ENERGY NEEDS ASSESSMENT FOR FARMERS – SITUATIONAL GUIDELINE

Western Cape Government
FOR YOU
Agriculture

GreenCape

Introduction

Energy has become an increasingly difficult component of production for the agricultural sector in South Africa. Agricultural producers are faced with three multi-faceted problems:

1. **Energy prices are increasing,** often at rates above inflation. This means rising input costs associated with production are reducing the profit margins for producers.
2. **Loadshedding[1] will persist** in the mid-term, probably with increasing intensity. This has already had a devastating impact on production in the sector, and means producers need to spend more money on alternative energy sources to continue operating.
3. **New climate policies** are being released that will penalise agricultural producers with high emissions. An example of this is the European Union's (EU's) Carbon Border Adjustment Mechanism (CBAM) which falls under the EU's Green Deal. If the CBAM was to expand to include agricultural products, South African producers would risk being priced out of SA's second largest market for agricultural exports.

Creating awareness about renewable energy solutions empowers farmers with the knowledge to adopt sustainable practices. The purpose is not only to reduce the environmental impact but also enhance the resilience of agriculture by educating stakeholders on these technologies which fosters a mind-set shift towards practices that can ensure long-term sustainable production. A situational guideline provides a structured approach to provide a basic overview of possible energy interventions for different producers. These interventions are guided by data collected from producers, industry associations and industry knowledge of the sustainable agriculture and energy programmes.

There are some important considerations that one needs to have in check before deciding to adopt any new renewable energy interventions.

1. Loadshedding: is a controlled process that responds to unplanned events in order to protect the electricity power system from a total blackout. While we generally use the word blackout loosely to mean "no lights" in our local area, a country-wide blackout has much more serious consequences. Blackouts occur when there is too much electricity demand and too little supply, bringing the power system into an imbalance and consequently tripping the power system in its entirety. https://loadshedding.eskom.co.za/LoadShedding/Description

This document offers a step-by-step guide to choosing a solution that makes the most sense for producers.

Abbreviations

AEF: Agro-Energy Fund

CASP: Comprehensive Agricultural Support Programme

CoC: Certificate of compliance

CPI: Consumer price index

DALRRD: Department of Agriculture, Land Reform and Rural Development

DoEL: Department of Employment and Labour

ECA: Electrical Contractor Association

ECB: Electrical Conformance Board of South Africa

EnMS: Energy management system

ESCO: Energy service company

EIA: Environmental Impact Assessment

EU: European Union

HVAC: Heating, ventilation and air-conditioning

LCOE: Levelised cost of energy

LCOS: Levelised cost of storage

NCPC-SA: National Cleaner Production Centre South Africa

PPA: Power Purchase Agreement

PV: Photovoltaic

ROI: Return on investment

SAPVIA: South African Photovoltaic Industry Association

SHF: Smallholder Farmer

STEP 1

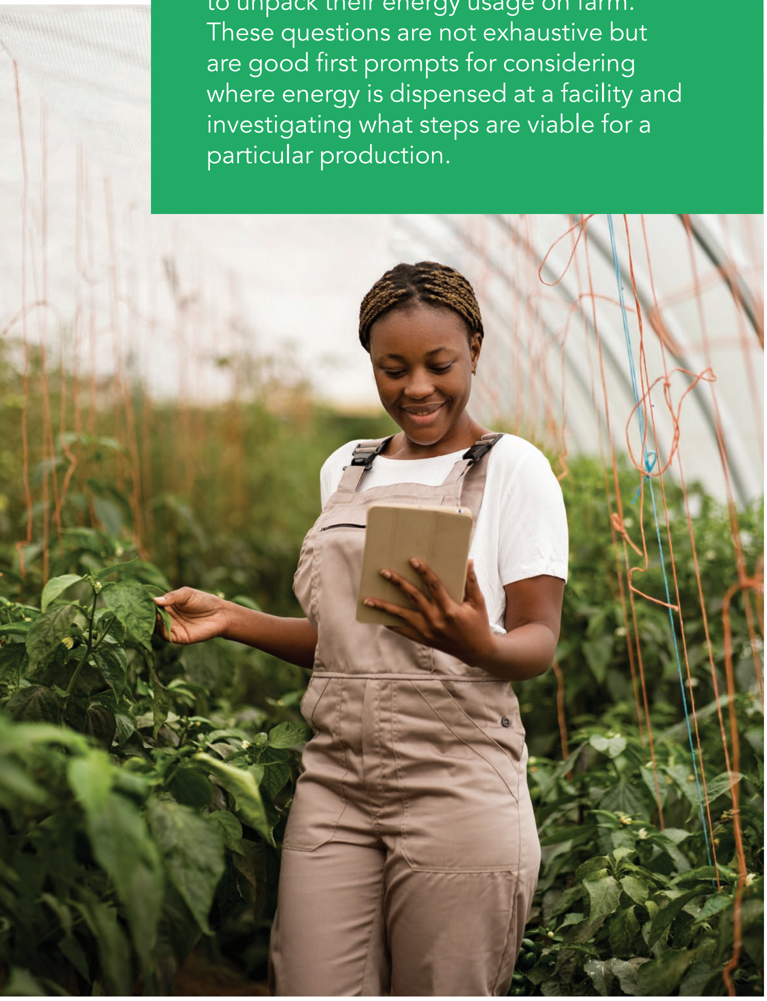
Using energy more efficiently

Energy is an important input in agriculture, coming in the form of electricity, diesel fuel, labour, fertiliser etc. Energy usage in agriculture differs between commodities, geographies and scale of production.

There is no one-size-fits-all model for energy use in the agricultural sector and so producers would need to understand the basics of their energy usage before embarking on a journey to greater energy resilience.

1.1. Understanding your energy basics

What follows are some questions agricultural producers can ask themselves in an effort to unpack their energy usage on farm. These questions are not exhaustive but are good first prompts for considering where energy is dispensed at a facility and investigating what steps are viable for a particular production.



1.1.1. ENERGY OBJECTIVES

Q: What does energy resilience look like to you?

Energy resilience is particular to each production facility and requires addressing the energy concerns of a producer. The energy concerns of agricultural producers can often be distilled into three energy objectives:

- Reducing costs: a producer is interested in spending less on their energy bill, particularly electricity
- Loadshedding resilience: a producer wishes to ensure that they are able to continue with production, even during loadshedding hours
- Reducing carbon footprint: a producer wants to reduce the carbon emissions associated with production, often in order to meet the standards of markets or their own environmental, social and governance (ESG) goals[2]

1.1.2. TIME OF NEED

Q: When do you need this energy the most – morning, day or night?

In order to implement the most appropriate energy intervention, it is important to understand the exact time you require the most energy. For example, in indoor farming; a producer needs a consistent and reliable source of energy for lighting, cooling and ventilation of the facility. Therefore, adopting a system that ensures a consistent supply of electricity is critical.

1.1.3. SEASONALITY

Q: What are your seasonal needs and consumption during those times?

It is important for a producer to understand their peak needs so that they are able to make an informed decision on the most applicable energy intervention. For example, if energy demand is highest during summer when there is enough sunlight, then a solar photovoltaic (PV) system might be a viable option. But if peak demand period is in winter, solar PV alone might not be a viable solution. The Western Cape receives winter rainfall, therefore it is important to choose a system that will create a balance between high demand and low demand seasons.

2. A framework used to assess an organization's business practices and performance on various sustainability and ethical issues

1.1.4. ENERGY DRIVERS VS ENERGY USERS

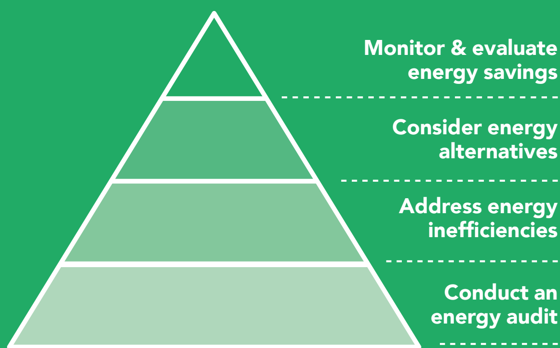
Q: What activities drive energy usage vs which equipment is used to drive those activities?

It is critical to understand the difference between energy drivers vs energy users. For example, a common energy driver of a horticultural farmer is irrigation. However, the energy user within that activity is actually the irrigation pump. Understanding the difference between the two can assist in opening up the solution space for energy resilience for that particular energy driver. For example, if the same horticultural producer were to investigate energy efficiency interventions focussed solely on the irrigation pump, they would determine that investing in a variable speed drive (VSD) or more energy-efficient pump. However, if they were to expand their investigation to target energy-efficiency of their energy driver, irrigation, the solutions would expand to looking at irrigation scheduling, design of the irrigation system, time of use options etc.

1.2. Conducting an energy audit

The first and most important step before making decisions around energy is to conduct an energy audit: assessing the energy needs at a facility and exploring actions to reduce energy usage while maintaining or increasing production. It forms the basis of energy resilience because any decision made requires an understanding of the energy flows of a particular facility. If a producer wants to conduct a self-audit, the first step is to walk around the facility, noting the energy flows for each building and piece of equipment.

An energy audit[3] can provide invaluable insight into energy flows in a system and is the first and most important step in implementing energy efficiency. It assists in realising total consumption and energy needs on farm and exploring actions to reduce energy usage while maintaining or increasing farm production. Energy audits can be performed by a qualified engineer or the producer to help understand the energy drivers, time of need to determine peak times of energy use as well as seasonality.



3. Energy audit: for more information on energy audits, click here.

For a more comprehensive, technical audit, producers can reach out to the National Cleaner Production Centre South Africa (NCPC-SA), which conducts free energy assessments to identify savings and provides recommendations for government incentives to reduce capital costs. A producer can complete an application to undergo an assessment by visiting industrialefficiency.co.za/enquiries/ or by emailing ncpc@csir.co.za.

Another option is Eskom's Energy Advisory Service, which supports customers in reviewing their current energy strategy and provides guidance that fits their energy needs. Eskom Advisors can conduct a Level I energy audit, which involves an analysis and audit of electricity usage.

This audit can assist in establishing the need for a larger or smaller supply point, recommended potential for load management or a tariff review. Advisors also provide information and contact details regarding several available external funding mechanisms, including tax allowances and incentives for customers. The service is free of charge and conducted at the premises.

More details can be found by visiting eskom.co.za/idm, calling +27 86 003 7566, or emailing advisoryservice@eskom.co.za.

1.3. Implementing energy efficiency interventions

Efficient use of energy resources contributes significantly to the overall sustainability of agricultural practices. By minimising energy waste and optimising processes, the environmental footprint of farming practices can be reduced significantly.

This, in turn, reduces input costs. Energy efficiency is closely linked to the judicious use of other resources such as water, land, and nutrients. For instance, by optimising energy use in irrigation systems, the system not only conserves energy but also minimises water usage, addressing the growing concerns over water scarcity.

There are a number of technological interventions that each producer can adopt to maximise their production at a lower cost such as switching to more efficient lighting; running the right irrigation pumps and implementing the correct system for heating, ventilation, and air-condition (HVAC). More information and resources on energy efficiency in agriculture can be found here.

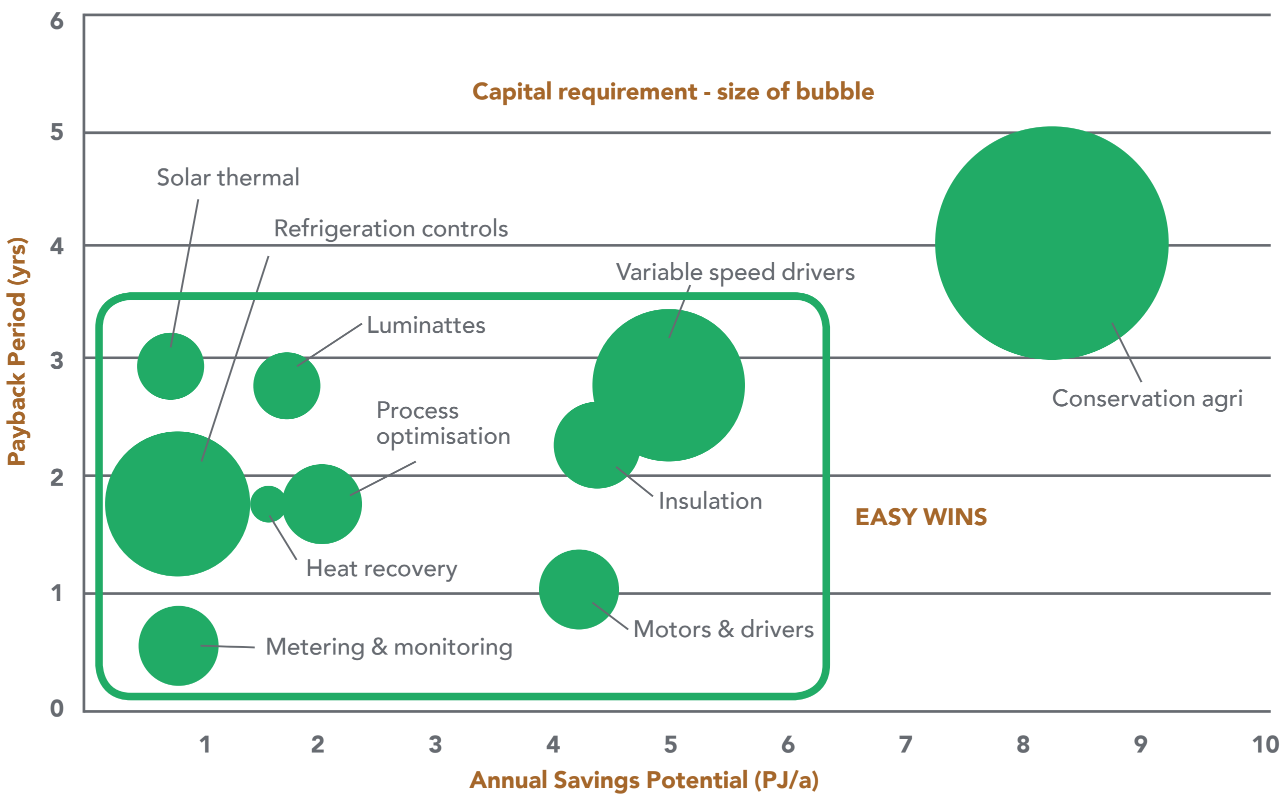


Figure 1: Opportunity map for energy efficiency interventions

The most relevant energy efficiency interventions for the agricultural sector are represented in **Figure 1,** with the size of the bubble representing the relative capital cost for each intervention. Most energy efficiency interventions can be implemented in the short-term and have a payback period of less than three years. Additionally, even if a producer decides to make an investment in an alternative energy system, they should start with energy efficiency. This is because a more efficient production system would result in a smaller alternative energy system requirement. This ultimately would result in a lower capital investment requirement and result in further savings for a producer.

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CASE STUDY

CONTEXT:

Daybreak Farms is a poultry company with operations in Gauteng, Mpumalanga and Limpopo. Its abattoir in Sundra slaughters an average of 5.5 million chickens, processing chicken into consumable products that are sold in retail as fresh meat. Daybreak Farms' process engineer engaged with the NCPC-SA to identify pathways for optimising energy utilisation at their facility by implementing an energy management system (EnMS).

INTERVENTION:

The scope and boundaries of the EnMS included electricity, coal and diesel. The physical boundary only included the abattoir facility of Daybreak Sundra. The breakdown of energy utilisation shows that electricity accounts for 68% of energy use, followed by coal and diesel at 20% and 12% respectively. Furthermore, refrigeration and lighting account for 70% and 4% of electricity usage respectively. And all of the energy produced by coal (100%) is used in hot water heating.

LESSONS:

Daybreak Farms saw continued performance improvements from May 2018 that positively impacted on job retention and creation. It also noted a few lessons:

- **For the implementation of any system to be effective**, the commitment of management is imperative, as well as the allocation of required resource to effect it.
- **Measuring is key to making data-driven decisions** and should be initiated early in the process. As staged by Daybreak Farms' process engineer, Lesetja Mangale, "What is not known, can't be managed".
- **Setting realistic timeline and target dates** are important in ensuring continued development of the system and upholding motivation amongst staff during the implementation process.

SUMMARY

Step 1 of this guideline has helped you do a **needs assessment** of all your **energy requirements, peak usage times** and prompted you to understand energy efficiency.

This analysis will serve as a foundation for determining the most suitable renewable energy intervention based on all the information provided.

Table 1: Summary of the 2018 energy efficiency interventions at Daybreak Sundra

In 2018, two interventions were implemented:

Energy uses/ users	Energy source	Intervention	Investment (R)	Savings (R/Yr)	Payback (Yr)	Utility savings (kwh)	GhG emissions reduction (Tonnes CO_2/Yr)
Lighting	Electricity	Replace office lights with LED and increase EnMS awareness	R4 030	R21 896	0.18	18 400	18.95
Refrigeration / Production	Electricity	Reduce machine idling and reduce heat loads in cold rooms (reduced lighting and door opening)	R0	R281 174	0	236 281	243.37
		TOTAL IMPLEMENTED	**R4 030**	**R303 070**	**0.01**	**254 681**	**265.32**

Table 2: Additional potential energy efficiency interventions not yet implemented at Daybreak Sundra

Further interventions were planned for 2019 but kept being postponed:

Energy uses/ users	Energy source	Intervention	Investment (R)	Savings (R/Yr)	Payback (Yr)	Utility savings (kwh)	GhG emissions reduction (Tonnes CO_2/Yr)
Water heating	Coal	Insulation of hot water pipes	R33 000	R28 646	1.15	220 360	226.97
Water heating	Coal	Reduce boiler temperature setpoint on conveyer control	R20 000	R34 405	0.58	264 652	272.59
Water heating	Coal	Insulating ash container	R220	R5 540	0.04	42 622	43.90
Lighting	Electricity	Install skylights in service areas	R48 750	R51 609	0.94	43 369	42.10
Lighting	Electricity	Install motion sensors in offices	R25 200	R51 609	0.49	43 369	44.67
Refrigeration	Electricity	Install heat recovery system in refrigeration plant	Potential savings to be quantified by external refrigeration expert				
Refrigeration	Electricity	Optimise refrigeration plant operation					
		ANTICIPATED TOTAL 2019 PIPELINE	**R127 170**	**R171 809**	**0.74**	**614 372**	**630.23**

STEP 2

Choosing the right alternative energy option

There are a number of alternative energy solutions[4] a producer can choose from and these are all based on needs assessment, site-specific characteristics, technological suitability and reliability. The suitability of each technology is based on the producer's objectives which have been broadly categorised into:

- **Reducing costs**
- **Loadshedding resilience**
- **Reducing carbon footprints**

The decision of investing in alternative energy technologies is also influenced by economic and technical implications. Economic considerations include capital expenditure (CAPEX), operating and maintenance expenses, and levelised cost of energy (LCOE) and the technical considerations include land availability, environmental impact assessment (EIA), and the availability of service providers.

Most producers might be unfamiliar with the concept of LCOE, but it is widely used within the energy space. LCOE is a useful measurement used to assess and compare alternative methods of energy production. LCOE is calculated for an energy-generating asset, but the levelised cost of storage (LCOS) can be used for an energy-storage asset and is calculated in the same manner. LCOE is calculated to be the average minimum price at which the electricity generated by an asset is required to be sold in order to offset the total costs of production over its timeline. In other words, what is the minimum cost of the energy that an asset generates over its lifespan.

2.1 Considering your technology options

2.1.1. SOLAR PV

Solar PV, also known as solar panels or solar cells, is a technology that converts sunlight into electricity. It is a renewable energy source widely used in commercial, industrial and agricultural applications.

Advantages	Limitations
Can power energy-intensive operations of the facility	The correct sizing of the system becomes critical to ensure efficiency of the solar system
Effectively reduces energy consumption requirements from the utility and offsets the municipality's energy bill	• Depends on the availability of sunlight and the point of connection of the critical load • Security is an issue if the farm is remote

4. More information on described technologies available:

Solar PV: https://www.westerncape.gov.za/110green/energy/solar-pv-home-and-business

Battery: U.S. Department of Energy International Energy Agency (IEA). 2022.

Diesel: https://energyeducation.ca/encyclopedia/Diesel_generator#:~:text=Diesel%20generators%20are%20very%20useful,to%20mechanical%20energy%20through%20combustion

Biogas: Dieterich, B., Finnan, J., Hochstrasser, T. and Müller, C., 2014. The greenhouse gas balance of a dairy farm as influenced by the uptake of biogas production. BioEnergy Research, 7, pp.95-109.

Small-scale wind and hydro generation: U.S. Department of Energy International Energy Agency (IEA). 2022.

Additional information: https://sites.google.com/greencape.co.za/reandeeatwwtwsinsa/home

2.1.2. BATTERY

A battery system refers to a device specifically designed to store energy for later use. It consists of batteries along with associated components. Batteries in these systems can store energy from sources like panels, wind turbines or the power grid and release it when necessary.

Advantages	Limitations
Provides backup power during outages ensuring consistent and uninterrupted operations on farm	• High capital cost associated with technology
	• Requires regular maintenance to ensure performance and efficiency • Limited life cycle and requires replacement

2.1.3. DIESEL GENERATOR

A diesel generator is a device that can be moved around or kept stationary and uses a diesel engine to produce electricity. It consists of an engine and an alternator. When the engine operates it powers the alternator, which generates energy. Diesel generators are commonly utilised as power sources during power outages in areas where there is no access to the grid and in various industrial applications due to their reliability and efficiency.

Advantages	Limitations
• Provides a continuous and reliable power supply	• Not environmentally sustainable
• Diesel generators are known for its high power output	• Fuel to run the generator is expensive and the price frequently fluctuates

2.1.4. SMALL-SCALE HYDRO

This technology harnesses energy from flowing water to produce usable electricity. The generation capacity typically ranges between 5 kW and 100 kW. This power generation technology is based on the gravitational potential of water flowing from a higher to a lower elevation. The system typically uses turbines and generators for electricity generation. Small scale hydroelectric systems are especially effective, in areas where there is a flow of water providing an environmentally friendly source of energy.

Advantages	Limitations
The system is easily managed for running pumps and other critical activities on farm	Installation requires a sufficient and consistent water flow
Ideal for farmers who want to reduce their carbon footprint	High initial investment cost for system construction

2.1.5. BIOGAS

A renewable fuel is biogas, which is produced through the digestion of organic matter under anaerobic conditions. It is primarily composed of methane and carbon dioxide gases and can be used for energy purposes such as heating, generating electricity and even as a fuel, for vehicles. It offers an efficient way to convert waste into valuable energy resources while also reducing greenhouse gas emissions.

Advantages	Limitations
Reduces carbon footprint	High initial investment cost for constructing biogas digesters
Good diversion and value addition to organic waste	• Requires large and consistent volumes of feedstock • Inadequate expertise for construction and maintenance

2.1.6. SMALL-SCALE WIND GENERATION

Wind energy uses naturally occurring wind currents to rotate a turbine for electricity generation. This technology has not been extensively adopted in South Africa due to its complexity and high CAPEX and OPEX costs. Here are some important considerations for wind generation:

- **Determine** the most appropriate scale and location of turbine for the site
- **Initial assessment** of on-site wind resource
- **Technical assessment** of physical and planning constraints and initial technical issues that may affect the viability of the investment
- Initial assessment of **project costs**, payment and return on investment (ROI)
- Provide an **objective view** as to the level of risk should the project proceed to a planning application

Advantages	Limitations
A clean source of energy which does not contribute to climate change	Requires high wind resource for system efficiency and generation
• Reduce dependence on fossil fuels • Low operating costs	Capital cost might be low compared to other investments, but the yield i.e. LCOE could be variable and fairly low if there isn't good wind resource

2.1.7. SOLAR AND BATTERY STORAGE

When a solar PV system is combined with energy storage in the form of a battery it creates what is commonly referred to as a "solar plus battery" system. This combination offers benefits such as storing energy for night-time and cloudy days. This results in increased energy security by providing backup power during grid outages and further maximising the utilisation of solar energy.

2.1.8. SOLAR AND DIESEL GENERATOR

The combination of solar and diesel are well suited for areas with unreliable sources of energy. The addition of solar energy reduces the fuel costs and is more predictable for the long term. Additionally, there is quick ROI due to the high investment potential of solar, and the offsetting of diesel by generating power using solar reduces your carbon footprint. Solar hybrid systems are systems that combine power from a PV system and another system, which is in this case, diesel. This combination is known as a PV diesel hybrid system or solar diesel hybrid system. This combination offers benefits such as: supplying energy for night-time and cloudy days; increasing energy independence; reducing costs through peak shaving; providing backup power during grid outages; maximising the utilisation of solar energy; minimising environmental impact; and potentially saving money through time of use pricing optimisation. Additional advantages of the system include: increased PV generation, supply without interruption, no power wastage, carbon emission reduction and the hybrid systems can be scheduled.

Table 3: Energy technology comparison in relation to key metrics of energy objectives and economic and technological considerations

The table below provides a comparison between the technologies listed above, particularly in relation to key metrics of energy objectives, economic considerations, and technical considerations.

The table is a high-level summary – producers should take time to do their own research to supplement the information below.

Technology	Objectives			Economic			Technical		
	Cost saving	Loadshedding resilience	Reducing carbon footprint	CAPEX	OPEX	LCOE	Land availability	EIA	Access to service providers
Solar PV	✓		✓						
Battery		✓							
Diesel generator		✓							
SS Hydro*		✓	✓			No data			
Biogas		✓	✓						
SS Wind*			✓			No data			
Solar PV + Battery		✓	✓						
Solar + diesel generator	✓	✓							

GREEN highlights technology that has: lower CAPEX and OPEX costs relative to other technologies, low LCOE, not restrictive in terms of land use and has considerably high access to service providers.

ORANGE highlights a technology that has: medium to high CAPEX and OPEX costs, LCOE. These technologies can be restrictive in terms of land-use depending on the size installation and has fewer number of service providers

RED highlights a technology that has: high CAPEX and OPEX costs, requires EIA and has limited access to service providers

SUMMARY

Step 2 of this situational guideline provides an understanding of the different technologies that are available for producers and briefly highlights the advantages and limitations of each technology. However, **this guideline will focus on four different interventions** and provide context on the suitability of each system to help a producer to make a more informed decision.

The solutions highlighted include: **solar, solar with battery storage; solar with diesel and biogas**. This section of the guide has helped guide each producer to understand which technology makes the most sense for their farm operations.

STEP 3 Making the investment

By carefully considering the following important steps before investing in alternative energy sources, you can mitigate the risks, maximise returns, and ensure the successful implementation of energy projects on your farm.

3.1. Financial analysis

Perform a detailed financial analysis to assess the economic feasibility of alternative energy investments. Consider upfront costs, ongoing operational expenses, potential energy savings, available incentives, and financing options.

3.1.1. CAPITAL OUTLAY

The table below provides the estimated capital cost of investing in different technologies, depending on the system size and/or storage capacity. The average costs per kWp tend to decrease with increasing size, mainly due to economies of scale:

Table 4: Estimated CAPEX costs for different technologies depending on size and/or storage capacity

R/ kWp	< 500 kWp	500 – 1 000 kWp	> 1 000 kWp
Solar PV	12 000 – 15 000	11 500 – 14 000	11 000 – 13 500
Biogas	20 000 – 52 000	16 000 – 82 000	13 000 – 24 000
Energy storage is measured in Watt-hour and should not be seen as generation technology on its own. An energy source is required to charge the device			
R/ kW	**< 500 kW**	**500 – 1 000 kW**	**> 1 000 kW**
Diesel generator	2 000 – 4 000		
Advance lead acid	1 500 – 2 000		
Lithium-ion	5 000 – 7 000	4 500 – 6 500	4 000 – 6 000
Vanadium Redox Flow	8 000 – 14 000		

The prices in the table above are for standard systems; however, increasing complexities of a system can lead to increasing capital cost. For example, additional civil works and/or more complex configurations. The table below illustrates the cost multiplier associated with different configurations of PV systems.

Table 5: Estimated cost-multiplier for different solar PV systems

Types of PV systems	Estimated cost-multiplier	Reason
Rooftop	1.00	Most common type of system due to availability of roof space.
Rooftop (with asbestos replacement)	1.30 – 1.50	Asbestos Abatement Regulations specifies the phasing out of this type of roofing and the Department of Employment and Labour (DoEL) has taken a stance to prohibit PV installations in this case, hence a roof replacement will be required. Financiers and insurance providers also typically avoid asbestos roofs due to the long-term risk.
Ground mount	1.10 – 1.20	If you have the available land area and rooftop space is unavailable. The cost premium is due to the required mounting structure and civil works. An EIA is required for system above 10MW and with a physical footprint of more than 1 hectare.
Floating	1.50 – 1.75	If you have a compatible body of water. Cost premium is due to the required float which is price dependent on import/order volumes.
Carport	1.25 – 2.00	Depends on parking area and influence of existing vs required parking infrastructure on mounting costs. Added benefit of providing shade and visibility for sustainable brand promotion.

3.1.2. LCOE AND LCOS

As stated in **Step 2,** the **LCOE** is a useful measurement used to assess and compare alternative methods of energy production.

$$\textbf{\textit{LCOE}} = \frac{\textbf{\textit{Total life cycle cost}}}{\textbf{\textit{Total lifetime energy production}}}$$

$$= \frac{\textbf{\textit{Capital outlay + Operational costs + Maintenance costs + etc.}}}{\textbf{\textit{Total lifetime energy production}}}$$

$$= \frac{\textbf{\textit{R}}}{\textbf{\textit{kWh}}}$$

This metric is very useful in evaluating whether a project is worth investing in, in circumstances where:

- A producer wants to reduce per unit cost of their electricity – if their LCOE is lower than their current Eskom unit tariff, it is a good indication that they will be spending less on their electricity over the lifespan of the technology
- A producer wants to invest in the asset that will provide them with the cheapest electricity – the lowest LCOE among the technologies should be the asset able to produce the cheapest electricity over its lifespan in comparison to the other technology options available

Table 6: The When and Why for energy generation technologies

	The When and Why	LCOE (R/kWh)
Solar PV	Most popular energy-generation system, due to its wide applicability across South Africa, constantly decreasing costs and increasing number of service providers available. Solar PV has the additional benefit being a 'green' energy and is used increasingly by producers, looking to cut their carbon emissions.	R0.54 – 0.75
Anae-robic digester	Attractive dual benefit of managing waste whilst generating energy in the form of biogas. Requires investment in additional infrastructure to convert the gas into electricity. Also requires consistent access to feedstock i.e. works best where the waste stream is already produced on-site.	R1.22 – 3.18

Below are the **LCOS** values for storage/back-up systems. As can be seen, although diesel generators are much cheaper in capital outlay, the cost of electricity from a diesel generator is more expensive than most other battery storage technologies. The difference between these values is only expected to increase as the cost of diesel[5] continues to rise.

It is important to note, that the LCOS values for advanced lead acid, lithium-ion and vanadium redox flow batteries includes the cost of recharging the batteries using Eskom electricity (R2.00/kWh). For systems that use electricity generated from cheaper technologies (e.g. solar PV), those LCOS would decrease further.

Table 7: The When and Why of energy storage technologies

Technology	The When and Why	LCOS (R/kWh)
Diesel generator	Traditional means of providing continuous power supply. Although they are efficient and relatively cheap, rising diesel prices and demands of loadshedding is making it less cost competitive than storage technologies. Emissions are intensive which may have carbon tax implications.	R5.00 – 10.00
Advanced lead acid battery	Improved cycle life and depth of discharge over traditional lead acid. Good for small scale, ad-hoc applications over a short period of time. Relatively short life span of 1-2 years, depending on use.	R4.00 – 5.00
Lithium-ion battery	The industry standard for battery storage due to high energy density, high efficiency, fast flexible discharge/recharge, low maintenance and competitive costs. Will last 8 years, depending on use.	R4.50 – 6.00
Vanadium redox flow battery	Emerging technology for applications larger than 400 kWh. Can be cost competitive with Li-ion where > 4 hours of back-up is required.	R5.50 – 8.00

3.2. Select a service provider

Research and evaluate potential service providers or contractors to install and maintain the alternative energy system. Choose a reputable service provider with a track record of successful installations and reliable customer support.

Engage with local communities, stakeholders, and neighbouring landowners to address any concerns and build support for the alternative energy project. Consider the potential social and environmental impacts of the project and develop strategies to mitigate negative effects.

3.3. Quality assurance

With the increase of fly-by-night energy service companies (ESCOs), selecting a good installer can be quite daunting for those who are looking into alternative energy systems for the first time.

However, there is key information a producer should ask for that will allow them to discern whether an installer is a reputable service provider or not. This list is based on selecting a solar PV system, but a producer can apply the same steps for all alternative energy systems.

5. The price of diesel as of 6 March 2024 = R21.70/L (coastal) and R22.42/L (in-land)

1.

The necessities – these are the minimum requirements a producer should require from an ESCO:

- Must be registered with the DoEL as an electrical contractor according to government regulations [click]
- Experience with solar PV installations – ask for references from previous clients about how well systems have worked and previous clients feel like they received the system that they wanted
- Experienced personnel – the personnel installing the system should always be a master electrician.

2.

Advisable extras – these are considerations which can assist in proving an ESCO is credible as well as having a pathway for recourse in case of any bad quality work:

- Be a member of the South African Photovoltaic Industry Association (SAPVIA)
- Be registered with the Electrical Contractor Association (ECA) or any equivalent e.g. Electrical Conformance Board of South Africa (ECB).

3.

Third party accreditation – these are accreditation programmes that can help in providing additional peace of mind that an ESCO has been appropriately trained in correctly sizing and installing an alternative energy system:

- SAPVIA's PV Green Card
- ECA's Solar School
- P4 Quality Assurance Certification

Additionally, it is important that any small-scale embedded generation (SSEG) system be registered with the local municipality or Eskom, if a producer intends to maintain their connection to the grid network. The application has a few compliance requirements such as sign-off by professional engineers on structural integrity and electrical work as well a certificate of compliance (CoC) that must then be handed over by an installation or master electrician. While any one can register their system, it is highly recommended that the ESCO installing the system manages the registration, as they are familiar with the requirements of the application process. It is important to note, that this registration process is at an additional cost and should appear as a line item on the quote.

3.3.1. READING YOUR QUOTE

When a producer receives their quote, there are some pieces of information that should be included:

SOLAR COMPANY (PTY) LTD
VAT NO: 1234567
CELL: +27 80 765 2726
EMAIL: email@solarco.co.za
POSTAL ADDRESS:
PO BOX 1111
Elsenburg
7607

QUOTE

NUMBER:	QU0001
DATE:	01/01/2024
EXPIRES:	01/03/2024
SALES REP:	J. DOE
BILLED TO:	**FARMER JOE**

Page 1/3

CONCEPT PROPOSAL: SSEG SOLAR ALTERNATE POWER

Proposed system: 1

The proposed system is a 110 kWp solar PV system with battery capacity of 120 kWh. Our suggested system will offer a consumption off-set of 67%, a bill reduction of 62% and a self-consumption of 75% and a Grid-Tied Hybrid SSEG application is done with the City of Cape Town

Contactable references: 2

Mr. Limi, Limi Farms, Large Residential/Agricultural, Stellenbosch Farms, 087 464 3276
Registered SSEG Installation, 24 kVA, 3 Phase, Eskom direct
Ms. Tuis, Residential, Foreshore, 087 374 3368
Registered SSEG Installation, 10 kVA, Single Phase, City of Cape Town

1. System information

- Size of the system: does this size make sense for the known load profile of the facility?
- Type of system: is it grid-tied, hybrid, or off-grid?
- Estimated system power generation: estimated system power generation in kWh and as a percentage of total consumption

2. Contactable references

- References for previous installations done by the ESCO of similar sizes and applications
- References aren't always included in a quotation, but a producer should ask for them if not included

A producer can analyse their quote further by comparing the cost of their components to the component cost ranges GreenCape calculated from industry engagements conducted in 2020. However, due to increased demand over the past few years, the cost of PV modules has declined further by 15 – 30%, so the values found in more recent quotes may be lower than the cost range for PV modules indicated.

Table 8: Component cost ranges in ZAR/kWp

	< 100 kWp	100 – 500 kWp	100 – 500 kWp
PV modules	4 000 – 7 500	4 200 – 5 500	4 000 – 5 100
Metering	150 – 350	50 – 200	30 – 200
Protection and switches	450 – 2 700	350 - 2 500	350 – 2 000
Inverter	950 – 1 500	700 – 2 400	700 – 2 000
Mounting and structures	450 – 1 700	400 – 2 000	400 – 1 700
Engineering	150 – 850	70 – 1 500	40 – 1 000
Construction	500 – 2 000	750 – 1 500	650 – 1 200

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Page 2/3

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Description	Quantity	Price	Nett Price	Total
SPTW550-W-550W TongWei Solar Module	200.00	R3 850.00	R770 000.00	R885 500.00
DC Cable 6mm red	3500.00	R24.50	R85 860.00	R98 612.50
DC Cable 6mm black	3500.00	R24.50	R85 750.00	R98 612.50
Surge EXP9BP-N 4 Mod 2pole K 32A	16.00	R1 043.00	R16 688.00	R19 191.20
Sunsynk 50k Hybrid inverter	2,00	R185 000.00	R370 000.00	R425 500.00
Earthing	5,00	R28.00	R140.00	R161.00
Freedom Won Lite Business 40/32 HV Battery N	3.00	R291 000.00	R873 000,00	R1 003 950.00
COC Electrical	1,00	R1 560.00	R1 560.00	R1 794.00
Labour (per hour)	160,00	R625.00	R100 000.00	R115 000.00

3

3. Line items

- Breakdown of the costs (e.g. panels, equipment, installation, registration)
- Each component should include brand details, quantity, unit price and nett price as well as the total

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Page 3/3

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Description	Quantity	Price	Nett Price	Total
Extended warranty	1.00	R30 400.00	R30 400.00	R34 960.00
SSEG Registration	1.00	R45 000.00	R45 000.00	R51 750.00
Container and Transport	1.00	R55 000.00	R55 000.00	R63 250.00
Extended Producer Responsibility levy – solar panels	1.00	R7 207.20	R7 207.20	R8 288,28
Extended Producer Responsibility levy - inverter	1.00	R488.52	R488.52	R561.80

Payment terms: 50 - 80% upfront, 20 - 50% within 7 days after installation
All quotes/sales order are subject to any variations, from time to time, in any third party costs,
such as rates of freight, insurance costs, custom duties, exchange rates, costs of materials,

4

4. Terms and conditions

- Quote should also include the payment terms
- Quote should clearly state what is excluded, any discounts, length of validity of the quoted prices and warranties

3.4. Access to financing

Explore financing options available for alternative energy projects, such as grants, loans, tax incentives, and leasing arrangements.

Evaluate the financial implications of each option and choose the most cost-effective financing solution for your energy solution.

Historically, producers who wanted to invest in alternative energy systems had to finance the system either straight off their balance sheet or through debt finance. However, other financing options have become available for those who need alternative energy systems but may not have the means to purchase the system outright or might not want to take on the risk of owning and maintaining the asset.

Finance option	Description
Outright purchase	Capital outlay can be self-funded from the balance sheet. Best for those who want to maximise the savings benefit from the system and have access to the funds immediately.
Debt finance	Capital needs to be raised, most commonly from commercial banks. Best for those who want to maximise the savings benefit from the system, but are unable to access the full funds immediately.
Lease agreement/ Rent-to-own	Monthly payments made to an ESCO that will install and maintain the system throughout the lease period. At the end of the lease, the asset is either taken away or the lease is renewed, if under a lease agreement. If under the rent-to-own model, ownership of the asset (as well as its maintenance) is handed over at the end of the lease agreement. Best for those who cannot afford the previous two options, but want to own the system in the long-term. Advantageous for those who want to minimise taking on the system performance risk over the lease term.
Power Purchase Agreement (PPA)	Producer is able to purchase electricity from an ESCO, where the system can be set up on-site or at another site. Best for those who don't need or want to own the asset. Benefits of being able to access utility bill savings from day one of operations with the developer ensuring adequate system performance.

Below is a simple decision tree in assessing the best fit for the various financing solutions.

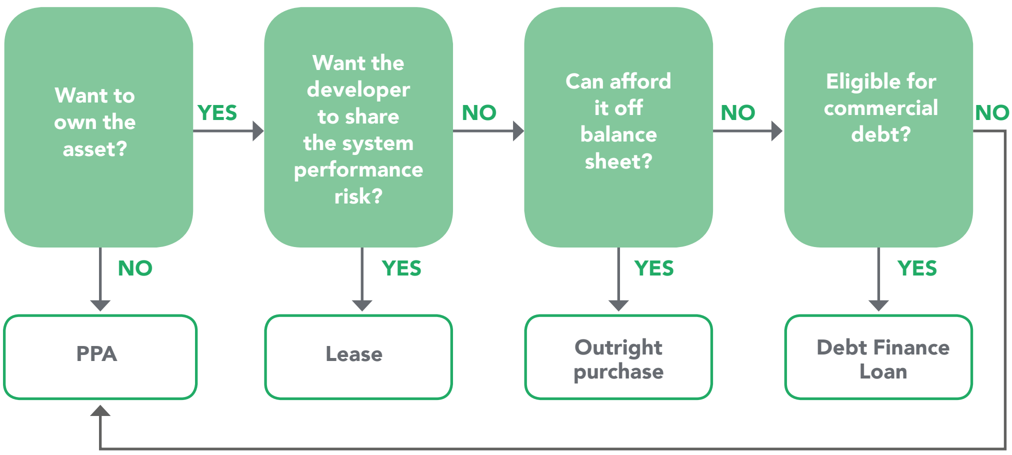


Figure 2: Decision tree for different procurement options of solar PV

The table below provides estimates of the market prices for procurement options of solar PV that a producer can use as a benchmark against quotes that they might receive.

Table 9: Cost estimates of different procurement options for solar PV

Procurement option	Term	< 500 kWp	500 – 1 000 kWp	> 1 000 kWp
Outright purchase (R/kWp)	N/A	R12 000 – 15 000	R 11 500 – 14 000	R 11 000 – 13 500
Debt finance (R/kWp)	5 – 10 years	Above amortised plus interest pa		
Lease-to-own (R/month)	10 years	R7 000 – 120 000	R100 000 – 200 000	> R210 000
PPA (per kWh)	10 – 20 years	R1.00 – R1.45	95c – R1.15	80c – 90c

3.4.1. REQUIRED DOCUMENTS FOR FUNDING APPLICATIONS

Below is a checklist of information a producer should include in any funding application they make for an alternative energy solution. This checklist can assist in illustrating that the chosen system is a right fit and that the necessary due diligence has been taken before going to financiers.

Solar PV checklist

- ☐ Is the 12-month load profile included
- ☐ Are the electricity provider details captured?
- ☐ Does it include the current electricity tariff (R/kWh)?
- ☐ Has the available installation space been identified?
- ☐ Do you own your property?
- ☐ Is there sufficient space for the proposed system?
- ☐ If a roof installation, does the roof contain asbestos?
- ☐ Does the solar system have a pitch angle between 15 – 45 degrees?
- ☐ Does the system have a northerly orientation?
- ☐ If a roof installation, can the roof support 15 kg/m^2?
- ☐ Is there lightning protection?
- ☐ Is the roof/space shadow-free?
- ☐ Are there any constraints (e.g. trees, buildings etc.)?
- ☐ Are civil works required?
- ☐ Is security required?
- ☐ Is the installer a member of SAPVIA or trained as a PV GreenCard installer?
- ☐ Has the installer included a warranty/guarantee?

Generator checklist

- ☐ Has the maximum demand been captured?
- ☐ Has the minimum load been captured?
- ☐ Have the fuel costs been captured?
- ☐ Does the system need an environmental impact assessment?
- ☐ Are civil works required?
- ☐ Is security required?

Energy storage checklist

- ☐ Has the 12-month load profile been captured?
- ☐ Has the minimum load been captured?
- ☐ Has the load duration been captured?
- ☐ Has the installer included a warranty/guarantee?
- ☐ Are civil works required?
- ☐ Is security required?
- ☐ Is the battery system combined with solar PV?

3.4.2. GRANT FUNDING AND BLENDED FINANCE

There are a few options for grant funding and blended finance available in South Africa, particularly for producers who were previously disadvantaged or for operations where the investment could be catalytic to job creation and increasing productivity.

- Comprehensive Agricultural Support Programme (CASP)

The Comprehensive Agricultural Support Programme (CASP) is a national governmental initiative, which was established in 2003. The aim of the programme is to support provincial departments of agriculture (PDA) to create a favourable environment for Smallholder Farmers (SHFs) and to expand the provision of support services for the development of agriculture.

Agriculture-related projects that are eligible for CASP funding include:

i.) farmers;

ii.) agricultural macro-system within the consumer environment;

iii.) agro-processing and valueadding projects;

iv.) subsistence and household food producers; and

v.) community projects.

- Agro-Energy Fund

The Land Bank, in partnership with the Department of Agriculture, Land Reform and Rural Development (DALRRD), has established a blended finance programme called the Agro- Energy Fund (AEF). This is meant to fund the purchasing of capital equipment and infrastructure for alternative energy sources directly linked to energy-intensive farming operations. The fund is intended to target high energy-consuming commodities such as dairy; poultry and piggeries, irrigated commodities; and on-farm agro-processors. However, the fund is not limited to just those commodities.

There is a sliding scale for the grand component on of the scheme for each producer category (30 – 70%), with the total dispensed funding capped at:

- R500 000 for small-scale farmers
- R1 million for medium-scale farmers
- R1.5 million for large-scale farmers

3.4.3. COMMERCIAL BANKS AND OTHER TRADITIONAL FINANCE MECHANISMS

One of the most common avenues for raising capital to obtain an alternative energy system is from debt finance. The biggest four banks in South Africa have a multiple investment instruments for PV and are increasingly structuring deals so that one's monthly loan repayments are less than the estimated electricity savings. This is so that one is able to benefit from the cost savings of the investment (even marginally) from the start of the loan term.

Table 10: Summary of solar PV investment options from South Africa's four leading banks

	ABSA	FNB	Nedbank	Standard Bank
Main investment instruments for PV	• Term loans • Asset & property finance • Central Provident Fund (CPF)/ Mortgage Backs Business Loan (MBBL)	• Term loans • Asset & property finance • Instalment sales agreements	• Term loans • Asset finance • Nedbond	• Term loans • Personal loans • Asset & property finance • Access bonds
Investment size requirements	• None – does not set lower or upper limits, but return profile must be feasible	• R150 000 – R50 million	• None	• Dependent on the merits of the installation project being considered
Investment period	• Provide scope for both shorter and longer terms than typical PV finance options	• 5 – 10 years	• Up to 10 years, dependent on the cash flow models	• Up to 10 years on commercial opportunities, but dependent on considerations related to each installation project being considered
Security/collateral requirement for debt	• Dependent on funding structure, but often taken against either the underlying property or asset	• Dependent on funding structure, but often taken against either the underlying property or asset. Unsecured funding may also be available	• Usually in the form of assets or sureties as well as the PPA in the case of IPPs	• Underlying property/asset guarantees or cessions
Inputs on further risk reduction	• Regulatory certainty • A second-hand market for solar PV assets • Wheeling	• Regulatory certainty • A second-hand market for solar PV assets • Wheeling	• Regulatory certainty • A second-hand market for solar PV assets • Wheeling	• An improvement in market dynamics brought about by regulatory environment • Standardisation

CASE STUDY

DEBT FINANCE

CONTEXT:

The solar PV system installed at Kenridge Centre is a Grid-Tied PV system configured to generate electricity for self-consumption, with excess generated electricity being exported back into the electricity grid. Being grid-tied, this system does not produce energy during loadshedding periods, but is able to when extended through a battery-tied system that provides power to essential loads or an appropriately sized generator.

BUSINESS DETAILS:

Business name: Inframax Holdings

Location: Kenridge Centre, Cape Town

Developer: AW Power (2020)

Loan provider: Nedbank

System size (kW): 156 kWp

Electricity generated in a year: 268 500 kWh

Yearly electricity consumption: 564 000 kWh

Commercial debt interest rate: 7%

Monthly loan payments: R29 400

Payment escalation per annum: 5%

Contract term length: 7 years

Municipal tariff: R1.61/kWh

Monthly electricity costs without PV: R77 000

Monthly savings: R35 000 (45%)

KEY INSIGHTS:

As stated previously, many commercial banks are structuring deals so that the monthly loan payments are lower than the expected monthly savings. This means that, even though the new PV system was not bought off of the balance sheet, Inframax Holdings is still saving on its electricity bill during the contract term length of the loan. It is also important to note that the lifespan of a well-maintained PV system is longer than 20 years and so once the loan is paid off, Inframax would realise the full monthly savings of R35 000 for more than 13 years.

3.4.4. INNOVATIVE FINANCING MECHANISM

There are a number of ESCOs, offering innovative finance mechanisms that are filling in the gaps within the market of those unwilling or unable to access grant funding, blended financing or debt finance from commercial banks.

For access to an extensive database of ESCOs who are able to provide innovative financing, feel free to get into contact with GreenCape at energy@green-cape.co.za

CASE STUDY

SOLAR PPA

CONTEXT:

Helderberg College of Higher Education is a private higher education institution. Helderberg College opted for a grid-tied solar system in a bid to:

1.) reduce the monthly energy costs for the school; and

2.) contribute to a sustainable environment for its scholars to grow up in.

BUSINESS DETAILS:

Business name: Helderberg College

Location: Somerset West, Cape Town

Developer: Sosimple Energy

PPA provider: Sosimple Energy

System size (kW): 233 kWp

Electricity generated in a year:
373 300 kWh

Yearly electricity consumption:
373 300 kWh

Starting PPA rate: R0.86/kWh

PPA escalation per annum:
Inflation-linked - CPI = ~5%

Contract term length: 15 years

Municipal tariff:
R1.35/kWh – summer | R2.15/kWh – winter

Monthly savings:
R0.31/kWh – summer | R1.11/kWh – winter

(23% savings in summer | 50% in winter)

KEY INSIGHTS:

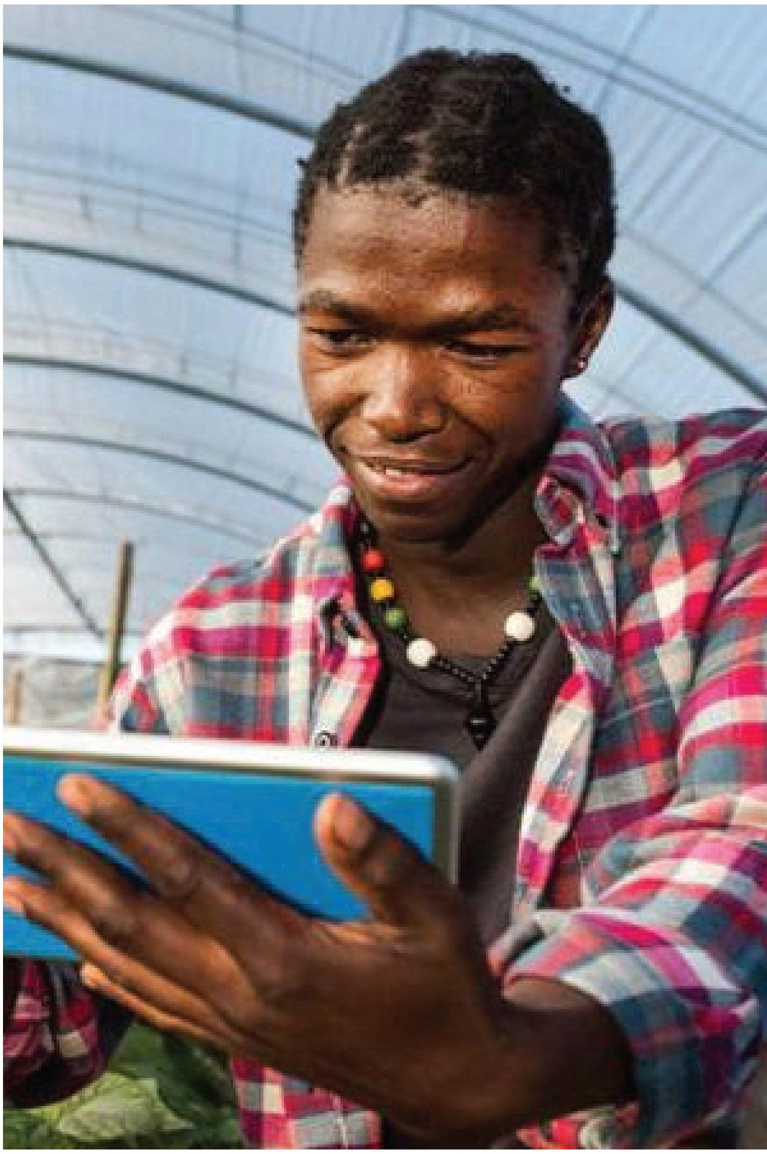
PPAs are a viable financing model for producers who do not want to take on financial burden and risk of performance of an alternative energy system.

However, the pool of ESCOs which are able to provide this service is still relatively small.

3.4.5. TAX INCENTIVES

There are five renewable energy incentives one could take advantage of, namely:

1. Section 12B – There is an increased allowance of 125% of the cost of qualifying investments in the first year the asset is first brought into use. There is no limitation of the maximum allowance claimed.
2. Section 12L – Section 12L provides as a deduction, in determining the taxable income of a taxpayer, an amount in respect of energy efficiency savings. The deduction will be calculated at 95c/kWh of energy efficiency savings and has to be measured and confirmed by an institution, boards or body as prescribed by regulation. It must be noted that one must make an initial investment of measuring energy before implementing any energy efficiency interventions. This required investment means that this tax incentive is more effective when one anticipates energy savings over 30%.
3. Tax rebate for private households – Private households can claim a 25% rebate on the cost of PV solar panels, up to R15 000 per individual.
4. Section 12U – Section 12U provides capital allowances for roads and fencing used in the generation of electricity greater than 5mW from wind, solar, hydropower or biomass, comprising of organic wastes, landfill gas or plant material.
5. Section 37B – Section 37B provides for an allowance regarding the cost incurred in acquiring a new and unused environmental treatment and recycling asset or environmental waste disposal asset used in the context of manufacturing.



Clean forms of energy, such as solar, wind, and hydropower, are both successful and readily available, yet investment in them has fluctuated. The affordability, ease of availability and technological maturity of oil in some regions has contributed to the slow uptake of investment in renewable energy projects.

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Western Cape Government
FOR YOU
Agriculture

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