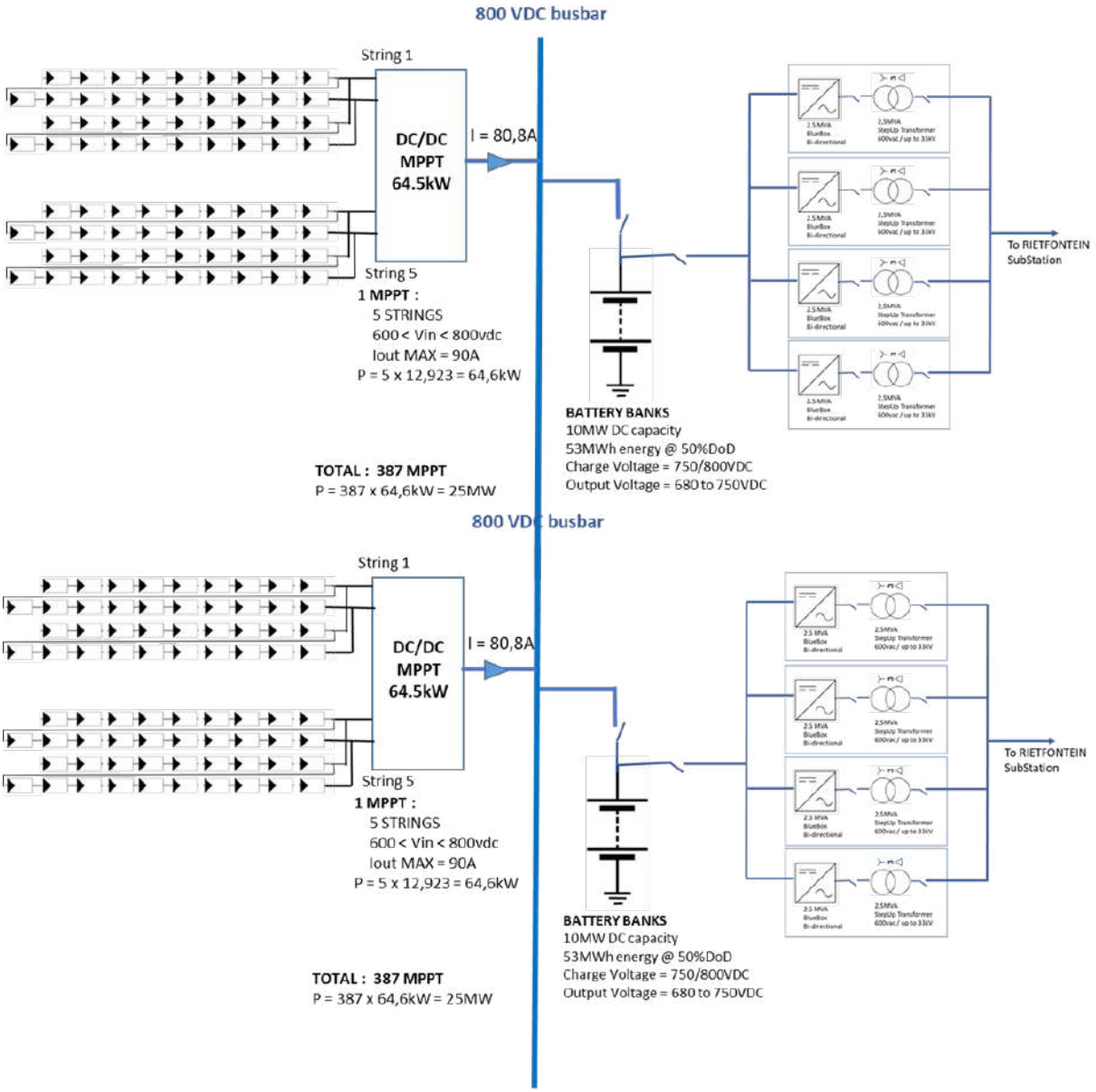
A proper and detailed EIA will include the risk mitigation to reduce potential negative impacts to an acceptable level.

2.3 The Technical Solution: The Indicative Layout and Global Presentation

The indicative layout of the final size of the 50 MWp Solar PV Plant is shown below:

In various phases, InovaSure plans to install a Solar Photovoltaic Ground Mounted Solar Power Plant of 50MWp consisting of 20 Kaco "Blue blocks" containerized inverters of

2.5MWp each which would be connected on the Medium Voltage (MV) 11kVac to 33kVac bus-bar (voltage to be confirmed) thereby bundling all other sources of power (i.e. the battery bank) and linked via the overhead line to the Rietfontein 16/28 substation.



Considering PVGIS estimates, the 50MWp solar field output would have an approximate generation of 88GWh per annum:

PV MODULES

Technical details of a Solar Photovoltaic Module (Jinko Solar) JKM340PP-72 are:

- Polycrystalline, Dimensions – 1956 X 992 X 40 mm
- Max Power Rating: 340 Wp

- Rated Current : 8.90 A
- Rated Voltage : 38.2 V

Mounting Arrangement is:

- Mounting: Fixed Type, Tilt angle (slope) of PV Module: 30°
- Designed for holding suitable number of modules (the solar mounting structure will receive 2 rows of PV modules in the portrait position).
- Frames and leg assembles of the array structure, is made of steel Hot Dip Galvanized
- Stainless steel nuts, bolts and any other section conforming to the Solar PV system to meet the design criteria.
- For this project the best available structure available, designed to provide maximum strength against the wind that may occurs in this area, will be used.

INVERTERS: The Central "BlueBlock" Inverter (KACO) that will be provided:

The central multi-module BlueBlock inverters are optimized for solar plants with 1500vdc Maximum inputs (voltage open circuit) from solar modules and design for lean commissioning and maintenance via remote monitoring and services.

125kVA inverter module

- No. of 125kWp units: 400;
- Rated DC Capacity per unit: 125 KWp;
- Input Voltage range: 900 to 1000 VDC;
- Output Voltage: 600 VAC Frequency: 50 Hz
- Efficiency: 98.5%

DC COMBINER BOXES: Argus type combiner box includes:

- 20 strings input up to 1500 VDC
- String input terminals DC plugs; 200 A / 12 A per string
- Surge protection device I+II
- DC switch (400A)
- String fuses

- String monitoring

ARGUS type Combiner box

The 20 x 125kVA units associated to their Combiner boxes are integrated in an outdoor containerized solution:

Container description:

Steel housing container IP 65 with 40mm insulation including the followings:

- Low Voltage AC distribution
- Medium Voltage step up transformer
- Medium Voltage Switchgear

DC SIDE:

- 20 units of 125kWp
- 20 combiner boxes Argus type

LV DISTRIBUTION SIDE

- 2 circuit breakers of 2,500A 4 poles
- Surge Protection Devices (SPD) level I+II
- 20 strip fuse breaker NH01
- UPS 18Ah 230Vac

MV TRANSFORMER

- Up to 33kVac, oil insulated

MV SWITCHGEAR

- RRL

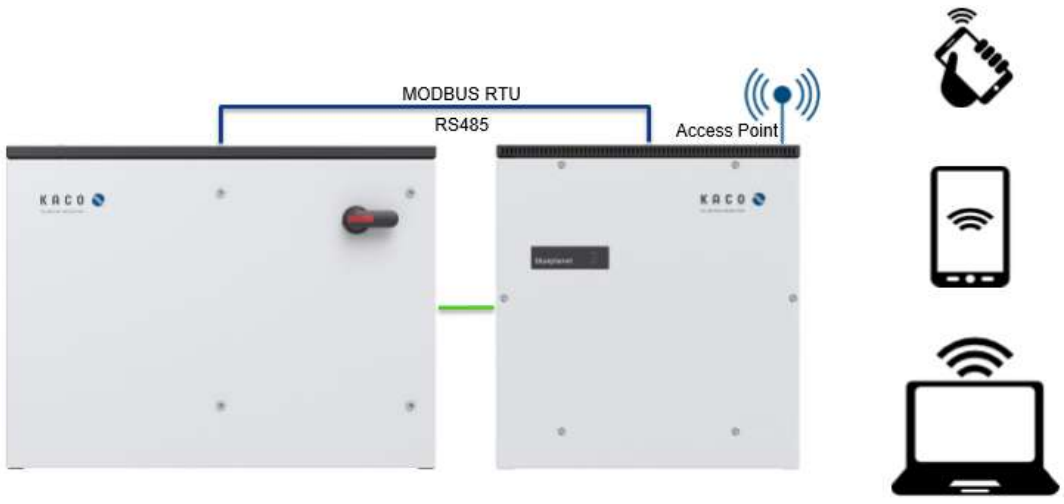
LV & MV Cables: LV (up to 1500vdc) and MV Cables (up to 33kVac) and glands will be robust and high temperature resistant.
They will be having excellent weatherproofing characteristics to provide a long service life. The connectors with high current capacity and easy mode of assembly are used for the connections of the power plant cables. Cables will be supported by cable trays

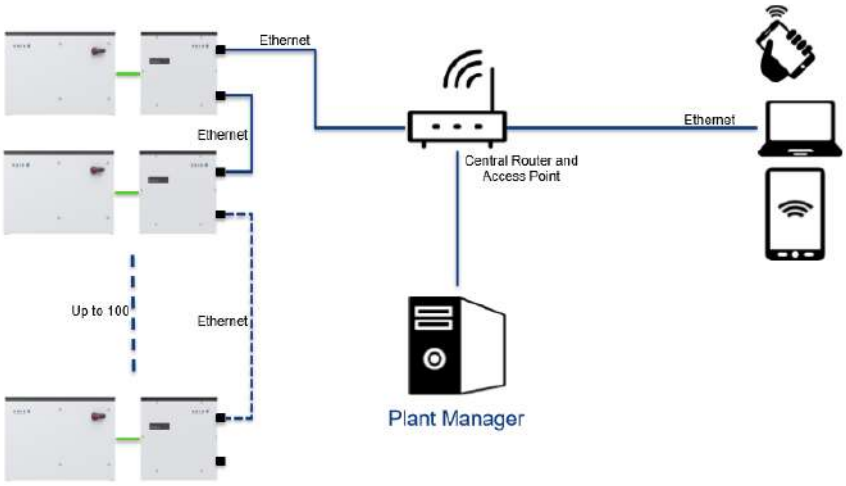
SCADA Monitoring System: BP125 is a direct wireless system fitted with Modbus RTU (Real Time Unit) and using RS 485 telecommunication field bus.
The BP125 provides extensive options for local and remote monitoring on your PC i.e: the records of:

- Currents, voltages
- Temperatures
- Power and yields **of every individual inverter's string and inverter.**

The stored installation data is transmitted every day in a text file to an e-mail address of choice. The data logger also automatically reports by e-mail, fax or SMS if the installation exits the operating states specified by the user.

The alarm parameters can be matched exactly to the technical properties of the installation.





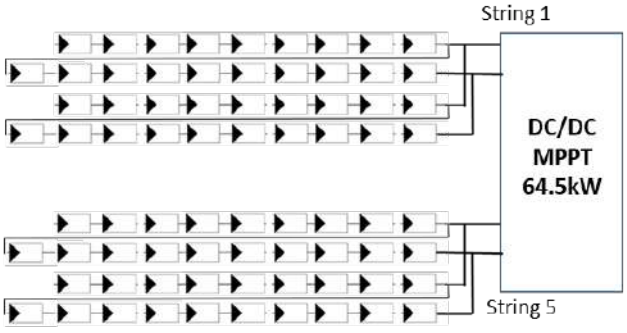
2.4 Description of Main Plant

50MWp solar field consists of:

- 147,058 PV modules of 340Wp each
- 8 Bluebox inverters of 2.5MWp including
  - 20 units of 125kWp
  - 20 Argus type combiner box of 20 strings each maximum
  - 1 Step Up transformer of 2.5MVA

PV strings architecture:

1 STRING :
- 19 PV modules in series
- 2 rows of 19 PV in paralelle
- Imp = 2 x 8,91 A = 17,8A
- Vmp = 19 x 38.2 = 726 VDC
- P = 17,8 x 726 = 12,920 Wp



1 MPPT :
5 STRINGS
600 < Vin < 800vdc
Iout MAX = 90A
P = 5 x 12,923 = 64,6kW

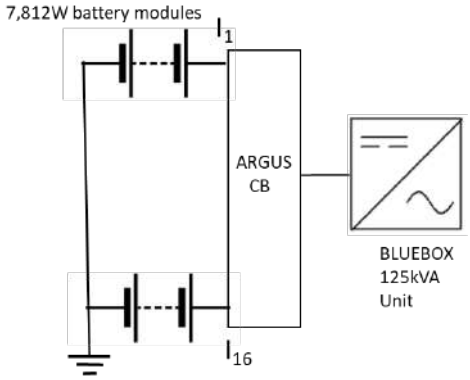
- Each 50kW MPPT receives 8 strings

- 8 strings x 18 PV in series = 144 modules per MPPT
  = 184 x 340Wp per PV = 48,960 Wp

TOTAL POWER per battery bank = 500 MPPT x 48,960Wp = 24,480MWp

BLUE BOX CONTAINERIZED INVERTER:

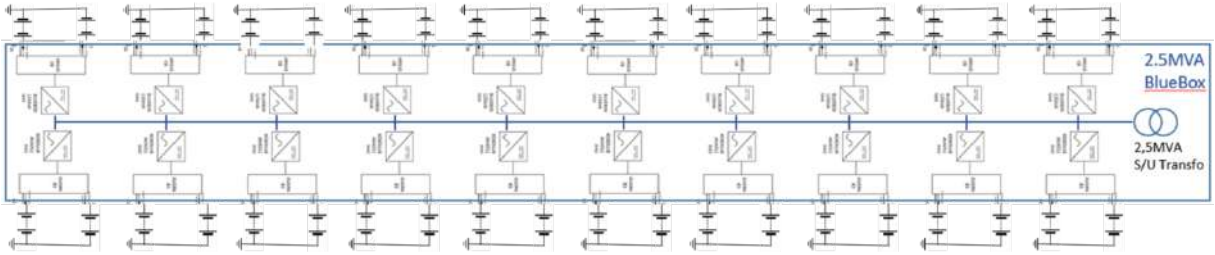
- 20 x 125kWp = 2.5MWp



BATTERY STRING 1 to 16

- P = 16 x 7,812Wp = 125kWp

One unit of 125kWp fed from 16 modules of battery of 7,812 W each.



20 x 125kW batteries = 2.5MWp

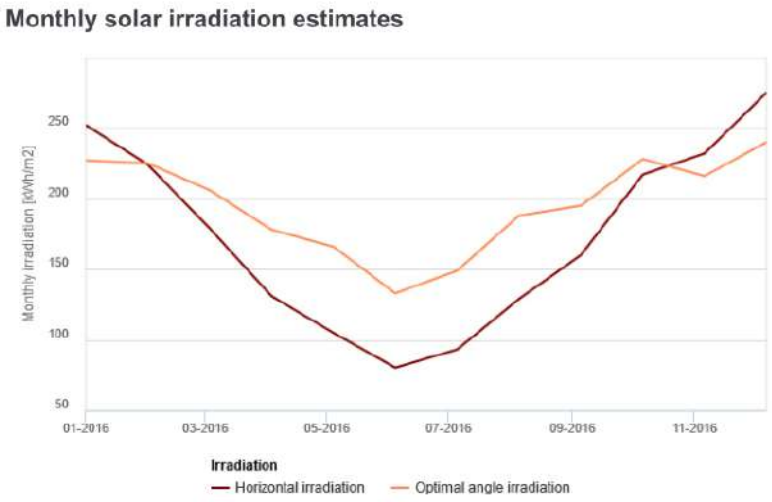
4 BlueBox per 10MW battery bank

8 Blue Box in total for 50MWp solar

2.5 Solar Resource Measurements

Biorex used the PVGIS database to evaluate the Energy output on the sites with the following captured outcomes:

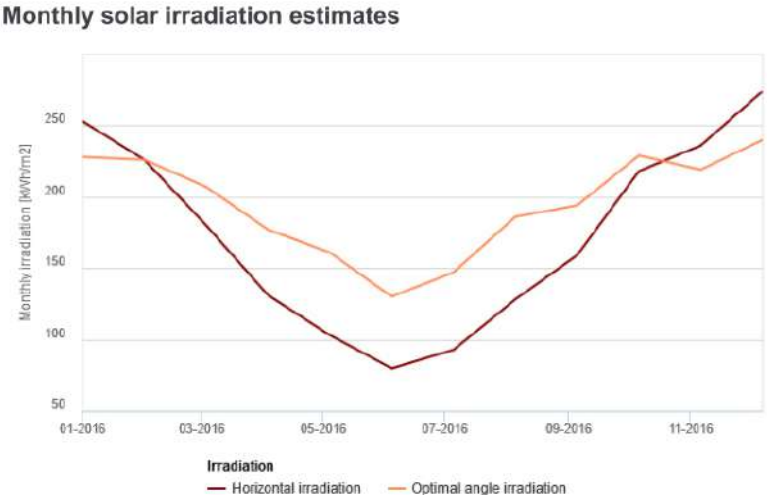
SITE 1 – RIETFONTEIN RE28



Global horizontal irradiation		Global irradiation optimum angle	
Month	**2016**	**Month**	**2016**
January	252	January	227
February	224	February	225
March	179	March	206
April	131	April	178
May	105	May	166
June	80.4	June	133
July	93.2	July	149
August	129	August	188
September	160	September	195
October	217	October	228
November	232	November	216
December	275	December	240

Site 1 has an estimated annual Global Horizontal Irradiation of 2 078 kWh/m²/year and 2 351 kWh/m²/year at the 32° optimal tilt angle.

SITE 2 – JAGTBERG RE33



Global horizontal irradiation	
Month	**2016**
January	253
February	226
March	180
April	131
May	103
June	79.7
July	92.6
August	128
September	159
October	218
November	236
December	274

Global irradiation optimum angle	
Month	**2016**
January	228
February	226
March	207
April	177
May	151
June	130
July	147
August	186
September	194
October	229
November	219
December	240

Site 2 has an estimated annual Global Horizontal Irradiation of 2 080 kWh/m²/year and 2 344 kWh/m²/year at the 32° optimal tilt angle.

Both sites have an excellent solar irradiation; a few differences are due to diffuse radiation impacted by soils nature.

Following the Equipment selection described in the above section (Technical), the estimated output to be injected to batteries of the Energy Vault are:

SITE 1 – RIETFONTEIN RE28

Provided inputs:		
Location [Lat/Lon]:	-33.546, 21.855	
Horizon:	Calculated	
Database used:	PVGIS-CMSAF	
PV technology:	Crystalline silicon	
PV installed [kWp]:	50 000	kWp
System loss [%]:	2	
Simulation outputs:		
Slope angle [Â°]:	32 (opt)	
Azimuth angle [Â°]:	162	
Yearly PV energy production [kWh]:	**99 500 000**	**kWh**
Yearly in-plane irradiation [kWh/m2]:	2 270	kWh/m²
Year to year variability [kWh]:	1 590 000	kWh
Changes in output due to:		
Angle of incidence [%]:	-2.6	%
Spectral effects [%]:	0.5	%
Temperature and low irradiance [%]:	-8.8	%
Total loss [%]:	-12.4	%

SITE 2 – JAGTBERG RE33

Provided inputs:	
Location [Lat/Lon]:	-33.576, 21.783

Horizon:	Calculated	
Database used:	PVGIS-CMSAF	
PV technology:	Crystalline silicon	
PV installed [kWp]:	50 000	kWp
System loss [%]:	2	
Simulation outputs:		
Slope angle [Â°]:	32 (opt)	
Azimuth angle [Â°]:	162	
Yearly PV energy production [kWh]:	**100 000 000**	**kWh**
Yearly in-plane irradiation [kWh/m2]:	2 280	kWh/m²
Year to year variability [kWh]:	1 270 000	kWh
Changes in output due to:		
Angle of incidence [%]:	-2.6	%
Spectral effects [%]:	0.6	%
Temperature and low irradiance [%]:	-8.5	%
Total loss [%]:	-12.1	%

The Performance ratio calculated is 88,6 %.

Note that this project is only providing DC current to the Batteries of the Vault. A typical Solar PV Plant will suffer more losses due to the DC/AC conversion. As per Environmental Conclusions, and even if Site 1 has a slightly lower Energy output (-500 000 kWh/year), Biorex considers this Option (Rietfontein 28) as the most suitable site for the implementation of the Photo Voltaic aspects of the **INOVASURE** Energy Vault.

2.6 Financial Overview from the Pre-Feasibility Study

A preliminary Financial Model, including the above inputs and assumptions provided by **INOVASURE**, has been established for the full project in all its phases. The main findings are stated below:

CALITZDORP

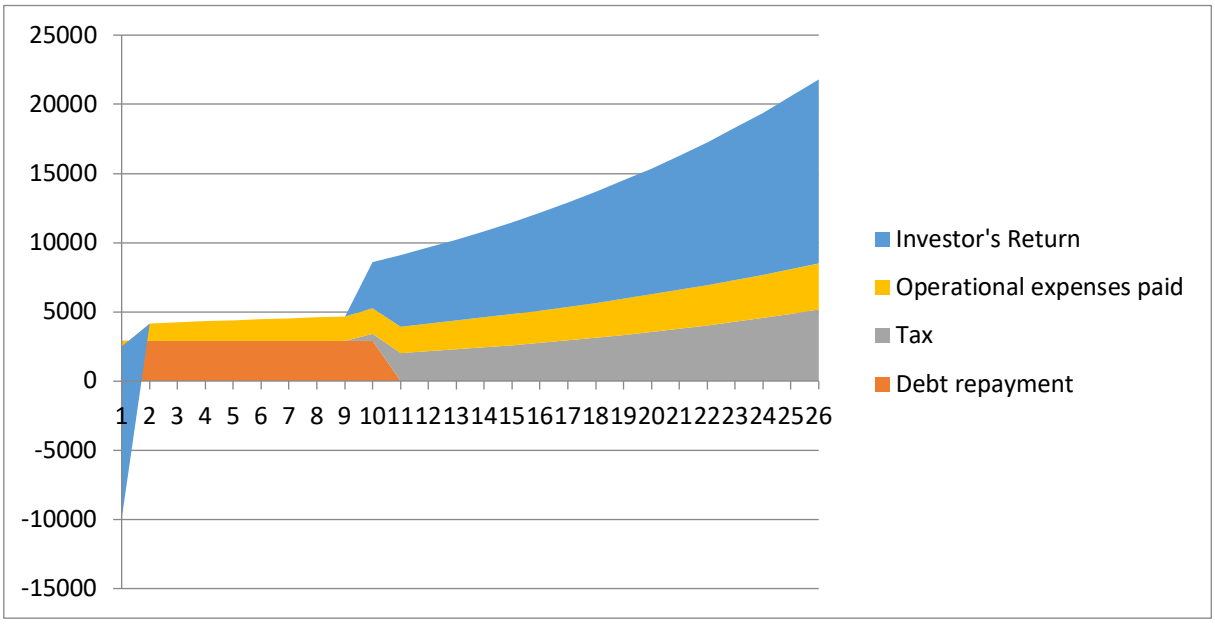
INVESTMENT		
		Unit
PV Panel Peak Power	340	*Wp*
Number of modules	147 059	*#*
Total PV Plant Capacity	50 000	*kWp*
CAPEX	523 734 796	*ZAR*
Development Costs	78 792 406	*ZAR*

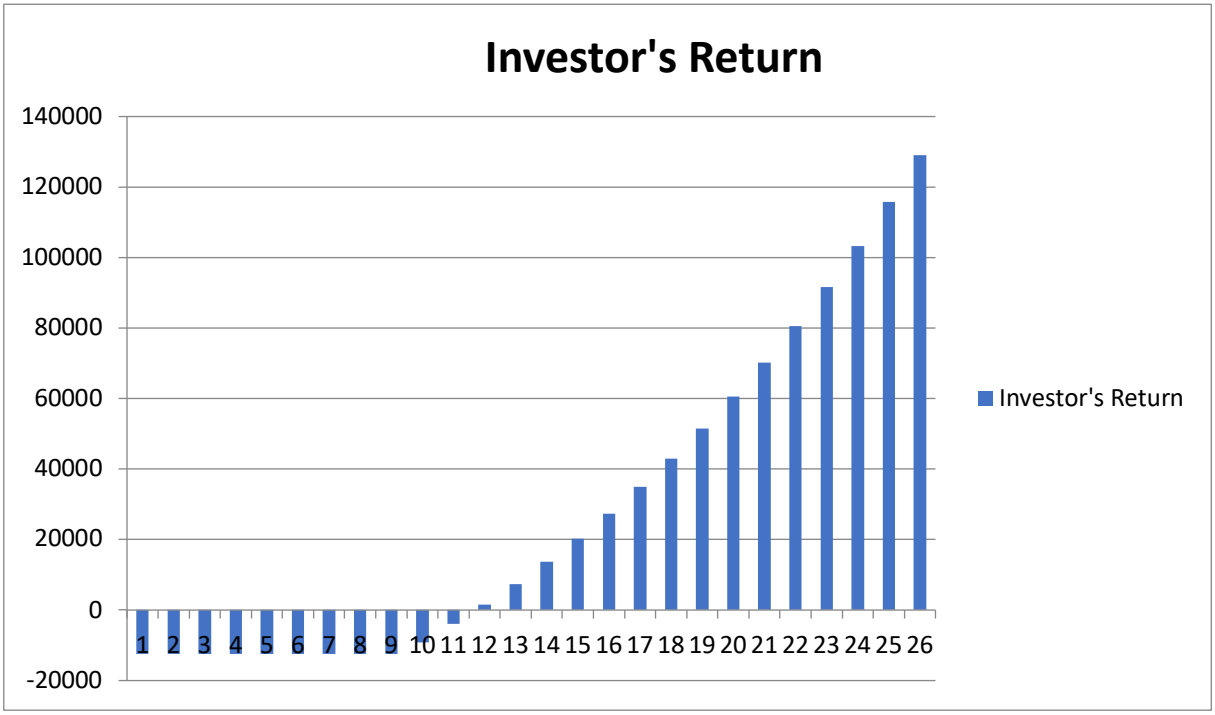
The Power Production of the Solar Plant is shown – assuming the full 50MW has been installed:

POWER PRODUCTION		
Average Irradiation project location GHI	2 080	*kWh/m²*
Performance Ratio (estimate)	80%	
Annual Production (Year 1)	99 500	*MWh*
Annual Degradation	0.5%/year	

The expected revenue assumptions are stated below – assuming there are two PV installations at 50MW:

PRICE & COSTS INFORMATION		
Off-Taker Tariff	0.74	*ZAR/kWh*
Indexation	5%	*CPI*
First Year revenues	78 047 800	*ZAR*
OPEX	18 100 412	*ZAR*
Debt Service (90/10 Debt/Equity)	-42 176 904	*USD*
Internal Rate of Return (project)	**ZAR**	
Debt/Equity ratio	90/10	
Min DSCR	1.0	
Avge DSCR	2.2	





The outcomes of the technical feasibility study that was undertaken, and that were reported on here, were used as inputs to the financial modeling of Part C of the Overall Feasibility Process for Stages 1 and 2. This in turn was used to prepare the submissions to funders and investors that have shown an interest in the Overall Energy Vault and associated interventions such as is the case in support of the Kannaland Local Municipality and its stakeholders.

2.7 Disclaimer

This document is strictly for business planning process information purposes. Projections in the report have been compiled for illustrative purposes and do not constitute final forecasts.

The eventual outcome of the business planning roll-out process may be more or less favourable than that portrayed.

3. INTERVENTION #03: BROADBAND & SMART METER

3.1 The "Last Mile"[4] Broadband and Smart Meter Content Delivery

A Last Mile Broadband and Smart Meter Content Delivery Pre-Feasibility Report was prepared for the Kannaland site. The report serves as a case study for any other selected Energy Vault Site. The definitive report for the Kannaland Local Municipality and surrounds will be prepared during the next phases of the implementation and roll-out of the InovaSure Energy Vault program in South Africa.

This part of the Kannaland Local Project Feasibility Report therefore covers the "Last Mile Broadband and Smart Meter Content Delivery Report", dated 08 November 2018 that was prepared by LiveSure, **INOVASURE** and Spectrum Utility Management (SUM). It is aimed at the implementation of a "Last Mile" Broadband and Smart Meter Content Delivery Solution in the Kannaland District in the Western Cape which will service up to 37 000 Residential Units in Kannaland and Surrounds (and 2000 Informal Settlement Units through the LivPak B4I electrification project).

At the heart, the solution is required to primarily manage the Electricity Supply (and other utilities in further phases) to a premises including but not limited to a user friendly consumer interface for control and purchases of electricity as well as allowing for macro control in terms of load management in the general sense.

Furthermore, the smart meter will serve as the primary broadband access point on the premises which should seamlessly connect multiple Wi-Fi enabled devices to connect to the World Wide Web through the smart meter. The internet connection has to be a minimum of 6 Megabytes per Second to enable other content to be delivered to the premises through various smart devices.

[4] Report by LiveSure, INOVASURE and Spectrum Utility Management (SUM): "Last Mile Broadband and Smart Meter Content Delivery Report", dated November 2018

In order to effect the internet connectivity to the premises, an LTE Network is to be constructed to enable wireless connectivity on at least 4.5G between the premises and the nearest Sub- or Mini-Sub Station. A third party Licenced Spectrum utilisation arrangement will be implemented with a suitable supplier to align with regulatory requirement for the deployment of the LTE Network. This arrangement is out of scope for this report.

The Sub- or Mini-Sub Station is viewed as the aggregation point for the last mile LTE network. The aggregation point will backhaul to a centralised Data Centre via a new Fibre Network to be installed to enable the required capacity to deliver the specified minimum connectivity rate

3.2 Project Scope: Fibre Reticulation Installation

Refer to the original Report by LiveSure, **INOVASURE** and Spectrum Utility Management (SUM): "Last Mile Broadband and Smart Meter Content Delivery Report", dated November 2018.

The standard specification covers the principles, responsibilities and requirements applicable to the design and construction of buried (underground) duct (conduit) infrastructure for Kannaland with a suitable service provider for the installation of all Fibre Optic Infrastructure to enable effective backhaul capacity between the Aggregation point and the Data Centre. The standard specification also covers the requirements and allowable methods for the excavation of trenches, placement of ducts in the trenches, bedding and backfilling, compaction and re-instatement of surfaces. It also addresses construction of hand holes and access chambers.

The following aspects of the project scope for the **fibre installations to subs and mini-subs** (estimated at 45 for the full deployment into Kannaland and surrounding Municipalities) refer:

- Scope;
- Application;
- Priority ranking of relevant documentation and rulings;
- Applicable documentation;
- Definitions;
- Abbreviations and acronyms;

- General requirements and obligations;
- Material requirements;
- Construction requirements; and
- Maintenance requirements

In the absence of specific network design a budget of **R585-00 per running meter** will be provisioned for Fibre Reticulation Installation that was recommended.

3.3 Project Scope: LTE Installation for Last Mile Connectivity

Refer to the original Report by Livesure and **INOVASURE:** "LiveSure: Thin Client Technology, Last Mile Broadband and Smart Meter Report", dated November 2018 for the LTE installation for the Last Mile connectivity. This is not repeated here in this part of the overall report.

3.4 Project Scope: Smart Meter and Broadband Connectivity

Refer to the original Report by Livesure**, INOVASURE** and Spectrum Utility Management (SUM): "Last Mile Broadband and Smart Meter Content Delivery Report", dated November 2018.

The basis of the functional requirement as specified is essentially to enable the smart meter application to double up as a broadband router which, in turn, will enable multiple smart devices to connect to the internet via the smart meter infrastructure which in turn connects the Internet via the LTE Infrastructure. This platform will allow for multiple applications and content to be accessed and streamed to each resident whilst simultaneously allowing for real time efficient energy (utilities) management.

Technical Specifications are discussed in the original report to cover the following aspects of the project scope:

- Synapses Control centre:
    - Software applications;
    - Hardware components;
- Synapses Gateway;
- Synapses Load Management and Metering Module; and

- Powerflex IV Communication Device

The proposed solution does not require new metering infrastructure to be installed throughout. It can operate on legacy infrastructure and essentially turn any meter into a smart meter. Further, where the electrical reticulation is configured on poles or in kiosks where multiple units are serviced from one point, the configuration could further be adapted for further cost savings. This aspect needs to be further investigated and has not been taken into consideration for the budget as herein presented for the Kannaland (and surrounding Municipalities) Energy Vault Project.

3.5 Facility Requirements

The total energy management and monitoring CAPEX Budget (as per the financial modelling that was undertaken) amounts to approximately R124m (excluding VAT):

ENERGY MANAGEMENT AND MONITOR	
DESCRIPTION	**TOTAL COST EXCL VAT**
TOTAL CAPEX (Plant and Equipment)	R98 212 684
TOTAL CAPEX (Working Capital)	R26 055 913
Internal Rate of Return (IRR)	16.3%
Net Present Value (NPV) at 10%	R12 640 222

Table 1: Smart Meter Financial Modelling

The outcomes of the technical feasibility study that was undertaken, and that were reported on here, were used as inputs to the financial modeling of Part C of the Overall Feasibility Process. This in turn was used to prepare the submissions to funders and investors that have shown an interest in the Overall Energy Vault and associated interventions such as is the case in support of the Kannaland Municipality and its stakeholders.

3.6 Disclaimer

This document is strictly for business planning process information purposes. Projections in the report have been compiled for illustrative purposes and do not constitute final forecasts.

The eventual outcome of the business planning roll-out process may be more or less favourable than that portrayed.

4. INTERVENTION #04: THIN CLIENT TECHNOLOGY

4.1 Development of the LiveSure Thin Client[5] Technology

A thin client technology report was prepared for the Kannaland site. The report serves as a case study for any other selected Energy Vault Site. The definitive report for the Kannaland Local Municipality will be prepared during the next phases of the implementation and roll-out of the InovaSure Energy Vault program in South Africa.

This part of the Kannaland Project Feasibility Report covers the "Proposal and Specific Kannaland Implementation Project Feasibility Report" for the implementation of a "Last Mile" Broadband and Smart Meter Content Delivery Solution in South Africa with a case study pilot project identified in the Kannaland District in the Western Cape which would service 37 000 Formal Settlement Residential Units (and 2000 Informal Settlement Residential Units as a separate initiative with collaborator "LivPak B4I") as part of the **INOVASURE** Energy Vault Kannaland project.

More information about LiveSure, **INOVASURE** and the Thin Client Technology is included as attachments to this Report. LivPak will supply an electrification and telecommunications solution to the indigent Residential Units that will include connectivity.

[5] Report by Livesure and INOVASURE: "LiveSure & SUM: Thin Client Technology, Last Mile Broadband and Smart MeterReport I", dated November 2018

At the heart of the **INOVASURE** Energy Vault, the solution is required to primarily manage the Electricity Supply (and other utilities in further phases) to a village, town or city, including, but not limited to, a user friendly consumer interface for control and purchases of electricity as well as allowing for macro control in terms of load management in the general sense.

Value added services of LTE enabled WIFI access, content provision, delivery of education, provision of Virtual Private Networks and concomitant Virtual Machines to citizens in the homes, and other related services are also enabled by the LiveSure basket of services.

The LiveSure unique Smart meter and telecommunications device will serve as the primary broadband access point on the premises which will seamlessly connect multiple WI-FI enabled devices to the World Wide Web through the smart meter. The internet connection must constitute a minimum of 6 Megabytes per Second to enable content to be delivered to the premises through LiveSure's various smart devices.

On a city–by-city basis, in order to effect the internet connectivity to the premises, an LTE Network is proposed to be constructed to enable wireless connectivity between the premises and the nearest Mini-Sub Station. A third party Licenced Spectrum utilisation arrangement is proposed to be implemented with a suitable provider to align with regulatory requirements for the deployment of the LTE Network. This arrangement is out of scope for this report but has already been proposed in separate draft agreements.

The Mini-Sub Station is viewed as the aggregation point for the "last mile" LTE network. The aggregation point will backhaul to a centralised Data Centre via a new Fibre Network to be installed by LiveSure at its own cost to enable the required capacity to deliver the specified minimum connectivity rate

4.2 Kannaland Local Project Pilot Implementation Project Scope

Refer to (Annexure A of) the original Report by Livesure and **INOVASURE:** "LiveSure: Thin Client Technology, Last Mile Broadband and Smart Meter Report", November 2018.

LiveSure provided the proposed specifications for the installation of the Fibre Optic Infrastructure at the Kannaland Local Municipality and surrounds in order to enable effective backhaul capacity between the Aggregation point and the Data Centre. This specification covers the principles, responsibilities and requirements applicable to the design and construction of the proposed buried (underground) duct (conduit) infrastructure for Kannaland and its surrounding areas where the smart meters will be installed. The standard specification covers the requirements and allowable methods for the excavation of trenches, placement of ducts in the trenches, bedding and backfilling, compaction and re-instatement of surfaces. It also addresses construction of hand holes and access chambers.

The following aspects of the project cope for the **fibre installations to subs and mini-subs** refer:

- Scope;
- Application;
- Priority ranking of relevant documentation and rulings;
- Applicable documentation;
- Definitions;
- Abbreviations and acronyms;
- General requirements and obligations;
- Material requirements;
- Construction requirements; and
- Maintenance requirements

4.3 Proposed Budget Inputs

In the absence of a specific network design, the cost for Fibre Reticulation Installation and the LiveSure Thin Client Technology implementation at the Kannaland proposed pilot project were estimated and calculated. This will be definitively and specifically calculated for Kannaland Local Municipality once the installation process commences.

There are estimated to be 45 mini-substations for the implementation of approxiametly 37 000 smart meters in the dwellings and the network is estimated to be 80 Km for the coverage of the meters in question. Kannaland Municipality's LTE Coverage and Broadband Installation is proposed for 37 000 Formal Residential Units (excluding some 2000 informal homes under separate connection and costing).

The total estimated cost will be **R205 309 500** (i.e. ca R205m) – see below:

1	RADIO NODE SUPPLY	QTY		
1.1	E-Node 2X40W	1215		
1.2	LTE Omni-Directional Antenna System	1215		
1.3	E-Node B Power Matriculation	1215		
1.4	E-Node B Light Pole Bracket	1215		
	Supply Price Per Mini sub		PRICE	ZAR 2 446 200
	Based on 4 E-Node B per MiniSub			
2	I&C SERVICES	QTY		
2.1	E-NODE B Installation	1215		
2.2	Antenna System Install and Test	1215		
2.3	E-Node B Power Installation	1215		
2.4	Access Transmission and Backhaul	1215		
	Implementation Price per Mini Sub		PRICE	ZAR 666 900
3	Access Transmission	1		ZAR 120 000
4	Backhaul Gb Transmission	Per Sub		
			Price	ZAR 70 000
	TOTAL PRICE FOR SUPPLY AND I&C PER MINI-SUB			ZAR 3 303 100
	Based on 4 E-Node B per minisub			

TOTAL PRICE for approximately 45 MINI-SUBS ZAR 153 339 500
Includes LTE NETWORK COVERAGE TO ALL 37000 HOMES

OPERATIONS, SUPPORT AND MAINTENANCE PER YEAR ZAR 21 590 000

5	Software Defined Network	QTY			
5.1	HetNet Sw License	1			R 2 590 000.00
5.2	HetNet Server Hardware	1			R 42 000.00
5.3	HetNet Configuration and Site Integration	100			R 350 000.00
5.4					
	Hw, Sw, Configuration and Support Price			PRICE	ZAR 4 500 000
6	**SUPPORT and OPERATIONAL COSTS**				
6.1	FIELD SUPPORT	PER YEAR			
6.2	HW SUPPORT	PER YEAR			
6.3	OFFICE, VEHICLES	PER YEAR			
6.4	HETNET ENGINEER	PER YEAR			
	TOTAL OPERATIONS,SUPPORT AND MAINTENANCE				
			PRICE	19 000 000	
	Fibre Network				
7	OPTICAL FIBRE NETWORK				
7.1	CIVILS AND FIBRE BUILD	2km PER SUB		**ZAR 46 000 000**	
7.2	ISP	45		**ZAR 1 125 000**	
7.3	OSP	45		**ZAR 1 395 000**	
	PRICE FOR OPTICAL FIBRE BUILD NETWORK			ZAR 48 520 000	
	SDN and ENODE B			ZAR 144 789 500	
	LiveSure Server Room for management purposes			ZAR 12 000 000	
	TOTAL PRICE FOR OPTIONAL OPTICAL FIBRE LTE NETWORK			**ZAR 205 309 500**	
	Cost per home			R 10 479	
	Total connections			19 593	
		CAPEX summary			
			45 mini-subs connectivity	R 153 339 500.00	
			Fibre LTE network		
			Total CAPEX	**R 153 339 500.00**	
			Working capital	R 70 000 000.00	
			Total Capital	**R 223 339 500.00**	

Table 3: Total Estimated Capital Cost Inputs to Financial Modelling

4.4 LTE Installation for Last Mile Connectivity

Specification and Functionality

LiveSure and its collaborators utilise market leading Software Define Communication Heterogeneous Network platforms in conjunction with state-of-the-art small cells to cost effective deploy LTE Networks quickly.

The hardware deployed can be installed by semi-skilled labour and operational budgets are cut to a 1/20 of Traditional Network OPEX.

A formal design for the Kannaland Local Municipality project has not been finalised but a baseline requirement was determined based on the number of meters (premises), being approximately 37 000 in formal settlements and 2000 in informal settlements, as well as the minimum connection speed of 6 Mbts/s required.

The projected budget provides for same LiveSure recognises the importance of a quality Broadband Network to enable the venture to achieve its key deliverables.

Access to Broadband is a basic human right and its importance as an economic driver cannot be underestimated.

Key benefits

It is well written that by 2021, over 60% of data carried over a wireless network will be transmitted over a small cellular radio. Added to this is the fact that also by this time IPV6 will be available globally allowing the thousands and thousands of further IP addresses required to provide the connectivity for all of the IOT requirements and smart city concepts.

From a design perspective, it is also well written that to physically provide these connections the air interface. The interface from a transmitting and receiving cell site to your cell phone/connected device must be reduced from the average 1.5km it is today to roughly 100m.

Today's LTE networks do not offer this paradigm, not yet anyway.

The investment required from the network operators to build out the infrastructure to meet these demands does not provide an effective return of investment due to legacy technologies and the profit margins needed by incumbent telco vendors.

LiveSure and its collaborators can address these issues now. Having partnered with leading edge technology providers, SUM can now offer a Software Defined approach in deploying 3g and LTE networks. The air interface has been re-imagined enabling functionality that historically is part of the NodeB and Core Network is now virtualised and delivered in a software package. This provides a number of key benefits including:

- Easy integration to most legacy core network vendors (Ericsson, Huawei, ZTE, Alcatel, Nokia);
- Removal of base band unit and all hardware below the tower removing need for build permission and large site lease;
- Much reduced footprint of ENode B allowing installation on street-poles, corners of buildings etc.;
- Added functionality including Voice over LTE (VoLTE) and WIFI calling (TWAG);
- Ability to use any backhaul including In band backhaul;
- "Light up" of rural areas that have no connectivity in days rather than weeks or months;
- Much reduced CAPEX requirement for Radio Network build out and expansions SDN ENode B a fraction of cost of traditional E Node B's from Legacy vendors;
- Makes 3G and LTE deployment quicker and more cost effective than enterprise WIFI to implement;
- Ideally suited to 3G Expansion, LTE Buildout, Smart City Connectivity's Rural and Urban applications; and
- The most efficient and cost effective solution for last mile LTE

4.5 More Budget Inputs

The budget estimates were calculated on the basis that each SUB-/Mini Sub Station will serve as an aggregation point and that not more than 80 residents will be connected to each SUB-/Mini Sub.

The number of units specked is based on easily achieving a 6Mbts/second connection rate.

	UNIT DESCRIPTION	QTY	ZAR
1	**Radio Node Supply**		
1,1	E-Node 2X40W	1	
1,2	LTE Omni-Directional Antenna System	1	
1,3	E-Node B Power Matriculation	1	
1,4	E-Node B Light Pole Bracket	1	
	Supply Price Per E-Node B		**ZAR 68 600**
	Based on 4 E-Node B per MiniSub		
	UNIT DESCRIPTION	**QTY**	**ZAR**
2	**I&C Services**		
2,1	E-NODE B Installation	1	
2,2	Antenna System Install and Test	1	
2,3	E-Node B Power Installation	1	
	Implementation Price per E-Node B		**ZAR 9 250**
	TOTAL PRICE: SUPPLY AND I&C PER MINI-SUB		**ZAR 311 400**
	Based on 4 E-Node B per minisub		
3	**Software Defined Network**		
	HetNet Sw License		
	HetNet Server Hardware		
	HetNet Configuration and Site Integration		
	HW, SW, CONFIGURATION AND SUPPORT PRICE		**ZAR 840 000**

Table 2: Units and Budget Cost

4.6 Network Schematic

The 3G/4G Outdoor and Indoor Solution Architecture is shown below:

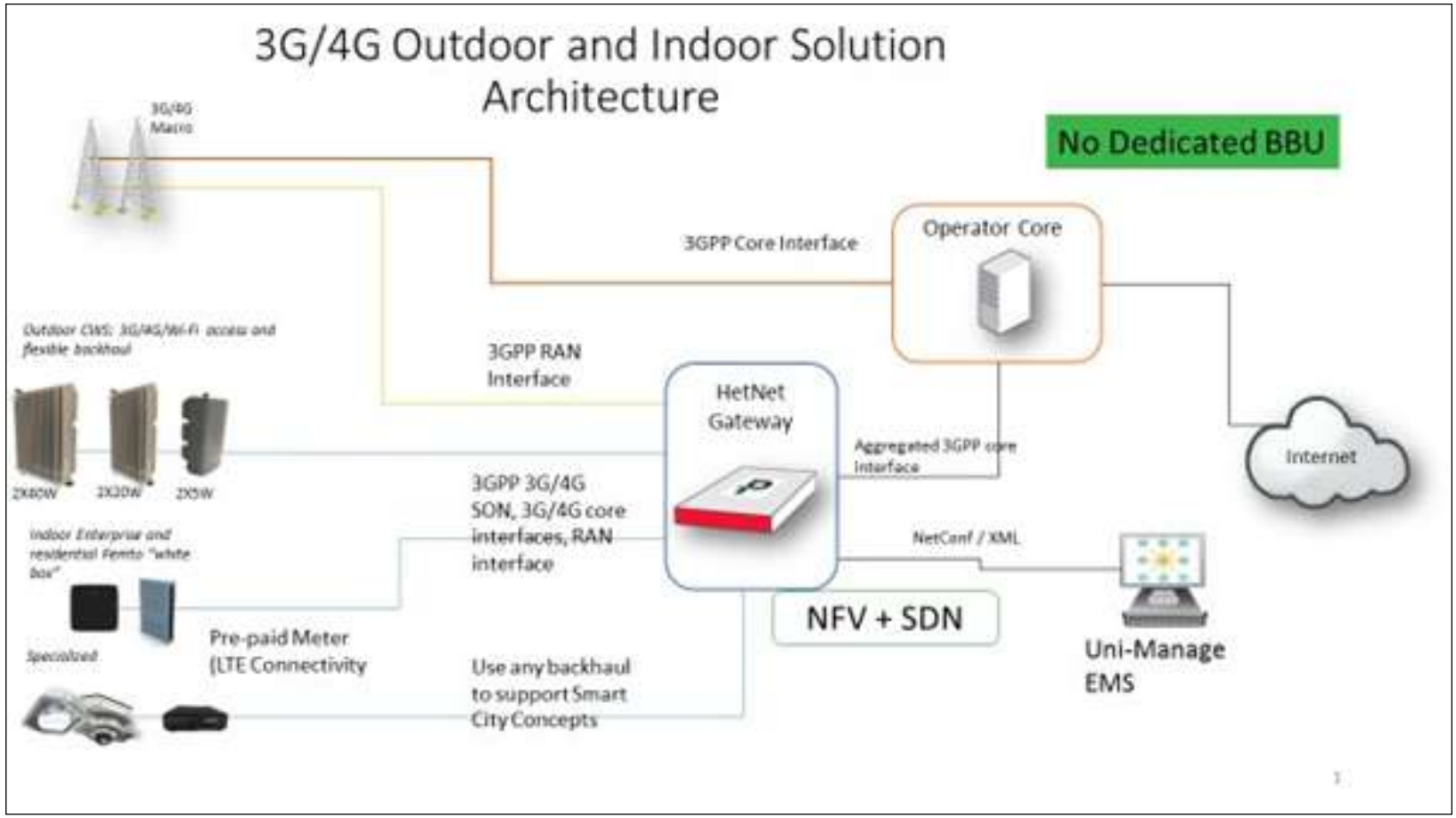


Figure 1: 3G/4G Outdoor and Indoor Solution Architecture

4.7 Smart meter and Broadband Connectivity: Specification and Functionality

The basis of the functional requirement as specified is essentially to enable the Smart meter application to double up as a broadband router which will enable multiple smart devices to connect to the internet via the smart meter infrastructure which in turn connects the Internet via the LTE Infrastructure. This platform will allow for multiple applications and content to be accessed and streamed to each resident whilst simultaneously allowing for real time efficient energy (Utilities) management.

The Technical Specifications are as follows:

Synapses Control Centre

- *Software Applications:*
  - Microsoft Operating System;
  - SQL Server, Oracle or MS Access for small systems;
  - Load Management Translator/Software;
  - Metering software with custom interface to financial system; and
  - Disconnection software with batch disconnection capability;
- *Hardware components:*
  - Metering and Disconnection server;
  - Load Management Server;
  - LAN/WAN;
  - GSM Modems or WAN Connection for communication with the Mini Substations; and
  - UPS and dial-up modem

Synapses Gateway

Features:

- Converts TCP/IP to bi-directional power line carrier;
- Converter option GSM to bi-directional power line carrier;
- 3x metering inputs with load profiles;
- 3x contactor set/reset options;
- RS232 diagnostic port;
- RS485 industrial bus; and
- Unlimited metering connections

Synapses Load Management and Metering Module

Features:

- Communication: bi-directional power line carrier;
- Four metering inputs:
  - 60A standard meter;
  - 100A standard meter with CT;
  - Three phase 60A and 100A standard meter;
  - Programmable for other pulse output meters — pulse or edge trigger;
- Status reporting on phase and meter type;
- LED status indication;
- Soft pickup after power failure;
- 255 selectable groups;
- Individually addressable;
- Relay, fail and bypass detection;
- Pattern shedding; and
- Switching capacity;
  - Option 1: 1x 20A relay; and
  - Option 2: 3x 20A relay individually addressable (Isolated)

Powerflex IV Communication Device Features

Communication Module

- One bi-directional RS485 bus for the Inteliprobe, to meter multiple AMR meters or a single Data streaming bulk meter;
- Can be managed and controlled from a remote location via GPRS, GSM or SMS connection;
- Uniquely addressable IP address;
- Remote APN setup and signal strength interrogation via SMS;
- External SIM access;
- Onboard PSU;
- DIN & Mini rail mountable; and
- New Over the air upgradable

Figure 2: Technical Specifications

Real-time Data Streaming and Load Control

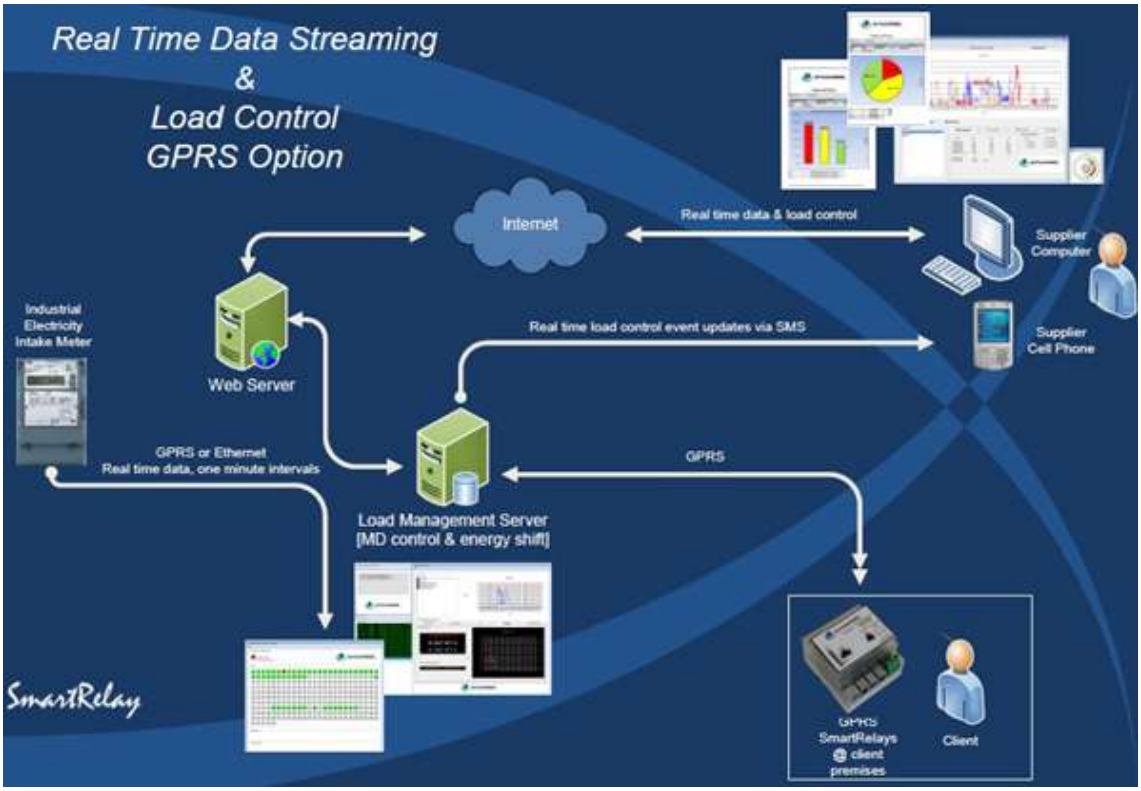


Figure 23: Real-time Data Streaming and Load Control

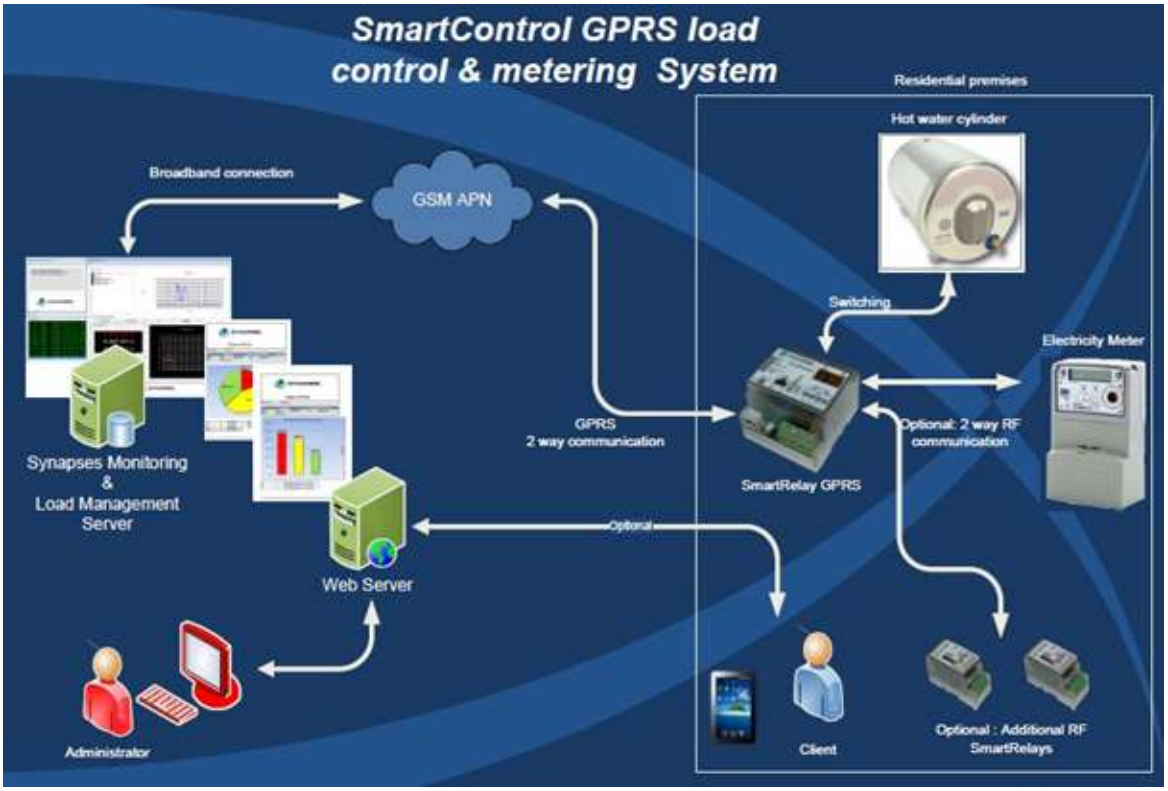


Figure24: SmartControl GPRS Load Control and Metering System

InteliProbe Features

- Optical IEC62056-21 interface to meter;
- Bi-directional RS485 Communication;
- Saves Meter serial number onboard;
- Read Consumption Register for Meters with IEC62056-21 interface;
- Read Consumption Time of Use Register for Meters with IEC62056-21 interface;
- Reporting of Meter communication error and serial number change states;
- 24 Hour load profile in 30-minute intervals;
- Record 30- minute interval Maximum Demand;
- Can switch 100A contactor for Remote Disconnect/Connect purposes;
- Can be managed and controlled from a remote location via GPRS/PLCC/Ethernet/802.11 Wi-Fi;
- Uniquely addressable IP address and by group;
- Daisy chain up to 32 meters with onboard RS485 Bus; and
- Device will register automatically on central AMR server, no configuration needed.

Overview

The Synapses InteliProbe Module fits onto electricity meters with an IEC62056-21 interface to expand the functionality to AMR and connection/disconnection.

The InteliProbe is a reliable, flexible and cost effective device that incorporates a wide range of functionality to enable better service delivery.

Figure 25: The Synapses InteliProbe Module

4.8 The LiveSure Thin Client Technology

The LiveSure Thin Client Technology ("LTCT") consists of a suite of technology components, using a specific strategy to solve a systems problem. The problem in question is that of the provision of exceptionally reliable, very low-cost Information Technology ("IT") solutions which are also suitable for deployment to non-specialist/technical users.

The current norm of Personal Computers ["PCs] (desktop and laptop) represents a solution which implies:

(1) High capital cost (hardware and software);
(2) High maintenance cost (specialist support);
(3) High levels of vulnerability (virus, trojan and hacker attacks);
(4) Low levels of utilisation (most CPUs power idle, especially when web browsing

and writing documents);

(5) Data vulnerability (costs / difficulties archiving, storing and transferring data); and
(6) User frustration with operating system design changing.

The LiveSure Thin Client computing is in many ways very similar to the old-school "client-server" or "mainframe-terminal" scenario. Currently, the most dominant manifestation of Thin Client computing is that of web browser – web server solutions. The idea is to centralise computing resources (data, computing power, etc.) with the client requirements being greatly diminished in the process, with the added benefit of shared access to data.

The LiveSure Thin Client "Computer" or "iThin Device" is a lightweight device that is purpose-built to connect to a remote server, with the Thin Client tasked only with collecting user input responses (mouse, keyboard, etc.) and providing feedback to the user (display).

All computing happens on the server. This is also referred to as "cloud computing". The server-side infrastructure makes use of software products that create a "virtual computer environment", into which operating systems, programs, etc. can be installed as would normally be done with a desktop computer

The key to the success of the LiveSure solution is in the construct of the server and hypervisor environment. In this case, a Kernel-Based Hypervisor ensures a stable, highly efficient, low overhead environment without the burden of additional license fees for every new instance executed.

In addition, the hypervisor deployed on each node is linked through a mechanism write-up known as "clustering" (where several computers act in concert to carry a shared computational load), which ensures redundancy, and with several nodes used also increases redundancy through "Geo- clustering" reducing the impact of localised failures which would typically be a regional phenomenon.

The LiveSure server also uses a "Materialised Router" as a "Virtual Machine" ("VM") in the hypervisor to maintain the VPN (Virtual Private Network) connections, increasing communication efficiency as well as security with data compression and encryption. This not only improves performance, but also avoids very high costs associated with dedicated hardware traditionally utilised for this purpose.

The LiveSure Thin Client solution allows shared access to centralised computation and data storage resource, which enables more optimised utilisation of hardware and software, inherent shared data access and vastly improved security.

Desktop computer maintenance is practically eliminated with every new Virtual Machine easily created as a clone of an existing Virtual Machine and component compatibility and hardware redundancy is eliminated for the client.

A "crashed" machine is almost instantly revived by the roll- back of a previous snapshot of the Virtual Machine, using specialist enterprise backup storage solutions at no additional cost for the client.

With the server management being fully in control of the hardware and the Virtual Machines, any appropriate operating system can be presented by LiveSure to users, also enabling a better match between user skill / requirements and the computing solution.

The delivery device for the LiveSure Thin Client Technology is cheap and lightweight and presents a highly unique spearhead for the ground-breaking technology that the VPN offers through the Virtual Machine delivered by the Thin Client device. It comes in various sizes and shapes, is Android based and endorsed by Google and has various capabilities that range from a basic deployment system for the VPN within a Smart phone, tablet or Smart meter, up to an all-inclusive small mobile device that includes a projected keyboard, mouse and screen that can be utilized virtually anywhere where wifi is readily available.

LiveSure's Thin Client Technology and provision of a Virtual Private Network to each client on a Virtual Machine is highly suitable for educational, business, or general communication purposes and is uniquely positioned to render traditional PC's redundant worldwide due to its cheap, effective and secure environment.

LiveSure Basic iThin	LiveSure Express iThin	LiveSure Deluxe IThin
		

Figure 26: Thin Client Equipment

iThin Basic	IThin Express	iThin Deluxe
Processor o MT8735A o CPU: A53 Quad Core 1.45Ghz processor o GPU: Quad Core Mali 720 MP2	**Processor** o MT8735A o CPU: A53 Quad Core 1.45Ghz processor o GPU: Quad Core Mali 720 MP2	**Processor** o MT8735A o CPU: A53 Quad Core 1.45Ghz processor o GPU: Quad Core Mali 720 MP2
Operating System & Apps o Android 7.0 o Sentio Application o Office 365	**Operating System & Apps** o Android 7.0 o Sentio Application o Office 365	**Operating System & Apps** o Android 7.0 o Sentio Application o Office 365
Ports and Interfaces o 1 x HDMI o 1 x USB 2.0 Ports o 1 x USB 3.0 Ports o 1 x Micro USB Port o 1 x microSD Card Slot o 1 x DC in Audio port	**Ports and Interfaces** o 1 x HDMI o 1 x USB 2.0 Ports o 1 x USB 3.0 Ports o 1 x Micro USB Port o 1 x microSD Card Slot o 1 x DC in Audio port	**Ports and Interfaces** o 1 x HDMI o 1 x USB 2.0 Ports o 1 x USB 3.0 Ports o 1 x Micro USB Port o 1 x microSD Card Slot o 1 x DC in Audio port
System Requirements o High-definition monitor or high-definition TV with HDMI and capable of 1080p o A free Google Mail address for accessing and downloading Google Play Store applications	**System Requirements** o High-definition monitor or high-definition TV with HDMI and capable of 1080p o A free Google Mail address for accessing and downloading Google Play Store applications	**System Requirements** o High-definition monitor or high-definition TV with HDMI and capable of 1080p o A free Google Mail address for accessing and downloading Google Play Store applications
Connectivity o 4G LTE Cat 4 150Mbps / 50Mbps o Wi-Fi 802.11b/g/n o Bluetooth 4.0	**Connectivity** o 4G LTE Cat 4 150Mbps / 50Mbps o Wi-Fi 802.11b/g/n o Bluetooth 4.0	**Connectivity** o 4G LTE Cat 4 150Mbps / 50Mbps o Wi-Fi 802.11b/g/n o Bluetooth 4.0
RAM and storage o 2GB LPDD R3 RAM o 16GB EMMC o Mini SD Storage up to 64 GB	**RAM and storage** o 2GB LPDD R3 RAM o 16GB EMMC o Mini SD Storage up to 64 GB	**RAM and storage** o 2GB LPDD R3 RAM o 16GB EMMC o Mini SD Storage up to 64 GB
Security o Finger Print Reader	**Security** o Finger Print Reader	**Security** o Finger Print Reader
Battery o 4 hours (casual use), 2200 mAh lithium-ion battery	**Battery** o 4 hours (casual use), 2200 mAh lithium-ion battery	**Battery** o 4 hours (casual use), 2200 mAh lithium-ion battery
	Key Board [Add on Mod] o Virtual Keyboard that projects a keyboard onto any flat surface.	**Key Board [Add on Mod]** o Virtual Keyboard that projects a keyboard onto any flat surface.
		Insta-share Projector [Add on Mod] o Resolution 854x480 WVGA (480p) o DLP Technology o Brightness: 50 lumens nominal o Contrast ratio: 400:1 o Throw ratio: 1.2 o Image size: Up to 5-70" diagonal o Aspect ratio: 16:9 o Lamp life rating 10,000 hours

Table 5: Thin Client Equipment Specifications

Figure 27: Thin Client Technology at work

4.9 Conclusion on budget

The total LiveSure CAPEX Budget (as per the financial modelling that as undertaken) amounts to ca R223m (excluding VAT):

ENERGY MANAGEMENT AND MONITOR	
DESCRIPTION	**TOTAL COST EXCL VAT**
TOTAL CAPEX (Plant and Equipment)	R13 762 000
TOTAL CAPEX (Working Capital)	R9 000 000
Internal Rate of Return (IRR)	27.17%
Net Present Value (NPV) at 10%	R15 195 461

Table 6: LiveSure Financial Modelling

4.10 Conclusion

LiveSure is confident that it has the capability, key stakeholder involvement, technology and contracts in hand for the implementation of the Last Mile solution to the countrywide provision of **WIFI** connectivity for the delivery of Thin Client Technology via customised devices and smart meters to homes in South Africa.

It is proposed that LiveSure will obtain access to connectivity and broadcasting licenses through the LivPak Co0-operative models (referred to elsewhere in this report) and that LiveSure proceeds to implement the Fibre and LivPak connectivity Networks in the target Municipalities in South Africa for the delivery of the service to citizens by means of the Smart meters and other related Thin Client devices. The first implementation project of Kannaland will provide the base models for the deployment of the initiative to at least 119 other sites in South Africa.

The outcomes of the technical feasibility study that was undertaken, and that were reported on here, were used as inputs to the financial modeling of Part C of the Overall Feasibility Process. This in turn was used to prepare the submissions to funders and investors that have shown an interest in the Overall Energy Vault and associated interventions such as is the case in support of the Kannaland Local Municipality and its stakeholders.

4.11 Disclaimer

This document is strictly for business planning process information purposes. Projections in the report have been compiled for illustrative purposes and do not constitute final forecasts.

The eventual outcome of the business planning roll-out process may be more or less favourable than that portrayed.

5. INTERVENTION #05: BATTERIES

5.1 Tesvolt Company Overview

A Utility Scale batteries' report was prepared for the Kannaland Local Municipality site. The report serves as a case study for any other selected Energy Vault Site. The definitive report for the Kannaland Local Municipality will be prepared during the next phases of the implementation and roll-out of the InovaSure Energy Vault program in South Africa.

The company called Tesvolt represents one of the options for the provision of battery technology for manufacture under license in South Africa. Other options that were considered included EOS Energy Storage, TCNT, Fluidic Energy and others.

TESVOLT
STORAGETECHNOLOGY

Tesvolt[6] was named after the well-known inventors Nikola Tesla and Alessandro Volta (inventor of the battery) and develops and produces flexible battery storage systems with high capacities. Tesvolt has advanced technologies with its strategic partners, for example SMA SOLAR Technology AG. The company focuses primarily on quality "Made in Germany" products and solutions with energy storage systems that are produced and battery systems assembled in Germany.

The company was founded with the ambition to continue to drive the renewable energy sector forward. The company's co-founders, Daniel Hannemann and Simon Schandert, have been working in the photovoltaic sector for many years, they have excellent knowledge of the market and innovations in the renewables industry and their main goal was to develop and sell economical commercial and industrial storage solutions.

Tesvolt offers the following to its markets and clients:

- Planning support;
- Installation support;
- Individual planning of large-scale storage facilities;

[6] http://www.tesvolt.com/en/ueber-tesvolt.html

- Attractive purchase prices; and
- "German built" quality

Tesvolt's economical storage systems offer the following:

- 10, 20 , 30 , 40 , 60, 120 … kWh to MWh;
- On-grid;
- Off-grid;
- Autonomous supply;
- Emergency power capability;
- Peak load capping; and
- Modular and deployable worldwide

Some numbers and facts about Tesvolt are worth noting:

- Available and usable: Worldwide;
- Storage Availability: Worldwide;
- Start of production: 2015;
- Production capacity p.a.: 60 MWh; and
- Headquarters: Lutherstadt Wittenberg in Gemany

5.2 Kannaland Energy Vault Requirements

Project Overview

- Project name: Kannaland Local Municipality
- City/Municipality: Calitzdorp, Ladismith and Zoar
- State: Western Cape
- Country: South Africa

Power Generation Sources

The Tesvolt Energy storage system will be provided with remote management and monitoring provided as a rack mountable system for indoor implementation. The Kannaland Project contains multiple generation sources.

- Between 1MW and 25MW solar PV plant (DC generation supplied directly to the energy storage system); and
- 66KVA Grid Power

Kannaland Load Profile

An investigation of the Kannaland municipal area shows a load profile as shown below. The projected daily seasonal residential load profiles for Kannaland were adapted from the Eskom Residential Consumption Model, scaled and offset to align with historic Kannaland invoices.

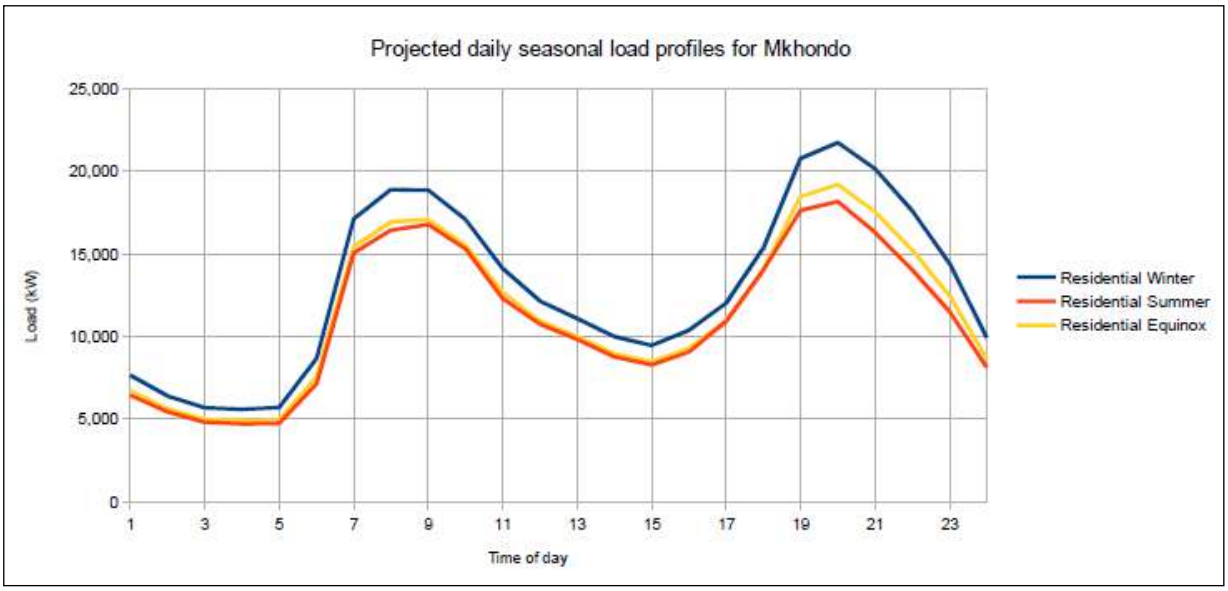


Figure 8: Projected Daily Load Profiles for Kannaland

Power Systems

There are several modes of power generation employed at the Kannaland site. The Eskom Grid and the solar PV plant supplies DC power to the energy storage system.

INOVASURE has two customers, the **Kannaland Local Municipality** and **ESKOM** (the national utility).

INOVASURE is providing the Kannaland Local Municipality an energy availability security program, ensuring that the Municipality does not get effected by ESKOM outages as a consequence of peak time load shedding or high peak tariffs.

INOVASURE Energy Storage Capacity and Load Management

The operational strategy is then to:

1. Allocate output to ensure the Kannaland NMD is not exceeded as non-dispatchable load reduction during winter (may be reduced during summer and equinox);
2. Provide enough MW's of dispatchable capacity to Eskom as additional peaking

capacity; and

3. Ensure energy storage systems are 100% charged 1 hour before peak hours

Daily Energy Storage System Duty Cycle for the standard INOVASURE Energy Vault

1. Charging to full capacity (40MWh to be available for both morning and evening discharge) at max peak of 12MW for:
   a) 8 hours from 10am to 6pm (primarily charged from PV system), and
   b) 9 hours from 9pm to 6am (grid charged)
2. Discharging at max peak of 12MW (nominal 10MW) for 5 hours per day, broken into two periods from;
   a) hours from 7am to 10am (30MWh), and
   b) hours from 7pm to 9pm. (20MWh)

5.3 Product Support Provided by Tesvolt

The Tesvolt Storage Systems:

Tesvolt's storage systems have been developed specifically for commercial and industrial applications. Products, safety, durability, performance and reliability are top priorities for Tesvolt's products and systems.

Figure 29: Tesvolt's Lithium Batteries

Tesvolt exclusively uses high-grade prismatic lithium nickel manganese cobalt oxide cells (lithium NMC) from Samsung SDI, which have been employed in high-quality electric cars. These cells are designed in such a way that they pose no risks to safety, even in the case of failure or mechanical damage. The above-average number of charge cycles and extremely long service life allow the storage systems to offer excellent economic efficiency.

The cells can be charged and discharged at 1ºC on a long-term basis and even at 4ºC for short periods (max. 20 seconds). The battery cells do not contain environmentally harmful heavy metals and can be recycled. As a matter of course, a take-back scheme is offered for Tesvolt batteries at no additional cost

Figure 30: Prismatic Lithium Nickel Manganese Cobalt Oxide Cells

The advantages of the Tesvolt oxide cells are:

- Reliable, advanced technology;
- Extremely cost-efficient;
- High capacities;
- Long service life of up to 30 years and 8,000 cycles;
- Recyclable;
- High efficiency rating;
- Maximum operating safety; and
- Low-maintenance

The active battery optimizer of Tesvolt:

The Active Battery Optimizer (ABO) is a technological innovation "Made in Germany" by Tesvolt. The ABO not only optimizes the cells within the battery modules, but also the individual battery modules in relation to one another. This process is the only one of its kind worldwide and, for the first time, ensures that an investment in a modular lithium storage system is both safe and sustainable. The ABO is located on the front of each battery module.

The cells in a battery system age differently depending on a variety of factors. Cell ageing can lead to differences in capacity and internal resistance, as well as variations in leakage

currents. This affects both charging losses and capacity, and thus has an impact on the voltage of each individual cell. On the other hand, excessive charging reduces the service life of the cells even further, quickly resulting in an avalanche effect if the problem is not rectified.

Cell monitoring and balancing systems are able to detect such differences in battery systems and correct them on a continuous basis. This process significantly increases the lifespan of individual cells. There are three types of balancing:

- **Passive Balancing:**
  Cells with excess voltage are discharged using fixed or selectable bypass resistances. Electrical energy resulting from the different states of charge is converted into thermal energy and lost;
- **Active Unidirectional Balancing (power pump or "charge pump" method):**
  Two transistor switches (MOSFET) and a choke are used to "pump" excess charge from one cell to the next. Since only the controlled discharge of circuits is permitted in this process, it is also referred to as unidirectional active balancing. However, charge can only be distributed between the cells in one direction here;
- **Active battery optimizer (by Tesvolt):**
  In contrast to unidirectional balancing, here, each cell can be charged by or discharged into all other cells in a battery module. This allows the battery system to be balanced quickly and efficiently

Figure 31: Cell Balancing by Tesvolt

The Tesvolt Battery Management System:

Tesvolt's Active Battery Optimizer ensures that battery cells are always charged and discharged in an ideal way. The optimizer monitors the temperature, voltage and state of charge (SOH & SOC) of each individual cell or module and controls them within the battery system.

This efficient distribution of energy means that only 1W (TS 48V) and 3W (TS HV) respectively are consumed by the storage systems per hour in standby mode (battery cabinet incl. batteries and ABO). This prevents unnecessary heating of the system, which would in turn require a cooling system.

The process significantly increases the service life of individual cells and, thanks to software and hardware-based shutdown mechanisms (dual redundant), sets new standards in cell protection and safety.

The Tesvolt BMS is primarily made up of two components – the Active Power Unit (APU) and the Active Battery Optimizer (ABO), which are each connected to a battery module.

Figure 32: The Battery Management System

The BATMON Cell Monitoring by Tesvolt:

The innovative Active Battery Optimizer and comprehensive monitoring of the storage systems down to cell level provides customers with software that can visualize the state of health (SOH – and voltage) and state of charge (SOC) of each individual cell.

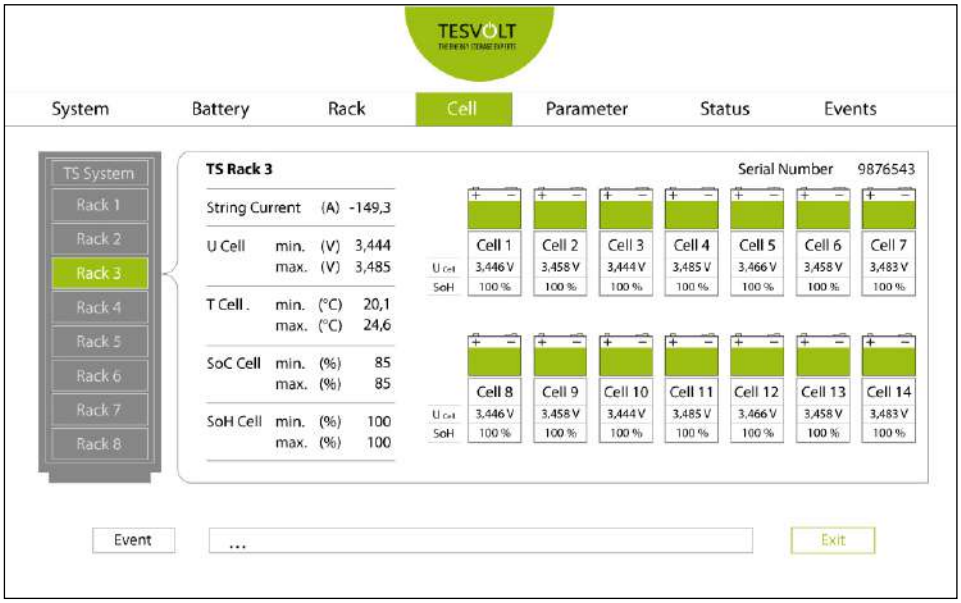


Figure 33: Cell Monitoring

Replace and Upgrade Batteries at any time:

Tesvolt's TS 48 V and TS HV 70 storage systems offer flexible configuration options at the moment of purchase and its capacity can be expanded years later due to innovative Active Battery Optimizer technology

The TS 48 Volt and TS HV storage systems are some of the highest performance storage systems currently available on the market and rate among the safest. They are designed for flexibility and extremely long service lives of up to 30 years – both key factors in achieving maximum profitability. These principles apply to all the components contained in Tesvolt's systems.

Product Manuals

- Installation & Commissioning Manual;
- Field Service Tools are Window's Based FE Battery Software to perform the following tasks:

- Network into the Battery to view real time data;
- Interrogate fault codes;
- Upload software locally; and
- Modify or edit battery settings;

- Field Service Manuals:
  - Performing regular (scheduled maintenance) and Fault Codes/Troubleshooting Procedures;
- Illustrated Parts Catalogues

Product Training

- Tesvolt will provide training to certify the customer or their designated third party installers in the installation, commissioning, and maintenance of the battery system.

5.4 Financial Modelling

Tesvolt and INOVASURE are currently finalising pricing in the light of the **INOVASURE** InovaBat Manufacturing Facility that will manufacture the battery under license:

ENERGY MANAGEMENT AND MONITOR	
DESCRIPTION	**TOTAL COST EXCL VAT**
TOTAL CAPEX (Plant and Equipment)	R207 058 205
TOTAL CAPEX (Working Capital)	R93 073 449
Internal Rate of Return (IRR)	12.89%
Net Present Value (NPV) at 10%	R53 403 414

Table 7: Vault Financial Modelling

5.5 Disclaimer

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6. INTERVENTION #06: LIVPAK OFF-GRID SOLAR

6.1 Development of Off-Grid Solar[7]

An off-grid solar report was prepared for the Kannaland site by the LivPak Living Security Secondary Co-operative in conjunction with B4I, its Operations and Maintenance collaborator. The report serves as a case study for any other selected Energy Vault Sites. The definitive operational implementation plan for the Kannaland Local Municipality will be prepared during the next phases of the implementation and roll-out of the InovaSure Energy Vault program in South Africa.

LivPak, in partnership with B4I and under license from **INOVASURE** in terms of the products and services, provides off-grid electrification, install lighting, provides connectivity, facilitates refrigeration services and makes e- learning possible for urban townships, rural and indigent resident areas. The outcome to achieve is dignity, innovation and the creation of local jobs and ownership through the electrification, connectivity and lighting of informal homes.

The off-grid aspect of the Overall Kannaland Project is aimed at providing various Micro-Utilities which will consist of Business Hubs/Nodes and approximately 2000 installations in informal dwellings. The powering of 2000 informal homes in Kannaland and the surrounding area will then be the groundwork for alignment and integration with the broader **INOVASURE** and LivPak Living Security Secondary Co-operative and the LiveSure Trusted Centre partnership. These Micro-Utilities will be leveraged for replication, funding, and expansion of the business model.

The target market and client base is under-served in under-serviced areas in a country like South Africa where 14% of households do not have access to electricity and where most of these homes are informal dwellings in township areas of South Africa.

[7] LivPak B4I Report: "Feasibility Study: Kannaland project", dated November 2018

Functioning at the electrification frontier, the LivPak initiative understands the ecosystem that is essential to supplying energy to locations that are beyond the reach of grid supply systems in South Africa and Africa.

6.2 The LivPak Living Security Secondary Co-operative

The objectives of the LIVPAK Living Security Secondary Co-operative are:

1.1 To provide access to the electrification and telecommunications and related services and products to its Primary Co-operative Members under license and grant and under the terms and conditions of the Licensing Agreement/s and Management Agreement/s set out in clauses 2.15 and 2.18 respectively above;

1.2 To generally watch over, promote and protect the interests of Members;

1.3 To promote and advance the economic welfare of Members by enhancing their access to the various relevant benefits;

1.4 To promote excellence in work, just and honourable practice in the conduct of business, and to eradicate malpractices;

1.5 To plan, develop, and oversee opportunities for the Members;

1.6 To develop, maintain and enhance Membership growth and retention programs;

1.7 To develop and maintain the financial and human resources necessary to accomplish the purposes and goals of the Co-operative;

1.8 To communicate the ethics, standards, purposes, goals and accomplishments of the Co-operative to its Membership, government, private sectors and the general public;

1.9 To promote and enhance relationships with various bodies, including the Primary Co-operative Membership base and other like-minded co-operatives and organisations, governmental agencies, commercial and non-profit organizations, and the general public.

1.10 To advise Members on matters affecting the relationship between themselves and other Members and between the various LIVPAK Primary Co-operatives as Members and the LIVPAK Living Security Secondary Co-operative;

1.11 To co-operate with the LiveSure Trusted Centre (LTC) *(* described in detail elsewhere in this Report*) and any other organisations and bodies which may be established to deal with matters which affect Members;

1.12 To acquire either by purchase, lease or otherwise any movable or immovable property, or also to sell, let, mortgage or otherwise deal with and dispose of movable or immovable property or other assets belonging to the LIVPAK Co-operative or use such property for such other purpose as the Members may approve;

1.13 To borrow, invest, lend, subscribe, receive or donate money for the furtherance of the objects of the LIVPAK Co-operative;

1.14 To use every legitimate means to encourage all organisations and entities who are eligible for Membership to become Members;

1.15 To affiliate with or to otherwise co-operate with any similar Co-operative;

1.16 To do such other lawful things as may appear to be in the interests of the LIVPAK Co-operative or its Members and which are not inconsistent with the objects or any matter specifically provided for in the Constitution.

Membership to the LivPak Living Security Secondary Co-operative is limited to persons and/or organisations / co-operatives / juristic entities who / which qualify for Membership due to meeting at least one of the criteria as listed below:

1.1 Persons who are employed by common employer(s) or who are employed within the same business district; or

1.2 Persons who have common membership in an association or organisation, including religious, social, co-operative, labour or educational groups; or

1.3 Persons who reside within the same defined community, rural or urban district, and which group receives funds from Members against the issue of shares or by means of the subscriptions of Members; or

1.4 Juristic entities or organistions or co-operatives with like-minded goals and objectives which are desirous of utilising the LIVPAK Co-operative's products and services, under a License Agreement/s and subject to a Management Agreement/s, and which hold valid tax clearance certificates from SARS and/or are duly registered with the requisite authorities.

The Smart Meter or “distribution device” used by the LivPak Primary Co-operatives is an electronic device which is provided under license by the LivPak Secondary Co-operative and the LiveSure Trusted Centre (LTC) to any Primary Co-operative to be utilised for the provision and management of, inter alia, Education and Energy Security, inclusive of an Internet Protocol (IP) Router and a base computer executing an operating system i.e Linux and Android, interfacing with broadband devices enabling the Distribution Device to communicate via LTE and route data packets to an internal WIFI communication protocol for the relevant structure that it is installed in, and which interfaces with a specialised set of electronic equipment to allow for the measurement of energy supplied to and from the relevant structure as well as to regulate a minimum of eight channels to be connected or disconnected, as the case may be, via a remote interface.

In the context of the LivPak Co-operative scheme, “Energy Security” means the provision of a continuous supply of power to an informal dwelling (shack or hut) by means of the services and products provided under license by the Livpak Secondary Co-operative to a Primary Co-operative and in turn provided and/or facilitated by the relevant Primary Co-operative to a member (shack or hut occupier or owner).

In the context of the LivPak Co-operative scheme, “Education Security” means the provision of a continuous supply of educational content to an informal dwelling (shack or hut) by means of the services and products provided and/or facilitated by the LivPak Co-operative and/or the LiveSure Trusted Centre to any relevant Primary Co-operative for use by its members.

In the context of the LivPak Co-operative scheme, “Energy Vault” means the secure grouping of installations and devices, as provided by and through the LivPak Co-operative and/or the LiveSure Trusted Centre, under license, to a Primary Co-operative member, for the provision by the relevant Primary Co-operative to its Members, of Energy Security with regard to such member’s residential or commercial building structure and which serves to effect, inter alia, the time related dispatch, storage and distribution of renewable energy at specified and agreed costs in terms of a so-called “Services and Product Purchase Agreement (SPPA) and as managed by the distribution device.

In the context of the LivPak Co-operative scheme, the “LiveSure Trusted Centre (LTC)” means a formally constituted legal body which shall be constituted by specialised independent persons, appointed by the Board of Directors of the LivPak Secondary Co-operative, which body shall audit, manage, oversee and adjudicate transactions and activities of the LivPak Co-operative/s against standard procedures and processes developed, implemented and managed by the LTC to ensure that the utmost degree of reliable governance is adhered to. The LTC shall be a secure financial-, governance-, information and communication technology (ICT)- and secure International Standards Organiation (ISO) aligned management and operational body with embedded superior standards of business process innovation, compliance, governance, internet security, risk management, ongoing monitoring and reporting systems that are conducive to the success of Co-operatives, as provisioned for in Articles 14, 36, 37 and 38 of the Act governing Co-operatives.

In the context of the LivPak Co-operative scheme, “Licensing Agreements” means on the one hand the agreements of grant and concession to the various relevant LivPak Primary Co-operatives to use the Intellectual Property (IP) and services and products of the LiveSure, InovaSure and LivPak Living Security Secondary Co-operative upon terms and and conditions contained therein, and on the other hand the concluded agreement of grant and concession by the LiveSure Trusted Centre, LiveSure (Pty) Ltd and InovaSure (Pty) Ltd to the LivPak Living Security Secondary Co-operative.

In the context of the LivPak Co-operative scheme, “LivPak Primary Co-operative” means any of the various Primary Co-operatives which become members of the LivPak Living Security Secondary Co-operative by means of the registration as such and the adoption of its Constitution and thereafter receive, under license, by means of completion of a License Agreement, access to the products and services which are provided by the LivPak Living Security Secondary Co-operative.

In the context of the LivPak Co-operative scheme, “Management Agreement” means the agreement entered into from time to time between the LivPak Living Security Secondary Co-operative and the various relevant LivPak Primary Co-operatives, as members, in terms of which the Licensing Agreements and Licensing Grants for the use of IP and services and products shall be regulated and managed.

In the context of the LivPak Co-operative scheme, a “member” means either a Primary Co-operative member of the LivPak Living Security Secondary Co-operative due to his / her / its membership to the Co-operative, payment of the Membership Fees and the conclusion of a Management and Licensing Agreement/s, as well as a member of the LivPak Primary Co-operative due to his/her utilization of the distribution device in the informal settlement dwelling or structure.

In the context of the LivPak Co-operative scheme, “Services and/or Products” means the various products and services relating to the provision and/or facilitation, by the various LivPak Primary Co-operatives, as provided / facilitated by the LivPak Living Security Secondary Co-operative and the LiveSure Trusted Centre (LTC), under license, of Energy, Water and Education Security to LivPak Primary Co-operative members, as well as the provision of Fresh Water and Sanitation services and products. These diverse products and/or services include processes for the development, implementation and management of the electrification of domestic and commercial buildings and structures by means of the installation of Energy Vault/s, telecommunications systems therefore, the provision of educational content with regard to such buildings and structures, the provision of entertainment content therefore and other Information Technology provision mechanisms relating to the relevant buildings and structures.

These services and products provided by the various LivPak Primary Co-operatives to their members, which in turn are members of the LivPak Living Security Secondary Co-operative, shall be enhanced, adjudicated and verified by and through the LiveSure Trusted Centre (LTC) for purposes of implementation by the referenced various LivPak Primary Co-operatives. These specific services or products include, but are not limited to the provision and/or facilitation of: electrification services, telecommunications services, education services, entertainment services, Information Technology services, co-operative finance services, co-operative funding services, pre-paid energy services and concomitant products, pre-paid data services, water provision and sanitation systems and services, VOIP telephony services, fractional software services, internet and/or server access services, co-operative banking services, co-operative and Members insurance services and products, Member value optimisation and exit strategies services and systems, inventory control services, stock exchange services, financial engineering services, financial metric analysis systems and services, collateral damage evaluation services, cashflow and forecast management services, securitisation and bond issues programs, medium term note programs,

procurement and tender advisory services, real-time funds-tracking services, land value capturing and real rights management services, Engineering Procurement and Construction (EPC) and building contract management services, product specification evaluation services, real time forensic services, internet security services, tender adjudication services, facility and plant operational advisory services, purchasing procedure systems services, inventory and costing advice services, competition analysis services and products, research and development services, industry and general economic metrics provision services, sectoral business process management (BPM) and business information management (BIM) services (with webmaster assistance), risk profiling services, environmental implications and carbon credit management services and products, virtual or shared office services and products, co-working systems and procedures services, shared virtual and physical meeting rooms services, travel assistance services, legal services (including patent protection services), accounting services, dispute settlement and arbitration services, human resource services, biometrics and personal equity depository (biobank) services, clearing and settlement of primary co-operative and counter party (merchant) transactional services, feasibility studies services, forex exchange services, spaza finance package services, education funding package services, financial savings products and services, grant funding facilitation services, secondary internet web master services and any such further products and services to be developed by the LIVPAK Living Security Secondary Co-operative and/or the LiveSure Trusted Centre. It is furthermore specifically understood that “Sanitation Services” means the provision and /or facilitation of services and products, under license from the LiveSure Trusted Centre (LTC) and/or the LivPak Living Security Secondary Co-operative, by the various LivPak Primary Co-operatives, relating to the management of solid waste and sewerage for a commercial or residential building or structure for a LivPak Primary Co-operative member and that “Fresh Water Services” means the provision and /or facilitation of services and products relating to the potable water for a commercial or residential building or structure by the various LivPak Primary Co-operatives for a Member.

In the context of the LivPak Co-operative scheme, “Services & Product Purchase Agreement (SPPA)” means the agreement concluded between the various LivPak Primary Co-operatives and a member, pursuant to the installation of a distribution device, in terms of which services and/or products are purchased and/or rented and/or facilitated from or by the various LivPak Primary Co-operatives in the various relevant communities, which services and products are in turn provided by and/or facilitated, under license, by the LivPak Living Security Secondary Co-operative and/or the LiveSure Trusted Centre (LTC);

In the context of the LivPak Co-operative scheme, "Water Security" means the provision of a continuous supply of potable water to a structure by means of the services and products provided and/or facilitated by the LivPak Living Security Secondary Co-operative and/or the LiveSure Trusted Centre (LTC), under license, to the various relevant LivPak Primary Co-operative's Members.

6.3 The INOVASURE LivPak Kannaland Program

The LivPak Co-operative Program is introduced in various communities around South Africa. The communities will also receive, on a retail basis, the appropriate appliances for the DC power environment like fridges, fans, televisions and smart communication devices.

The outcome to achieve is dignity, innovation and the creating of local jobs and ownership through the electrification, connectivity and lighting of informal homes.

The first initiative for the LivPak Kannaland Primary Living Security Co-operative will be to provide the electrification and telecommunications services to between 1000 and 2000 households (including rural and surrounding areas) in conjunction with the relevant stakeholders.

BACKGROUND AND DISCUSSION

The InovaSure LivPak solution was developed to be provided to all indigent communities in South Africa (and Africa).

The LivPak Co-operative will establish various Micro-Utilities which will each consist of a Business Hub/Nodes for between 100 and 1000 LivPak installations in informal dwellings.

The powering of hubs of 100 to 1000 informal homes in each Hub will then be the groundwork for alignment and integration with the broader InovaSure contracting, project, technology and partnership with the Kannaland Local Municipality.

These Micro-Utilities will be leveraged for replication, funding, and expansion of the business model by the InovaSure LivPak team through the LiveSure Trusted Centre.

Figure 34: LivPak Sub-Centralised System of 10 dwellings (including School (bottom – green roof) and LivPak Container Hub (bottom middle)

The LivPak Program's client base is underserved and underserviced areas in a country like South Africa where 14% of households do not have access to electricity and where most of these homes are informal dwellings in township areas.

Functioning at the electrification frontier, the InovaSure LivPak Program understands the ecosystem that is essential to supplying energy to locations that are beyond the reach of grid supply systems in South Africa and Africa.

Our DC hardware suppliers are all recognized leaders in the rural and township electrification space in South Africa with the Department of Energy:

KACO new energy.

MICRO CARE SOLAR COMPONENTS

Figure 35: KACO New Energy and Microcare as suppliers of some of the LivPak components

This approach is based on successful projects completed in South Africa and delivers power, possibilities, jobs, and new black entrepreneurial development in disconnected and indigent communities.

Based on a pay-for-usage rental business model and using solar power generation and battery storage for energy delivery, the revenue supports sustainability of both commercial and social engagement with low-end markets.

Built on micro-economic models sustainability, the risk mitigation is assured through:

- Social license and mandate
- Sub-centralized solar energy system
- Peer security and theft prevention
- Tampering deterrent infrastructure
- Affordable energy, water and connectivity packages
- Clean energy
- DC appliances
- E-services – e-learning portal and content
- ICT connectivity
- Thin client technology
- Remote monitoring, control, management and switching
- Vendor payment platform and fee collection protocol
- Local retail, support and maintenance staff
- Training and skills transfer

The LivPak Program - in the underserved and underserviced areas of South African informal housing areas - has the ability to meet the aggregated demand for energy, connectivity, information, lighting, refrigeration, e-learning and social media. Power is just the point of entry into informal settlements, which then leads to other human needs within indigent communities.

Aggregated demand is dependent on the ability of delivering a quality product and service. Developing a loyal customer base in these communities will influence, shape and establish future markets for other services and products with InovaSure LivPak Program project partners.

DC Micro-Grid principle:

Energy needs to be supplied to the lower LSM Consumer throughout the world. Fundamentally the energy use of this consumer would entail the use of lights, radios, televisions, cell phone charging, communicating, refrigeration and cooking.

To generate energy for this market, 3-4 KWH would be needed under normal daily usage. One of the main reasons for the lack of energy supply to rural, urban and peri-urban areas is that the capital cost to supply these areas can never show effective returns to the energy supplier. The infrastructure needed to supply this small amount of energy to this specific market is just to capital intensive. (The cost of installation per home is just too high). These markets unfortunately also do not have the potential growth capacity to enable a long term future return on investment. Therefore, if it was not for the InovaSure LivPak Program's ability to service this market share, they would never receive the energy they need.

The sustainable solution to energizing these communities would require:

- Reduction of the capital investment to supply the energy needed
- High efficiency in the needed energy for the domestic user
- An effective return on the initial capital investment

InovaSure undertook a study of various models to find a solution for this LSM Range before enabling the LivPak Program model. These models consisted of:

- Central independent main energy supply to communities (PV, CSP, Wind generation)
- AC supply to communities from PV Central unit distribution point. (hybrid system).
- De-centralized AC Supply with control methods.

Although some of the above models showed a reasonable capital return period, various factors in the consumer usage and understanding of energy used would not allow for a sustainable effective method.

Understanding the models installed throughout the world in the Solar Home Systems principle, we needed to see if this was a potential solution. The following was found to be problematic:

- The systems supplied were not modular, and therefore could not meet the markets requirements.
- Desperate need for the use of additional appliances was needed.
- A full effective support structure installed in areas was crucial but not developed.
- A well-controlled payment method was imperative but not available.
- It needed to be a profitable operation.
- It needed more involvement with community participation and incentive determination.

Analyzing each of the above issues, InovaSure focused on the DC use principle. It was determined that less than 1 KWH per day would be needed to facilitate this market range and supply all their needs. At this point we understood that with the supply of 1 KWH per day the solar solution is feasible. Modular application was then designed to reduce the initial installation capital but allow the system to have sufficient growth potential, without changing the hardware to accommodate the natural growth from the market itself to supply the energy of all appliances the consumer will need. Due to the lack of supply and high cost of DC Appliances, we focused to formulate an infra-structure to accommodate this supply at a reasonable cost.

We needed to understand the Rural, Peri-Urban and Urban. It became evident that the greatest need in the communities was the development and assistance of an economic framework for them to manage their own energy needs and benefit from this framework. What was required was to understand how these communities function, facilitate the training of this technology within their parameters and supply the necessary tools for them to empower themselves.

In rural areas InovaSure and its collaborators have thoroughly tested and installed many homes within this DC principle and the success rate has been astounding.

Adequate training is provided in all the LivPak Program functions. The cloud-based framework is constantly monitored and support is always available. Key features include:

- Solar system management with remote switching
- User administration and management
- A variety of automated billing options
- Vendor (POS) payment facilitation and management
- Stock control with system logistics

- Advance security features
- End-user interaction
- Detailed reporting and systems overview
- Audit trail system and user logging

Along with energy and connectivity access, customers are provided appliances that improve their quality of life. Based on the efficiency of DC energy principles, DC powered appliances that support a variety of energy requirements are bundled and offered as rental options.

Similar to the pre-paid meter environment, these packages support the very basics of indigent energy needs and progress to more expensive comfort appliance enhancing the available options to a customer as their energy requirements grow. The online management platform facilitates the process with automated debiting, vendor management and automated remote switching.

Home Installation:
Each home will be installed with internal reticulation. This reticulation will consist of the required hardware to supply 3-4 internal lights per house and, if required, an external light. The infrastructure distribution box will have the required input for additional appliances: radio, fridge/freezer, freezer, stove. This distribution box will also allow for all required cell phone charging via USB connection.

Additional to the distribution box, a DC plug box will be installed to accommodate a future music centre, DSTV or satellite receiver, television and/or fan.
The initial installation will prepare for all the future demands the client may have.

Payment:

Payments is done on a very simple basis of a monthly rental amount for the equipment and a monthly amount for access to the communications. The total of this is very affordable, Further options are also available for additional optional services and products.

TECHNOLOGY CONSIDERATIONS

The Sub-Centralized Unit:
This unit will house the electronic equipment to ensure energy is delivered to the potential of between 5 and 10 houses per unit.

The unit consists of:

- Sub-Centralized Kiosk
- Control switchgear for remote switching
- Central monitoring of input and output energy
- 5 -10 house fused circuit
- 960Wp prime crystalline solar panels
- 500A to 700A of solar battery storage
- 4m distribution pole with junction box and pigtail delivery for 5-10 houses
- Cable harness from unit to distribution pole
- Allocation of 20m distribution cable per house)
- Pre-cast cement footing fixtures
- Ready-mix and concrete for poles
- Grounding and protection
- Security Cage

Figure 36: The LivPak Solar Sub-Centralised System

The limitation pre-set on monitoring energy will be the safety net or sustainable gauge to ensure no overuse is allowed.

With a standard value applied per unit, the utility SME (Business Hub) will now be able to assign 5 -10 units of energy daily to customers. In the event an additional amount of 'units' become assigned, due to increase in demand, the Sub-Centralized system's modularity could be developed to house more units per day.

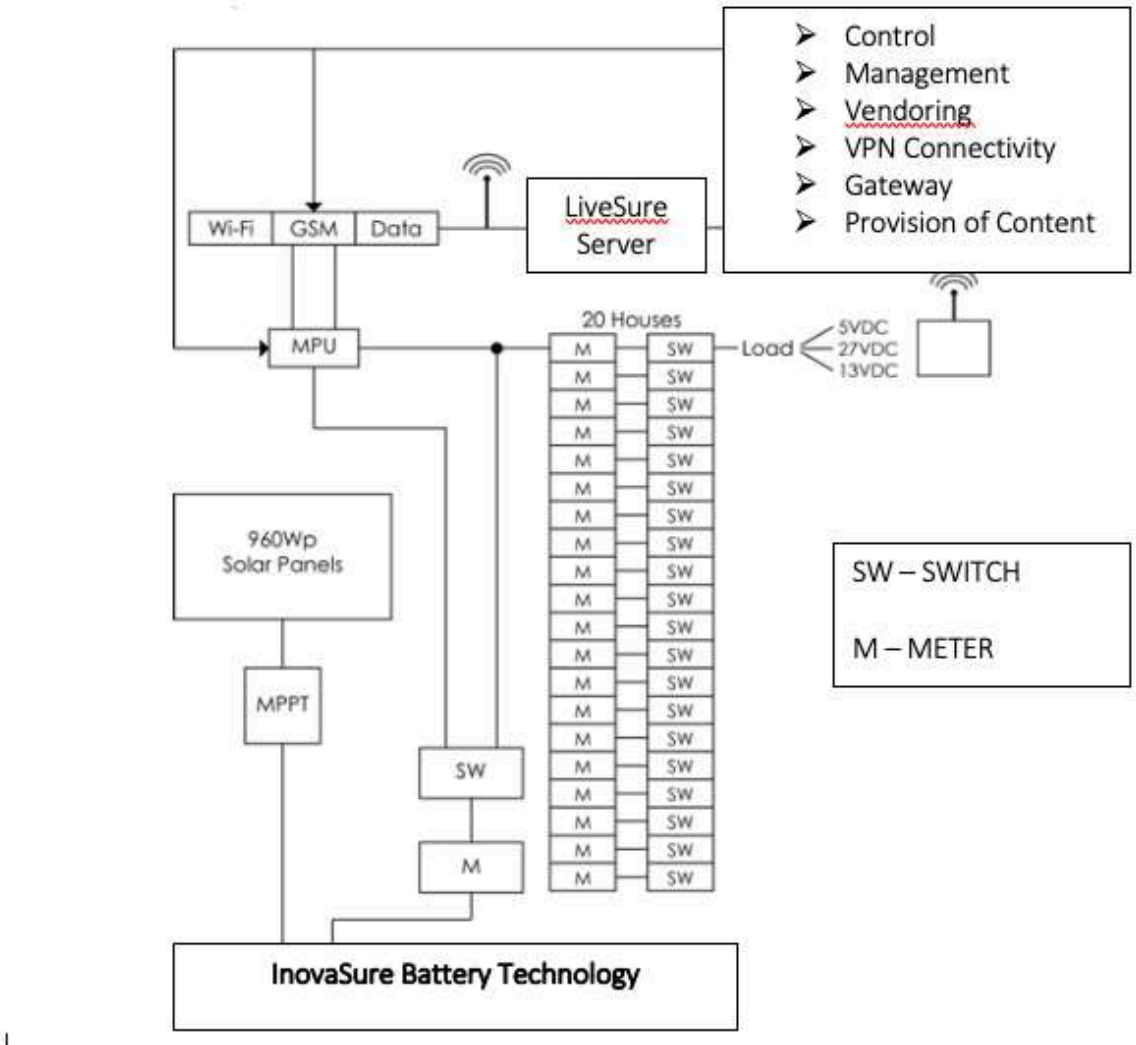

Figure 37: The LivPak System Technology

InovaSure LivPak Connectivity Solution:

The connectivity model is based on a Connectivity Service Provider Eco-system, which allows InovaSure and its collaborators to find and implement the best possible connectivity types to its business hub, client base and local school. This will also provide cost effective and highest possible speeds to the sub-centralized system and related customer base that currently cannot access reliable broadband connectivity.

The LivPak system makes use of wireless communications for connectivity. This is a combination of microwave, broadband satellite connectivity, LTE, broadband, power over power lines or any disruptive solutions in this space.

6.4 Product / Service Marketplace

The focus market place

The focus for LivPak is the peri-urban, rural and urban informal housing areas of South Africa that remain beyond the grid.

There is a constitutional right for all South Africans having access to basic services. In the informal housing areas there is a legal framework that consists of an interpretation of three policy documents:

- Free Basic Electrification Policy;
- Non-Grid Electrification Policy; and
- Un-Proclaimed Area Policy

This provides the legal framework to fulfil the service delivery right to electrification in an off-grid DC environment. **INOVASURE** can supply these policy documents if they are required for in-depth consideration and application

The current electrification market:

- In 2014, 27 billion USD were spent in Africa and Asia on lighting and mobile phone charging with kerosene, candles, battery torches or other fossil-fuel powered

technologies. All of these technologies are outdated, costly and energy inefficient as well as causing negative health and environmental impacts;

- The continent can save more than $12 billion annually by switching from candles, kerosene lamps and battery-powered flashlights to solar LED;
- The rate of electrification of in Sub-Saharan Africa has not kept pace with population growth;
- 95% of the 1,2 billion people without access to electricity globally live in Sub-Saharan Africa;
- Africa spends more on candles than on Coca-Cola;
- South Africa would save $500 million dollars per annum if there was a change from candles, kerosene and batteries to solar; and
- Electricity theft in South Africa is over R4 billion per annum and 40% of this theft is in indigent communities where the power supply is dangerous, costly and overloads current infrastructure

Marketing Strategy

Marketing efforts are focused only on the communities where installation will take place. Any misappropriated focus on areas, where promises are made that cannot be met, constitute a serious risk if there are unmet expectations.

Co-creation and market creation

The ideals of productive customers and partners in co-creation in low-income communities demand our realization that they set high standards. Our experience has shown that emerging-market customers are engaged and demanding customers. They don't spend easily because they don't have much disposable income and often makes them very conscious consumers.

To be co-creators, indigent communities require information that is accessible, and delivered in a language and medium that suits them. Introducing new technology and services like DC power requires information that is educational as much as it is persuasive. This information acknowledges and respects the community's culture and apprehensions. This legitimizes the community's existing life patterns and any stresses that this service and product change may create. Our product and service offering has to ensure that customers know:

- What we are;
- is the service and product convenient for them;
- is the service and product efficient;
- does it meet an appropriate need; and
- if it is aspirational

The increasing diffusion of smart cellphones and cloud computing in the township environment is supportive to new market customer communications. This has demonstrated for us the potential of direct communication as a business enabler and driver of volume.

Our marketing and communications strategy challenges the failed development strategies of the past that disregard the participatory engagement required in product and service development. It introduces a Co-operative System that includes all community members in the efforts to bring power, education and water to the indigent and impoverished in our Country.

6.5 Organisation and Staffing

As a private company providing licensing of products and services to Co-operatives, **INOVASURE** and LiveSure adapt power and connectivity solutions for township markets and use appropriate recruitment and staffing practices. We apply a range of tactics including local recruitment and immersion experiences to build understanding of local needs and opportunities. It is critical to the 'social license' that we receive from township communities that they are co- creators and partners to the LivPak Co-operative installation, adoption, retailing and revenue building of this business.

Key people in the Kannaland Local Municipality and other Energy Vault site communities will provide the following as partners:

- tested business approaches for working in townships;
- complementary resources and skills;
- access to the local community's social, opinion and power networks;
- information about the community's needs, goals and feelings;
- brand ambassadorship; and
- staffing as account managers, installers, sales reps and maintenance technicians

A divided past means the most effective and knowledgeable partners come from the community itself and this is key to our approach to the Kannaland Local Municipality and other informal settlements and its people. This may include municipal leaders, traditional leaders and/or entrepreneurial township middlemen. The LivPak Co-operative will employ staff and management from the local communities that form the customer base for power installation.

The staffing (per 1000 installations) in the local community consists of:

- LivPak Primary Co-operative Executive Managing Director
- Board of Directors
- 8 x Account and Sales Representatives; and
- 2 x Support and Maintenance Representatives

Employment may start with learnership and casual contracts and develop into permanent contracts based on performance and competence.

One of the goals of the LivPak scheme is to identify, lead and empower new black entrepreneurs utilizing an Enterprise Development (BBBEE) business system that establishes DC Micro-Grids.

By identifying, recruiting and working with individuals who have a passion for business, we create the opportunity for jobs and ownership. We equip local entrepreneurs with a sustainable and shared ownership business model. They are empowered through extensive on the job training, coaching and mentoring through the Co-operative. They are equipped with clean technology and a sustainable business model so they can confidently bring about innovation and lasting change within their families and communities.

6.6 Financial Projections

Energy is now available to this market segment with the correct capital value, satisfying the consumer’s needs, with the correct control mechanisms and effective capital return indicated, managed by the economic framework set up in the installed areas.

Once-Off Costs

An initial schedule of typical once-off costs was prepared during this technical feasibility study:

CapEx		Container 1	Container 2	
Container Design		R 650 000.00	R 650 000.00	
SSS (Houses)		R 7 971 678.00	R 7 971 678.00	
SSS (Container)		R 213 961.81	R 213 961.81	
Wifi Conectivity - Container		R 19 057.00	R 19 057.00	
Wifi Conectivity - School		R 49 438.75	R 49 438.75	
Wifi Conectivity - Community		R 449 497.00	R 449 497.00	
WiFi Sundries and Installation		R 12 000.00	R 12 000.00	
Conor Platform		R 300 000.00		
Telco Installation Fee		R 11 640.00	R 11 640.00	
Stock Capital Expenditure: Demonstration Inventory / Aircon		R 31 207.50	R 31 207.50	
Teacher Laptop (3)		R 23 556.21	R 23 556.21	
Manager Laptop		R 7 852.07	R 7 852.07	
2 in 1 sales reps devices (x8)		R 36 368.10	R 36 368.10	
2 in 1 learner devices (x20)		R 90 920.25	R 90 920.25	
Interactive Board		R 14 820.00	R 14 820.00	
Projector		R 9 120.00	R 9 120.00	
Charging Trolley		R 10 133.33	R 10 133.33	
Printer		R 1 400.00	R 1 400.00	
Security Hardware		R 14 352.00	R 14 352.00	
Total		**R 9 917 002.02**	**R 9 617 002.02**	**R 19 534 004.04**
Less Accrural for 2 months		R 336 169.56		
Totals		**R 9 580 832.46**	**R 9 617 002.02**	
				R 19 197 834.48

Table 3: Once-off Costs (indicative)

PNL Statement

The proposed deployment of the LivPak Off-Grid Intervention is supported by the PNL statement that was prepared as input to the Overall Feasibility Study. The outcomes (including financial) of the technical feasibility study that was undertaken, and that were reported on here, were used as inputs to the financial modeling of Part C of the Overall Feasibility Process. This in turn was used to prepare the submissions to funders and investors that have shown an interest in the Overall Energy Vault and associated interventions such as is the case in support of the Kannaland Local Municipality and its stakeholders – for an estimated 2000 dwellings.

The statement is shown below:

All Inc. Investment Sub-centralized Systems									
Expected Annual Increase in Rental Tarif	7%								
Annual Inflation (CPI)	5%								
		Year End 1	Year End 2	Year End 3	Year End 4	Year End 5			
Income									
Once Off Payments									
Electricity Registration Fee		R 600 000.00	R -	R -	R -	R -			
Revenue									
WiFi Connectivity Fee's		R 280 000.00	R 480 000.00	R 480 000.00	R 480 000.00	R 480 000.00			
WiFi Connectivity Top Up		R 338 000.00	R 624 000.00	R 624 000.00	R 624 000.00	R 624 000.00			
FBE Allocation		R 1 250 000.00	R 1 200 000.00	R 1 200 000.00	R 1 200 000.00	R 1 200 000.00			
Monthly Electricity Subscription (Average)		R 3 500 000.00	R 6 300 000.00	R 6 000 000.00	R 6 000 000.00	R 6 000 000.00			
Total Income		**R 5 368 000.00**	**R 8 604 000.00**	**R 8 919 000.00**	**R 9 249 750.00**	**R 9 597 037.50**	**R 9 961 689.38**	**R 10 344 573.84**	
Once Off cost Accrural		R 3 367 406.55	R 4 041 649.32	R 4 041 649.32	R 4 041 649.32	R 4 041 649.32			
Opperational Cost									
Insurance		R 3 600.00	R 4 320.00	R 4 320.00	R 4 320.00	R 4 320.00			
Telco Connectivity (Monthly)		R 90 000.00	R 120 000.00	R 120 000.00	R 120 000.00	R 120 000.00			
Manager Salary		R 190 000.00	R 240 000.00	R 240 000.00	R 240 000.00	R 240 000.00			
Staff Salaries (8)		R 304 000.00	R 384 000.00	R 384 000.00	R 384 000.00	R 384 000.00			
Administration HR, Admin		R 769 020.00	R 907 200.00	R 907 200.00	R 907 200.00	R 907 200.00			
SERR Synergy (Personnel)		R 3 300.00	R 3 600.00	R 3 600.00	R 3 600.00	R 3 600.00			
Accounting Services		R 40 000.00	R 48 000.00	R 48 000.00	R 48 000.00	R 48 000.00			
Telephone		R 14 400.00	R 19 200.00	R 19 200.00	R 19 200.00	R 19 200.00			
G4S Security (Monthly - Includes Dropsafe)		R 78 032.00	R 117 048.00	R 117 048.00	R 117 048.00	R 117 048.00			
vServices Portal (Conor)		R 238 000.00	R 564 000.00	R 564 000.00	R 564 000.00	R 564 000.00			
Stationery		R 1 700.00	R 2 400.00	R 2 400.00	R 2 400.00	R 2 400.00			
Cleaning chemicals		R 1 700.00	R 2 400.00	R 2 400.00	R 2 400.00	R 2 400.00			
Gardening		R 6 500.00	R 12 000.00	R 12 000.00	R 12 000.00	R 12 000.00			
SSS									
Battery Replacement									
Maintenance (Materials)		R 22 100.00	R 31 200.00	R 31 200.00	R 31 200.00	R 31 200.00			
Total Expenses		**R 5 129 758.55**	**R 6 497 017.32**	**R 6 497 017.32**	**R 6 497 017.32**	**R 6 497 017.32**	**R 6 497 017.32**	**R 6 497 017.32**	
PNL		**R 238 241.45**	**R 2 106 982.68**	**R 2 421 982.68**	**R 2 752 732.68**	**R 3 100 020.18**	**R 3 464 672.06**	**R 3 847 556.52**	
		Total Profit after 5 Years				**R 10 619 959.67**	**Total Profit after 7 Years**		**R 17 932 188.24**

Table 9: PNL Statement

6.7 Financial Modelling

The total Off-grid (LivPak B4I) CAPEX Budget (as per the financial modelling that as undertaken) amounts to ca R36m (excluding VAT):

ENERGY MANAGEMENT AND MONITORING	
DESCRIPTION	**TOTAL COST EXCL VAT**
TOTAL CAPEX (Plant and Equipment)	R31 054 145
TOTAL CAPEX (Working Capital)	R4 911 508

Table 10: Off-Grid (LivPak B4I) Financial Modelling

The Off-grid (LivPak B4I) financials are currently being converted to a Co-operative model in the overall Kannaland Local Municipality Project financials.

6.8 LivPak Snapshots

The following snapshots of the LivPak electrification and telecommunications system are provided in order to depict the program.

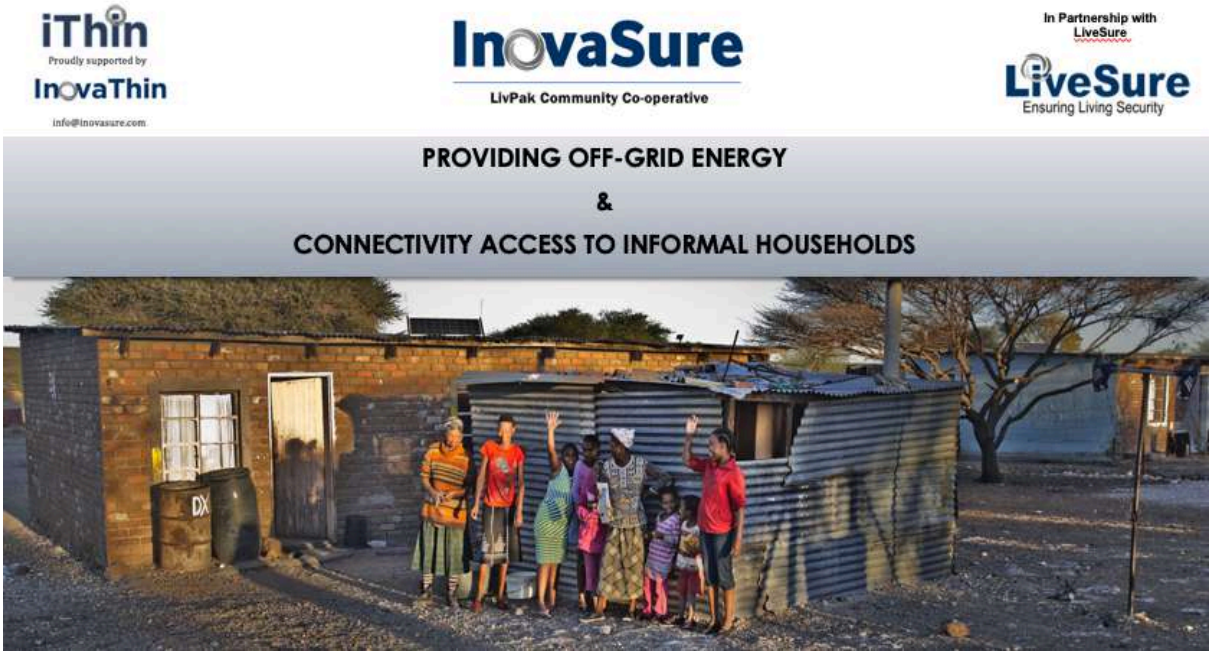

Figure 38: LivPak Snapshots

InovaSure
LivPak Community Co-operative

South African challenge as per the Electrification Statistics For March 2017 (DoE, 2017)

Province	Projected Households (April to March 2017)	Houses Without Electricity	Houses Electrified	Access Per Province
Eastern Cape	1 826 480	353 125	1 473 355	80.67%
Free State	891 184	110 352	780 832	87.62%
Gauteng	4 231 251	704 248	3 527 003	83.36%
Kwazulu Natal	2 748 760	501 262	2 247 498	81.76%
Mpumalanga	1 164 143	98 533	1 065 610	91.54%
Northern Cape	326 250	41 071	285 179	87.41%
Limpopo	1 534 999	50 689	1 484 310	96.70%
North West	1 149 559	152 075	997 484	86.77%
Western Cape	1 768 694	160 547	1 608 147	90.92%
TOTAL	**15 641 320**	**2 171 902**	**13 469 418**	**86.11%**

Figure 39: LivPak Snapshots

THE AFRICAN ELECTRIFICATION MARKET

- Nearly **1** in **5** people in the Africa live without access to electricity, amounting to **634 million** people in sub-Saharan Africa.
- Many of these people living in locations that are beyond the reach of the current grid system.
- In South Africa, the majority of un-electrified settlements will not receive grid power for the next **20 years**.

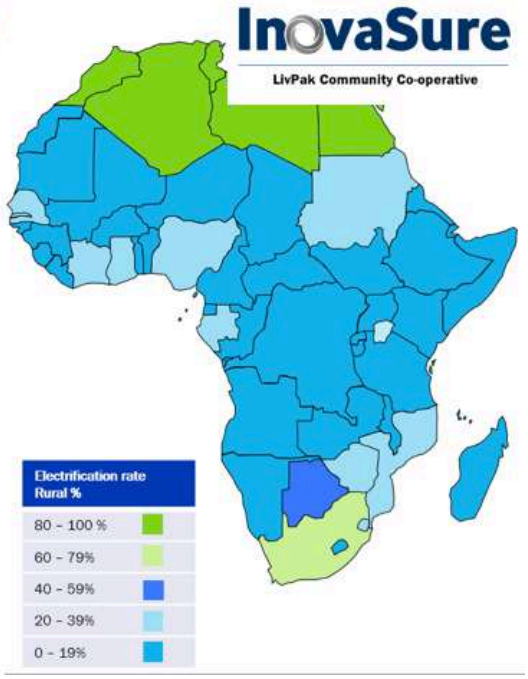

Figure 40: LivPak Snapshots

The InovaSure LivPak Community Co-operative Decentralized Unit

Supply a home with all the energy components including:

- 5 internal lights & 1 external light
- Plug box
- Radio & Cell phone charging station
- iThin TV device with Educational Content
- Further options for other appliances and services at extra costs

In our modeling it has become evident that the customer is prepared to pay between R150 and R380 per month for the electricity provided. The basic approximate average monthly payment is R250 (excl VAT) for the electricity package listed above.

A basic additional amount of approximately R115 (excl VAT) per month is payable for the Educational Content and Entertainment (Sport & Movies) and the protection plan for the equipment.

The customer also pays a once-off Co-operative Membership & connection fee of R500.

Figure 41: LivPak Snapshots

Figure 42: LivPak Snapshots

Figure 43: LivPak Snapshots

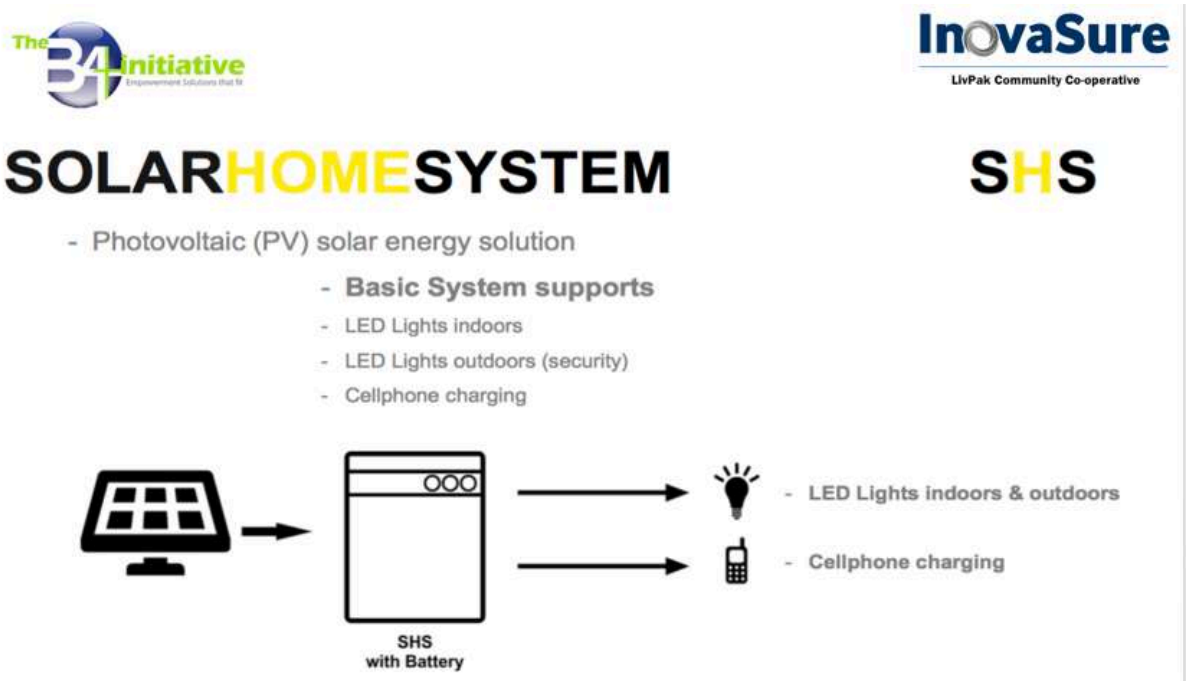

Figure 44: LivPak Snapshots

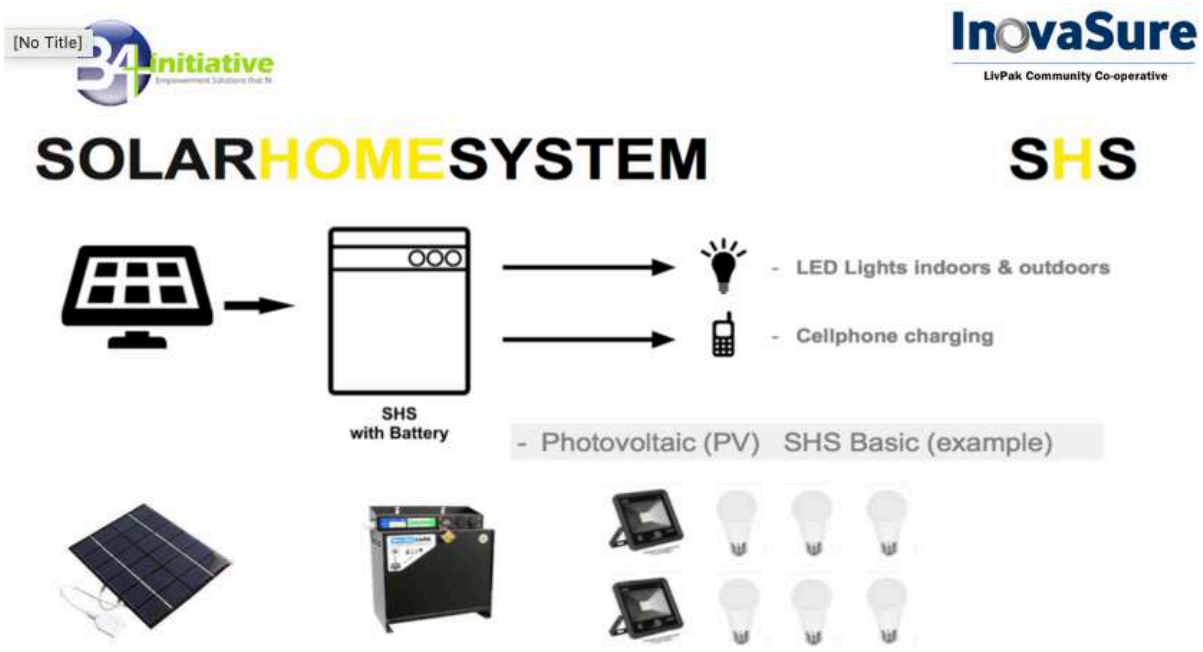

Figure 45: LivPak Snapshots

Figure 46: LivPak Snapshots

Figure 47: LivPak Snapshots

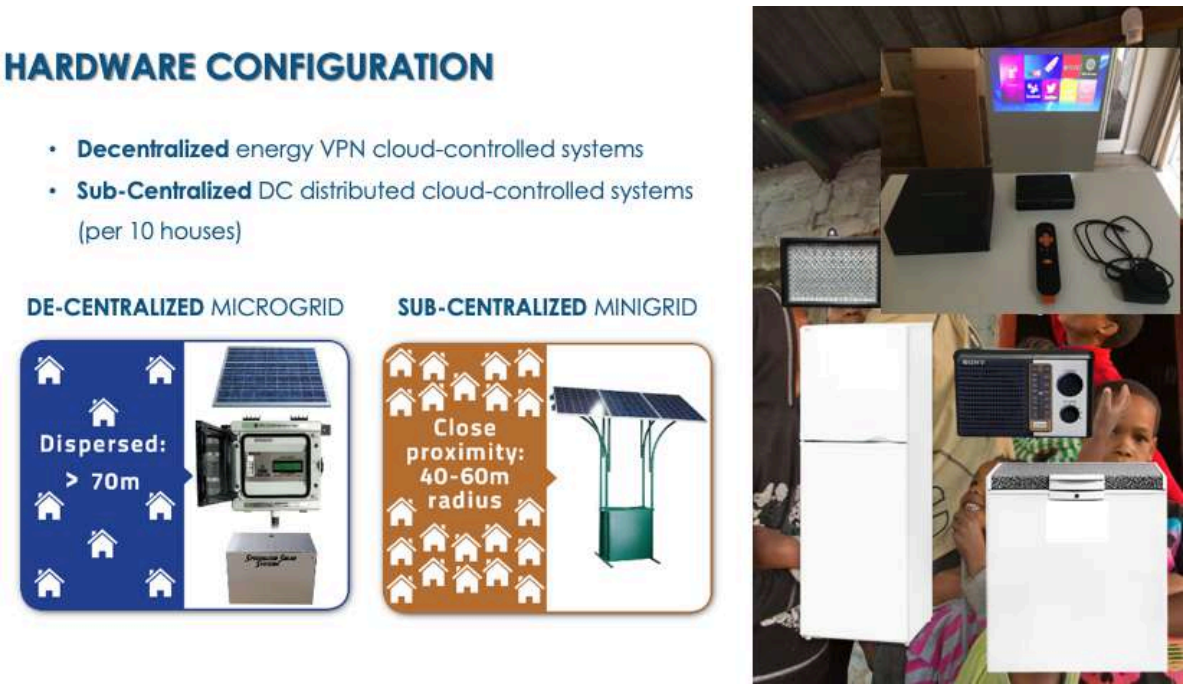

Figure 48: LivPak Snapshots

The LivPak systems can be upgraded, including:

- Fridge/Freezer
- DSTV
- Extra lights
- Fan
- Gas Stove
- Hot water
- Entertainment and video streaming
- Water & Shower products & services
- Sanitation services

as per the customers' needs and affordability.

All the above business models are managed via our LivPak Co-operative Membership management program.

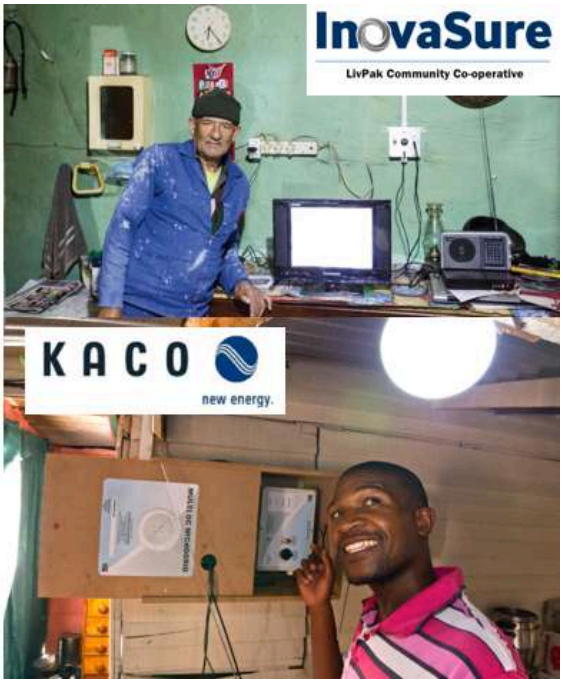

Figure 49: LivPak Snapshots

Figure 50: LivPak Snapshots

Figure 51: LivPak Snapshots

Figure 52: LivPak Snapshots

6.9 Disclaimer

This document is strictly for business planning process information purposes. Projections in the report have been compiled for illustrative purposes and do not constitute final forecasts.

The eventual outcome of the business planning roll-out process may be more or less favourable than that portrayed.

7 CONCLUSION

As was stated throughout this report the outcomes of the feasibility process as part of the broader business planning process is strictly for business planning process information purposes. Projections in the report have been compiled for illustrative purposes and do not constitute final forecasts.

The eventual outcome of the business planning roll-out process may be more or less favourable than that portrayed in the report

The process and the reported outcomes for each of the intended pilot site financial models (i.e. Kannaland Local Municipality) and for each of the subsequent implementation site models will be reviewed during the next phases of the implementation and roll-out of the InovaSure Energy Vault program in South Africa.

8 CONTACT DETAILS

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