

An aerial photograph of a farm. In the foreground, a large, light-colored building has a roof completely covered with a grid of blue solar panels. To the left of this building is a smaller structure with a red roof. In the background, there are several other buildings, including a large one with a green roof and another with a white roof. The farm is surrounded by fields, some of which appear to be vineyards or orchards. A road curves through the property. The overall scene is a rural, agricultural setting.

# GreenSparks

Solar Power



## Why Go Solar?

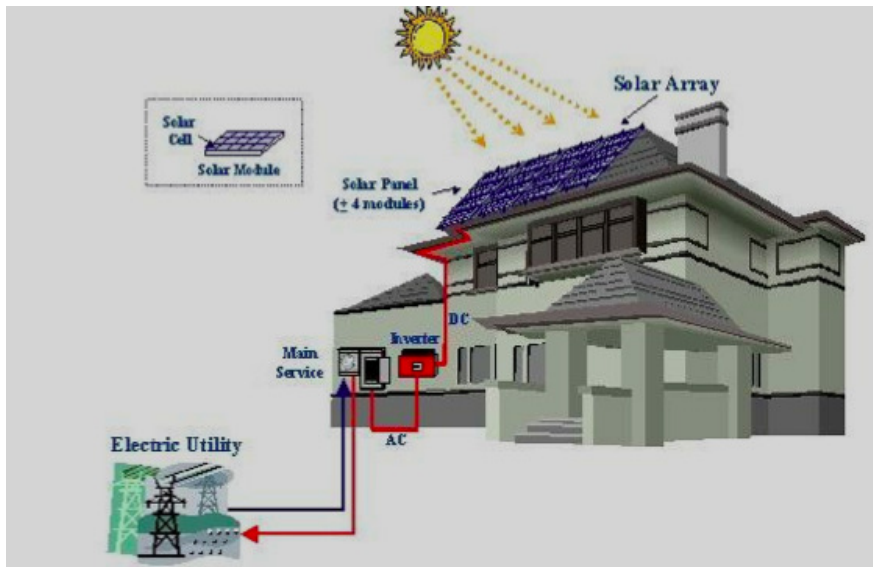
No more down time from ZESA  
Long-term financial saving  
No noisy generator  
The 'feel-good factor' of going *Green*

## The benefits of solar electricity

- ✓ *Energy security and independence:* have power when you want it and maintain a great lifestyle. Why should you suffer from continual power-cuts?
- ✓ *Cut your electricity bills:* sunlight is free, so once you've paid for the initial installation your electricity costs will be significantly reduced.
- ✓ *Send electricity back to the grid:* if your system is producing more electricity than you need we can grid-tie you so that any surplus is fed back to the grid to further reduce your utility bill.
- ✓ *Reduce your carbon footprint:* solar electricity is green renewable energy and doesn't release any harmful carbon dioxide [CO<sub>2</sub>] or other pollutants. A typical home solar photovoltaic [PV] system can save over a tonne of CO<sub>2</sub> per year - more than 30 tonnes over its lifetime.

In today's world, as everyone knows, energy is becoming a very expensive commodity. Energy

## 2. What is Solar Power?



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Photovoltaic [PV] systems consist of photovoltaic cells - that convert light energy into DC electricity - in panels and solar inverters that convert the DC electricity to AC. Because the source of light is the sun, the panels are commonly known as solar panels.

The word photovoltaic comes from "photo", meaning light, and "voltaic", which refers to producing electricity. Therefore, the photovoltaic, or PV as it is commonly referred to, process "produces electricity directly from sunlight".

Solar power offers consumers the ability to generate electricity in a clean, quiet and reliable way.

PV systems are being installed by those who:

- ❖ *do not have access to grid electricity;*
- ❖ *already have grid-supplied electricity, but due to frequent power cuts want to be independent of mains electricity;*
- ❖ *want to reduce the cost of their power requirements; or*
- ❖ *are concerned about the environment.*

When applications require larger amounts of electricity and are located away from existing power lines, PV systems in many cases offer the least expensive and most viable option.

Solar PV is really gaining popularity around the world now that efficient solar panels have become cost effective - in use today on streetlights, traffic lights, gate openers, borehole pumps, etc.

In Southern Africa, most alternative power solutions are prompted by a lack of grid-supplied electricity. In South Africa, ESKOM is increasing its tariffs by 30% pa. Zimbabwe will not be able to sustain its sub-economic mains electricity and will ultimately have to significantly increase tariffs as well.

Therefore, here at **GreenSparks** we recommend all businesses, dependent on power, at least augment their electricity supply with Solar PV - to not only ensure their energy security and comfort, but to also reduce their dependency on the power utility supplier and therefore obviate the need for what will become a very expensive commodity in the future.

## 3. Costs

Every customer has different requirements; there is no 'standard' or 'kit' system suitable for everyone. Therefore, to establish the cost of the correct system for you requires that a:

- *building survey,*
- *power consumption audit, and*
- *design and cost analysis;*

be carried out by a qualified solar electrical engineer, who will ascertain your exact requirements. This specialist time will be charged for, but we can give you a basic price guide first to establish if a PV solar system will be affordable and cost effective to you.

Capital payback period [ROI] – this will be advised after your PV system has been designed, but typically it ranges from 5 - 10 years, thereafter your solar electricity is for free. Not to mention the financial and hidden losses currently experienced in your business due to unproductive downtime hours.

ROI will depend on many factors – principally your mains power usage and the cost of your generator running hours during power outages.

For the purpose of establishing whether a Solar Power System is affordable to you – you can use our "rule of thumb" principals on this page as a guide.

Establish the peak kW (power consumption) and the total energy in kWh you expect to use per day.

- Explanation peak kW: this means the total kW you are using when all your major appliances are switched on at the same time. You should add about 25% to cater for inrush current e.g. when the fridge, washing machine, pool motor, lawnmower, etc. switches on.
- Explanation of kWh: kWh is a measurement of the electricity you use and is the same as the consumption in units on your electricity bill.

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To establish your power consumption you can check your electricity bills over the last twelve months, adjust for load shedding and then add all kWh together and divide by 365 days. This will give you the average daily electricity use in kWh. To estimate the cost of the required solar installation you must now approximate the size of the required Solar PV array, as follows:

$PV\ kW = av.\ daily\ kWh\ divided\ by\ 4.7h.$

Note: unless you are off-grid or want to be totally independent of mains power, you don't have to have your entire power consumption produced by solar. You can have solar complement your power requirements, enabling you to fall into a lower tariff bracket. However, we recommend providing for maximum PV coverage, as over the lifetime of the installation, that will give you the greatest return on your investment. Should your budget dictate otherwise, then you must decide what non-essential items can be left out of the solar solution, e.g. geysers, borehole pump, swimming pool, etc. As these 'non-essential' loads are typically heavy loads, the cost reduction can be significant.

As a rough guideline a solar installation will typically cost:

- 1 - 10 kW installed: +- \$7 - \$9 / Watt (Grid-Tie)
- 10 - 100 kW installed: +- \$6 - \$7 / Watt (Grid-Tie)
- 100 kW - 1 MW installed: +- \$5 - \$6 / Watt (Grid-Tie)
- 70kW - 1MW installed PV power plants, without energy storage, +- \$2 - \$3 / Watt.

Therefore, on a medium sized property (200m<sup>2</sup>) this cost will probably range between \$6 000 - \$15 000; on a large property (400m<sup>2</sup>) \$8 000 - \$25 000. This is dependent on many factors – your location, solar profile, direction your roof faces, azimuth and zenith angles, size of solar panel array, appliances you want covered, amount of battery backup time desired, etc., hence why we recommend having a professional survey.

Should you now decide that solar is for you, we will carry out a survey, professionally design your system and provide a detailed quotation.

## 4. Solar PV Panels



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*Design* - We only supply top of the range panels from leading brands. This is significant as they utilise high-output technology in the polycrystalline cell structure, resulting in higher efficiencies and durability.

*Roof load* - The monolithic construction of tempered glass, EVA and back sheet keeps its weight to a minimum - less than 12kg/m<sup>2</sup>. The reinforced 50 mm aluminium frame makes handling easy and allows for quick and simple assembly. These panel modules can withstand heavy loads up to 5400 Pa.

*Weatherproof* - The laminate guarantees total watertightness and long-term protection of the cells. Each module is subject to an individual quality control process and every cell is individually measured and sorted before the encapsulation stage.

If your budget allows, start with enough solar modules required to do the job, since this is where most of your power originates. Otherwise, perhaps start with half or a third of the panels and add the rest in subsequent years. This will help avoid battery problems and save many generator hours. Our systems are modular, such that you will be able to add more solar modules as needs dictate or finances permit. Consider your long-term objective when making these decisions.

*We design our systems so that future PV panels can be added one at a time as the need arises.*



Aluminium mounting system - neat corrosion free mounting that does not cause galvanic reaction with the aluminium frames of the panels. The frames are lockable with a ball bearing making removal almost impossible.

### Caution:

The PV panels have rear mounting holes that make roof mounting very difficult without the proper mounting system. Many solar installation companies make their own welded angle iron frames, which are unsightly and will rust - damaging the solar panels – we do not accept this practice. We have also seen PVC electrical wire used in direct sunlight – this wire will cause failure of the system as sunlight breaks down the insulation. This is why we use the same [solar cable](#) used in PV power stations worldwide.

Sunshine is free

Southern Africa has one of the best solar irradiation profiles

## 5. Solar Inverter

Aesthetically pleasing design brushed aluminium waterproof IP65 case.  
Robust construction for increased reliability.  
Extremely simple user interface.

### What are solar inverters?

Solar inverters turn the DC electricity, produced by solar panels, into 220V AC electricity necessary to run your appliances. These are not to be confused with controllers or chargers, which can only charge batteries from solar panels.

Solar inverters that produce AC are called grid-tied inverters. This type of inverter can only produce AC power if there is AC mains present. The PV inverters we supply have maximum power point tracking [MPPT], which, like a gearbox in a car, allows the PV panels to operate at their maximum efficiency. Without the MPPT feature, a lot of your potential PV energy will be lost. Imagine a car that only had a 1<sup>st</sup> gear!

PV controllers that produce DC generally charge battery banks. This harvested DC energy can then be used to power loads through the use of an inverter. Once the battery bank is fully charged and the inverter load has dropped down to a lower level, the potential PV panel energy is lost as there is nowhere for the energy to be used. However, if the inverter has grid-tie technology then it can send excess energy into the utility grid, slowing down or even reversing your electricity meter.



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Dimensions: WxDxH 353x182x605mm

Mass: 28kg

Power at 1500m altitude: 3492W

Low THD, pure sine wave output.

Robust construction for increased reliability.

Extremely simple user interface.

Wall mounted.

Aesthetically pleasing design - brushed aluminium waterproof IP65 case.

Easy of use.

Grid-tie solar inverter – exports solar energy onto the AC mains line.

Electronic overload and short circuit protection.

Transformer-free, noiseless design – also needs no cooling fans.

European efficiency rating: > 97%.

MPPT rating: >99%.

Perfect protection function.

GS4K grid-connected PV inverter is a single-phase string inverter, specially designed for PV power stations. It is highly efficient and reliable, with a compact design for neat installation.

Warranties: 2 years.

Designed life span: 25years.

## 6. Battery Back-up Power

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Typically, there will be need for a back-up battery bank to ensure continuous power supply during mains power outages. The size of the battery bank will depend on many factors – including consumer loads, expected load shedding regimes and cost.

The total system will be designed for optimal cost verses benefit.

We recommend Trojan batteries – built in the USA – with an expected life span of 10 years. Due to the high number of recharge cycles expected in systems installed in Africa we specify open lead-acid batteries as these handle this repetition better than maintenance free batteries.

Trojan's Industrial line of deep-cycle batteries is the newest addition to Trojan's lineage of high-quality flooded batteries. The Industrial line is engineered specifically to support renewable energy systems that require large daily loads where the batteries are cycled regularly. These high amp-hour capacity batteries are ideal for use in large off-grid photovoltaic (PV) systems, off-grid hybrid PV systems, grid-tied PV systems with battery backup, smart grid peak shifting systems and a variety of other applications. Tested to meet industry standards, the Industrial line features advanced battery technologies that deliver reliable power and is housed in a dual container construction for enhanced battery protection. Trojan's Industrial line is the perfect combination of performance and function.

*We check and maintain the batteries every 3 months to ensure your hassle free enjoyment of off-grid power.*

### Clean Energy for Life™

Trojan Battery Celebrates 85 Years of Providing Clean Power to the World.

With over 85 years of experience, Trojan Battery Company is the world's leading manufacturer of advanced deep-cycle battery technology

Long-lasting, reliable and clean, customers all over the globe know Trojan deep-cycle batteries deliver superior power to any renewable energy application.

Choose the best deep-cycle battery in the market - Trojan Battery...



*Trojan's Industrial line is the perfect combination of performance and function.*

## 7. Backup Battery Inverter



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Like the Solar Inverter, this inverter converts DC electricity from the battery bank to AC electricity and supplies it into your AC network.

Inverters, manufactured by MLT Drives, are designed and built in Africa with 'Africa' in mind. We have over the years been an integral part of their development in both their design and build. They are exported worldwide and we have successfully installed them in the USA as well as throughout Africa.

These inverters ensure that quality power to the load is maintained at all times, even when mains power is available. If renewable energy sources, such as PV, are available, power is first drawn from these sources before using mains or battery power. When no renewable energy is available, the load is powered by the mains grid supply with the inverter used to maintain the load voltage at its nominal value - even if the grid voltage varies (tolerance 150v – 280v).

It is not unusual to experience daily power cuts in many Africa countries. Sometimes these last for several hours at a time. It is essential therefore; that your inverter is capable of recharging batteries quickly when power becomes available again.

MLT inverters can recharge a one tonne battery bank from flat to full in 5 hours and also intelligently maintain and condition the batteries to keep them in top condition.

The system provides input for two AC sources so in addition to your grid supply a generator can be connected for backup. This generator can be auto-started when the batteries are low or demand requires it, or after a predetermined time. Generators are at their most efficient when running at 80% capacity. The inverters we supply capitalise on this and adjust their battery charge rate so that the generator runs at its optimum efficiency. AC sources can also be used to supplement the inverter when bigger loads need to be powered, making the system fully customisable.

We also offer intelligent control systems for industry, to allow multiple alternative energy sources to be integrated, e.g. synchronising multiple existing generators, whether stand-alone or to optimise grid-connected or off-grid systems.



*These inverters have been designed to power difficult loads like deep freezers.*



# 8. Installation

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GreenSparks installs all the equipment perfectly and with care.

We handle all of the following:

- *Distribution box wiring and modification, house wiring, supply of an electrician if any problems are found with the existing electrical reticulation.*
- *Battery housing in cabinets or custom rooms that are designed professionally – hydrogen is kept to a safe level, doors are padlocked and the batteries are kept cool.*
- *Labels, safety signs and warnings are provided.*
- *A manual documenting the system operation principles and care instructions is provided.*
- *Inspection and photo document of the key parts of the installation are made for future reference.*
- *Solar panels are treated with care and installed using the manufacturer's specified mountings, wires and connectors.*
- *Our systems are fully demountable – so should you be moving home or business at some future date, we can move your Solar power system with you.*

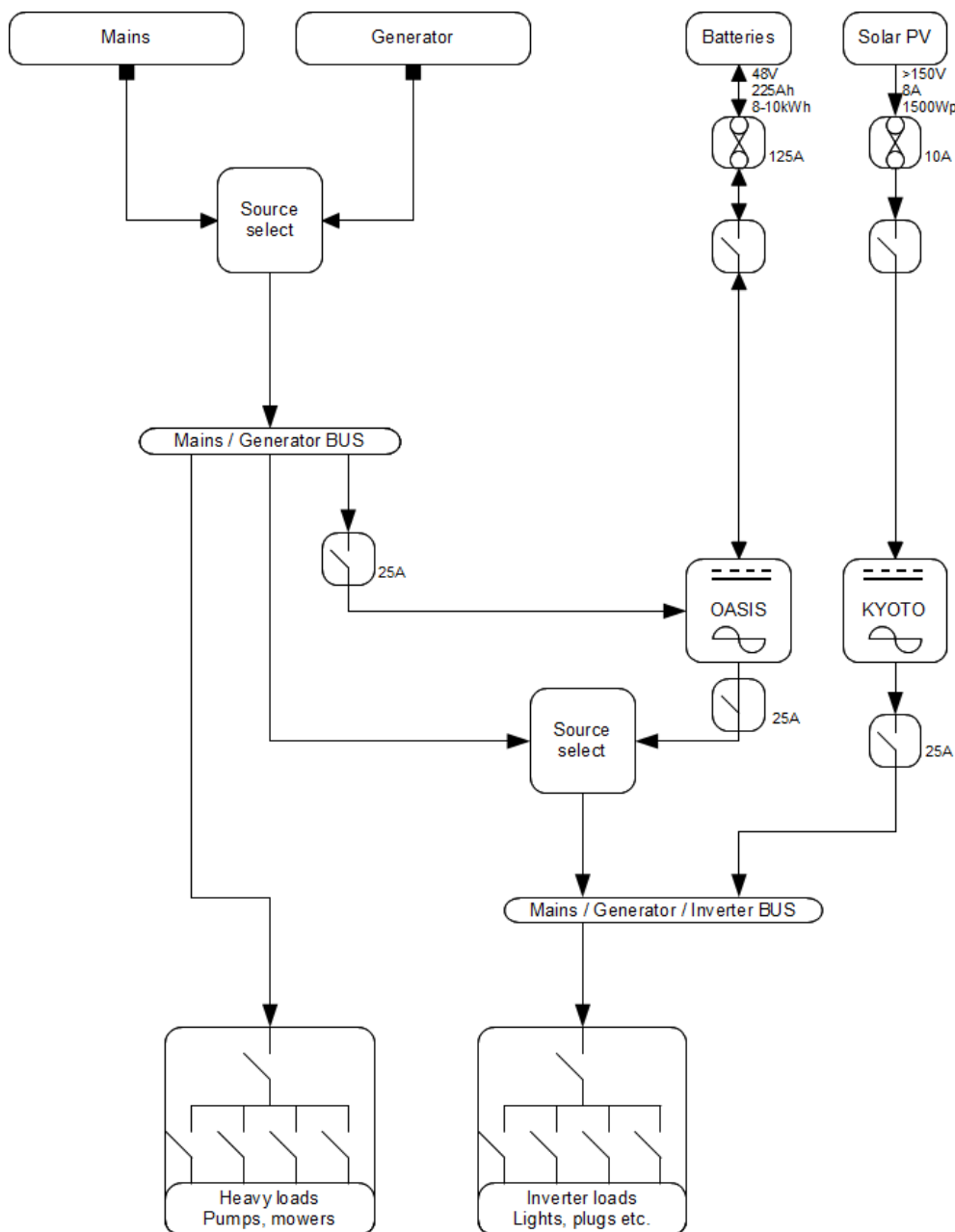


Custom Designed Solar Power Systems to Meet Your Needs

# 9. System Diagram

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Typical home/office system



A typical system diagrammatic that we provide for the customer is shown on the left.

With this drawing, the system can be easily understood by anyone who has to work on the system.

We carefully design all our systems so that important parts can be isolated and bypassed, if needed, without disrupting the power supply. Thus avoiding customer downtime.



**USA - the first prototype GPI inverter**

Designer and builder, standing proud, next to the first prototype 200kVA inverter. In the second quarter of 2012 this inverter was relocated to and commissioned in California.



**Lucingweni - rural electrification battery room**

Large battery rooms are constructed to protect batteries from the elements and in large installations to prevent people from being killed by high voltages. With large battery installations comes large voltages and like any mains power supply this is potentially dangerous. Huge battery rooms that run the likes of factories, entire villages, hospitals and hotels can have voltages up to 480V. These rooms must be designed by experienced solar engineers like **GreenSparks**.



**140kW grid-tied solar inverter system – Villiera Winery, Cape Town**

This inverter system was designed and installed by Neil Bradshaw (founder of **GreenSparks**) in 2010 and has had more than 99.9% uptime since it was commissioned. The system sends a service report once a week via SMS and can be controlled remotely. There are two 70kVA solar inverters and more than 580 solar panels configured in a high voltage DC layout to achieve optimum efficiency. The system often produces more power than the farm uses and the excess power is fed back into the Eskom grid from which it is recovered again at night time.



**GPI 480-201 250kVA inverters being packed to fly to Montana, USA**

Stock inverters are transported from the MLT factory and warehouse in South Africa all over the world. **GreenSparks** founder – Neil Bradshaw - watches over the packing process as the inverter weighs several tonnes and represents a significant investment.



**Off-grid installations have been done all over Africa using MLT's excellent inverters and panels**

Be it a remote lodge or farm building, **GreenSparks** will always provide and install high quality and reliable power equipment.



  
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