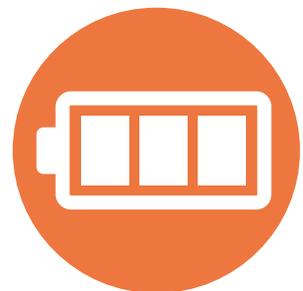




# SegenSolar Commercial Guide 2018



## Why SegenSolar?

- Wide portfolio of products ideal for commercial projects: in stock today.
- Commercial PV packages available.
- Project pricing available subject to status: speak to your account manager for information.
- We're experts in logistics: just tell us where and when.
- Comprehensive online designer tool to assist in purchasing your system.
- Check stock availability, place and track orders on-line.
- Create quotes for your customers with your logo, margin and payment terms on.
- Dedicated SegenSolar team on hand to help with pre and post sales technical support.

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## Introduction

Welcome to the second edition of the SegenSolar (Pty) Ltd Commercial Scale PV Projects Guide. The construction and operation of commercial scale solar PV systems rely on significant investment, with many things determining the success of the project and the performance of the PV array.

As a large supplier of complete solar PV systems, we offer a full range of products for commercial scale PV systems in the 10kWp - 1MWp range. This guide will help you understand the product aspects of commercial-scale solar PV, making it easier for you to design, specify and purchase a system from our extensive stock of market-leading brands.

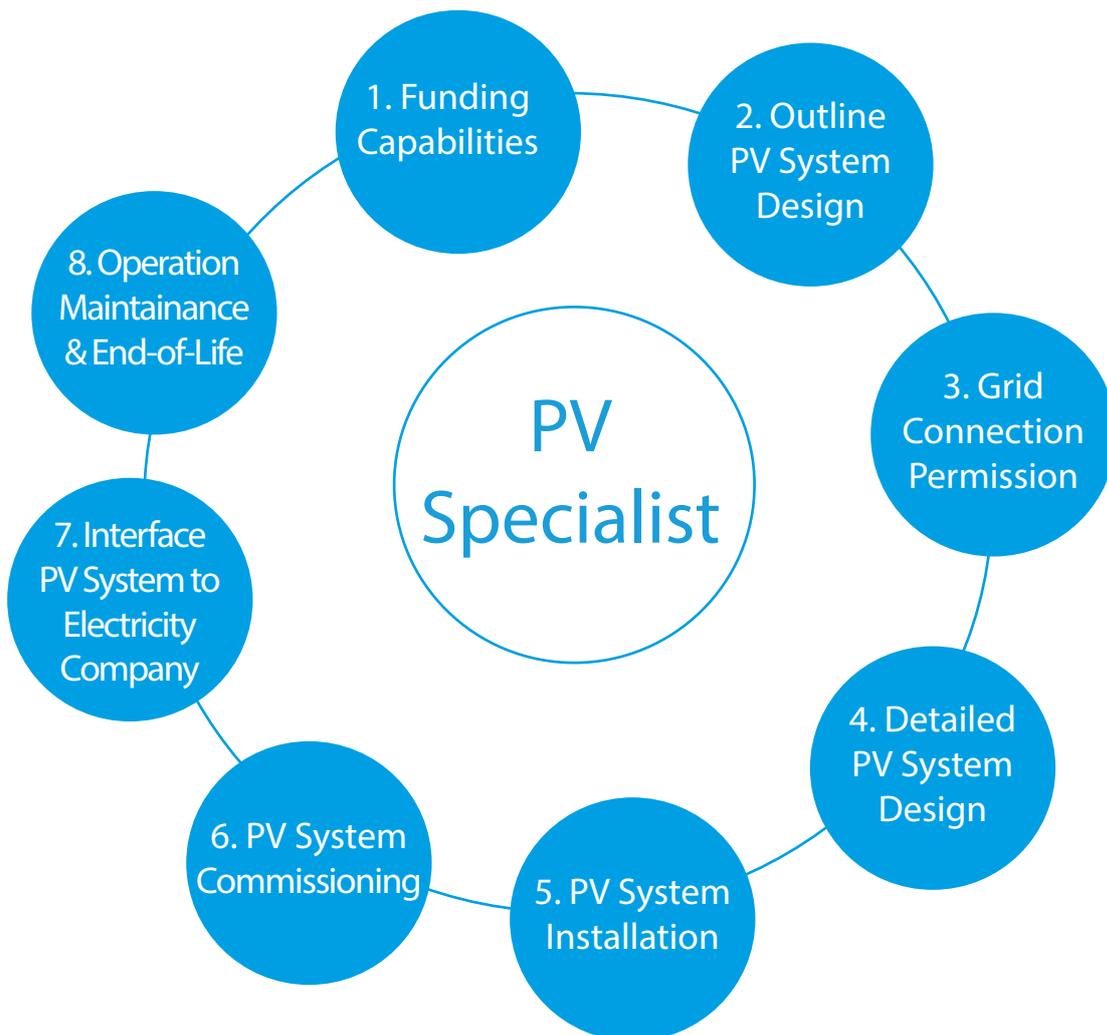
The guide also provides recommended processes for early recognition of projects that will not develop to application stage, by avoiding common mistakes such as late identification of unfeasibility, lack of funding or support and NRS 097 non-compliance.

For further details contact your account manager or call us on 087803 20663.

*Andy Pegg, CEO.*



A typical project cycle for a commercial scale installation should take into account all aspects from the start of the project through to the operation. Below is an example:



When taking on any commercial scale PV projects, regardless of the area of application, there is a basic 8 point plan that should be followed in order to avoid common pitfalls.

## 1. Feasibility Analysis

The first step towards the development of a technically and financially sound solar PV installation is the feasibility study.

Your client should have collated the relevant information and have it available for you to out-line the system design.

Information that should be made available to you should include:

**Site selection:**

Orientation, location, grid utility presence, land/roof, size, system size etc.

**Technical Surveys:**

Geographical information, site dimension, i, supporting images

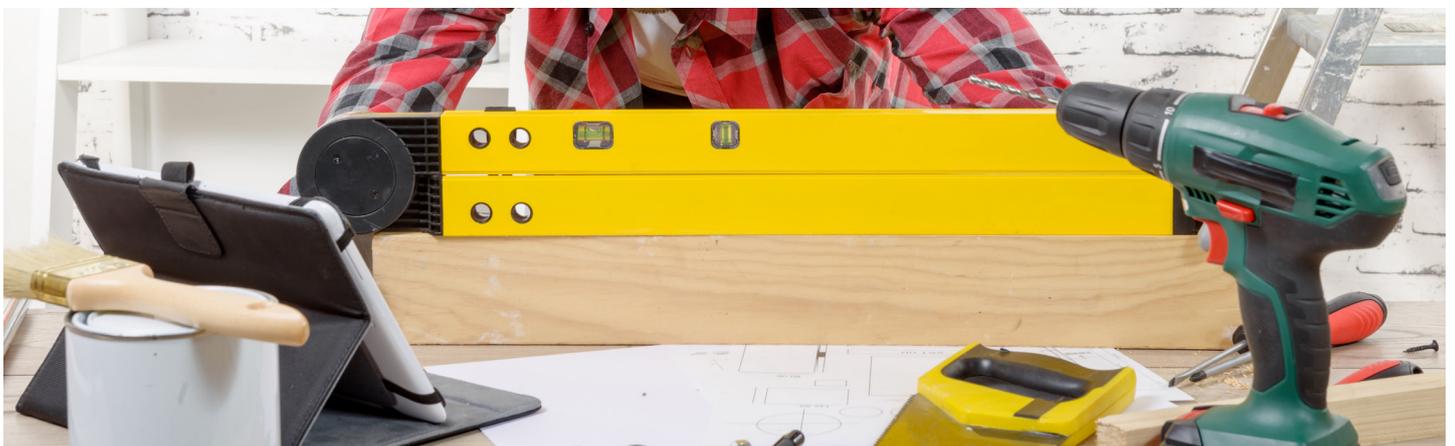
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## 2. Outline PV System Design

Ensure you understand your customer's expectations of the system. What are the most important factors to them? Best price, output, warranty cover, Tier 1 suppliers?

Once you have the information from the feasibility analysis, you can design the most appropriate systems taking into account site suitability, specific products (modules, inverters, mounting, cable, monitoring), minimising electrical losses and the requirements of the local utility for connection. You will then present your customer with the estimated system output under variable weather conditions so they are able to develop a business plan. Be prepared to explain your products choices, especially when being competitive.

The client may choose not to progress with the project or decide to use an alternative installer. Also consider that costs and product availability may alter, any quotes you provide should reflect this.



## 3. Business Plan

Based on your feedback of approximate system output, your customer should complete the business plan to confirm the project will progress, taking into account the estimated ROI.

It will be at this stage that the customer should also give you full details of how the project will be financed.

You must ensure that you are able to complete the project based on the finance available and arrange any additional enhancing that you may require in advance. Financing is one of the most frequent obstacles to the progression of an installation and yet it is often not approached until near the end of the project, wasting time and money of installer and client.

## 4. Complete PV System Design

Once you are contracted to complete the work (on provision of agreed planning), the design and specification of the PV system should be finalised. Ensure that the final design, cost and timeline meet the requirements of the customer and are suitable for the building or land where it will be installed.

At this stage you should have an idea of your preferred supplier, taking into account product availability and timeframe. It is also recommended that you finalise any long term monitoring and maintenance requirements with your customer.

## 5. Grid Permission

Does the project have the relevant grid permissions?

Is the PV array going to be connected to the National Grid?

Eskom and your local municipality will need to be notified of the project well in advance so that any local network constraints can be identified and upgrade works agreed or alternative arrangements discussed.



## 6. Confirm Suppliers/Products

### A: Finalise your supplier

Who can support your business/installation?

Trusted/long term relationship. Will they still be around in 10 years?

Product variation, stock availability, lead times, price

### B: Finalise your products

What products are best suited to the system?

Certificates available?

SMSL status on PV module?

Bankability on PV inverter?

Warranty?

You need to be aware of suppliers' time frame which may often depend on the size of the project and other market influencers. Log on to the SegenSolar Portal to find a list of the most relevant products for commercial scale installations, with future in bound stock dates.

## 7. Installation & Commissioning

Ensure you complete and share with the customer the construction and build sequence, including proposed time frames and any potential delays. This should include:

Site preparation

Rail mounting

Module installation

Wiring

Testing and commissioning

Testing and commissioning should include: Interfacing PV to electrical company, permission to connect and commissioning of monitoring equipment.

Finally there should be a full handover of the PV system to the customer, including all documentation.



## 8. PV Operation & Maintenance

It is likely you will have discussed a long term maintenance contract for the installation and agreed on a monitoring system. You should also discuss and document the options for end-of-life of the installation. Will the system be allowed to run after 25 years or will it need to be decommissioned? Will you look after the recycling options (PV cycle association)?

By looking at and identifying the full lifecycle of the project you can build long term relationships and maintenance contracts with your customers.



## Rules of Design:

When deciding on which modules and inverters to use for any large scale PV system, it is important to understand the basic rules of designing a larger system.

The electrical principles of any PV system from a single string of a small number of modules up to a multi-megawatt industrial scale PV plant, are similar, it is just the quantities and types of components that vary.



Where three or more strings are wired in parallel, either in a DC junction box or internal to the inverter it is essential that each string has its own string fuses, on both polarities. This will avoid reverse currents destroying modules in the event of a short circuit. These string fuses would typically be inside the inverter or in the DC junction box, depending on the manufacturer and inverter model chosen.

With any commercial scale system, serious consideration must be given to remote monitoring. This will ensure performance issues will be identified immediately. It also makes it easier for you to offer an O&M contract as part of your service.

Consider offering your customer an extended warranty for the inverter(s). Inverters are the most complex and expensive part of any install and being able to ensure your customer's system will continue to run for the entire length of the design life is important for achieving the ROI you've calculated for them. The SegenSolar portal shows which warranty durations are available for each inverter and allows you to easily add them to your quotes.

## NRS 097-2-1-2017

NRS 097-2-1-2017 is the name of the South African grid standard governing Small Scale Embedded Generation connected to low voltage networks. It covers both single and three-phase installations. Any inverter product being connected to a low voltage network grid must be certified to the NRS 097-2-1-2017 standards.

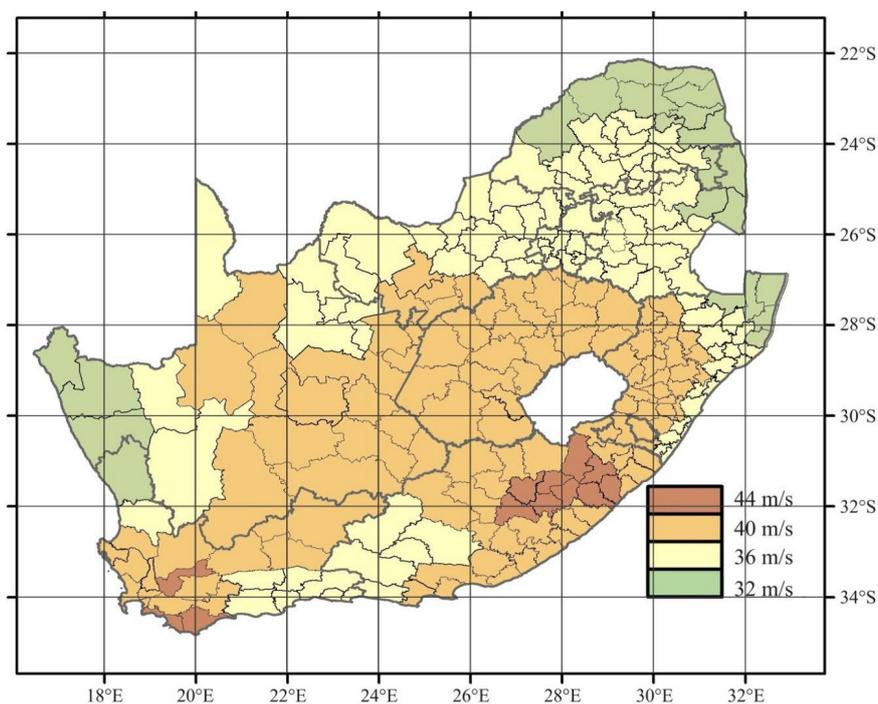
You can find inverter grid certificates on the inverter product pages. SegenSolar has a range of power management and export limitation products that allow instant constraint of inverter production to whatever the site export limit may

## Structural Considerations

**Roof Strength** - A commercial PV system is heavy and the roof must be strong enough to take its weight. It is important to ensure that the existing structure is able to carry the load of the panels, which will need to be checked by a structural engineer and proof supplied. In cases where strength work needs to be carried out, this can add significant cost and time to the overall installation project plan.

**Windloading** - PV arrays should be designed to withstand wind-forces as prescribed in building codes. However, there is a significant challenge in applying existing codes to commercial and industrial roof-mounted PV arrays. Wind loads (and uplift) vary by wind speed, location, orientation, pitch, positioning of panels etc, so full calculations should be completed on every commercial scale project. Flat roof mountings in particular, require careful consideration to wind loading issues when designing the system.

SegenSolar's design tool has windloading calculations for pitched roofs built in, telling you exactly how many roof anchors are required for your particular installation. The total weight of the on-roof components are also calculated for you, making it easy to give your structural engineer all the information they need to determine if the roof can take the increased loads.



When selecting modules for a commercial scale project, there are a number of criteria that need to be taken into consideration:

**Bankability** - This is the key element to get financing from banks and financial institutions for commercial scale projects. Systems being funded by a third-party will need to use panel manufacturers that meet the funder's requirements of being a SMSL (Silicon Module Super League) manufacturer.

**Efficiency** – When space for the number of PV modules to be installed is limited, a more efficient module allows a larger capacity system to be installed.

**Price** – When comparing costs of systems, you must avoid simply looking at the RWp, instead look at R/kWh/ annum, including the cost of the mounting system and installation, both of which increase with decreasing module efficiency.

**Warranties** – Different manufacturers offer different lengths and strengths of warranties. For commercial scale installs, longer term warranties are advisable for peace of mind.

SegenSolar supplies a number of modules suitable for commercial systems, The choice of brand depends on your client's requirements, which can range from the lowest cost module available.

SegenSolar currently stocks a wide range of commercial poly modules rated from 275W to 355W. For a full overview of the current cost and stock levels of relevant commercial modules go to; <https://portal.segensolar.co.za/nav/pv/Module/-market-commercial>



## Inverter Types

In recent years, the solar industry has seen radical changes in the inverter space. SegenSolar offers a selection of inverter sizes suitable for commercial scale applications, allowing almost any size system to be configured using a selection of rated outputs from a number of different manufacturers.

**There are two different categories of inverters suitable for mid-range commercial scale systems:**

**String Inverters** – Typically three phase inverters ranging from 6kW – 50kW supporting a small number of strings per inverter. For many sizes of system, one or more string inverters will provide good annual yields and system up time assurance, but can be limited in their flexibility of string design and siting. String inverter systems can be easier to design and install, but careful consideration needs to be given to linking the inverters to allow effective fault reporting and setting up communication.

**Power Optimised** – Developed to maximise the energy harvest, arrays using power optimisers have an individual optimiser per module, some of which are linked into one or more three phase inverters, each in turn wired together on the AC side. A power optimiser system will have a higher initial cost but if the requirement is to maximise the yield and minimise the total cost of ownership over the life time of the system then both deserve serious consideration, especially if there are any issues with shading or different array sizes.

## Inverter Warranties

Key to the total price of a system is the cost of any extended warranty. Many commercial scale funded systems will require a minimum 10 year – maximum 20 year warranty.

If a long term extended warranty is required, then the cost can be substantial and in some cases buying an inverter with a longer “out of the box” warranty can be cheaper.

The table below details the standard warranty provided by each SegenSolar supplied three-phase manufacturer and warranty extensions available.

| Manufacturer | Standard Warranty | Up to 10 years | Up to 15 years | Up to 20 years |
|--------------|-------------------|----------------|----------------|----------------|
| ABB          | 5 years           | ✓              |                |                |
| Huawei       | 5 years           | ✓              | ✓              | ✓              |
| SolarEdge    | 12 years          | ✓              | ✓              | ✓              |
| Solis        | 5 years           | ✓              | ✓              | ✓              |
| SMA          | 5 years           | ✓              | ✓              | ✓              |

## String Inverters

A commercial scale system designed using string inverters will usually consist of one or more three phase inverters between 6kW - 70kW (potentially different sizes in the same array), with two or more strings into each and linked together on the AC side.

SegenSolar offers three phase string inverters from five different manufacturers each, offering a variety of rating, MPP trackers, monitoring, protection, warranties and performance options. Each string inverter operates independently of the others, controlling between two and eight strings of modules and producing AC power which can be exported, or just used on site.

Whilst it is possible to design a large system with numerous smaller single phase inverters this is unlikely to be a cost effective solution and therefore not generally recommended by SegenSolar.

## String Inverters Manufacturer



Ginlong Solis inverters are compact and light weight with IP65 enclosures for outdoor installations virtually at any sites. The high quality and reasonable price make it a great investment.

Solis is ranked in the Top 10 for Global PV Inverter Market Shares (by Shipments). The bankable and reliable Solis inverter is listed on the Approved Vendor List (AVL) of top US third-party owned solar integrators Sunrun.

The larger Solis three-phase range is ideally suited to the Southern African market with quad tracker products ranging from 20kW up to 60kW to enable any size of commercial system to be cost-effectively designed.

Solis also sell a 70kW High Voltage inverter which SegenSolar can supply on a project specific basis for direct connection to an on-site transformer.

Solis inverters have an industry leading low failure rate of 0,5% measured over the more than one million sold and installed worldwide.





The Huawei FusionSolar Smart PV division specialises in production of their SUN2000 commercial PV string inverter range and shot to the World's number 1 commercial inverter manufacturer by shipment deployed in 2015 and firmly held the number 1 position in 2016 and 2017.

Huawei offers a full range of commercial 3 phase inverters, form 8kW to 50kW (low voltage) and 65kW to 100kW (for connection to a medium voltage grid) with full compliance to South Africa's grid standards.

## Some of the key selling points of the Huawei String inverters are:

- Bankability: revenue over \$90bn.
- Flexible Design: 2 MPPT to 6 MPPT.
- Wide MPPT voltage range: Increased yield.
- Reliability: Fan-less / no fuses.
- 100% Factory tested: All inverters are fully heat cycled post manufacturing.
- High Efficiency: Highest commercial inverter Euro efficiency of 98,5%.
- Integrated Surge Protection: AC and DC Type II surge protection.
- Rated: For use in hot African climates at high altitude
- String level monitoring: Providing fault diagnosis, alerts and reporting to improve yield.





SMA has a comprehensive commercial Tripower range; from small three phase 5kW to larger 50kW. All are packed with high-end features that ensure robustness, ease of installation and a long service life.

Multiple DC inputs are included with the inverters, increasing the design flexibility and eliminating the need for an external DC combiner box.

All Tripower inverters include Sunclix tool-free DC inputs that make it simple to connect everything up. Have electronic string protection, which offers reliable elimination of module reverse currents. This reduces the costs of DC cabling and fuses.

SMA inverters are fully IP65 compliant and every unit goes through stringent testing. This allows them to be installed outdoors if required. An optional software enabled feature called 'OptiTrac Global Peak' provides an alternative power-tracking algorithm optimised for partially shaded arrays.

SMA's built-in Webconnect functionality is built in, allowing easy connection to the SMA Sunny Portal. SegenSolar stocks the entire range of Tripowers, which have a weighted efficiency of up to 98.1% and are perfect for small to mid-sized commercial solar PV systems. The Tripower range has an impressively wide voltage range, which allows flexible string design even on complex roof areas, or optimising cable runs.

SMA's focus on sleek design and aesthetics led the way in the solar industry.



## solar**edge**

The SolarEdge commercial inverters (15kWp and above) are specially designed to work with dual optimisers, and are highly efficient (98% max.), lightweight and easy to install.

There is a greater flexibility to the number or mixture of optimiser and inverter components that can be used in a SolarEdge system and. The architecture provides a lot of freedom as to the number of modules in each string and linked into each inverter, so multiple different sizes of arrays and shading environments can easily be supported.

The SolarEdge system has internet based monitoring built-in, so there are no additional items needed for module-level performance data to be provided.

You can use all the unique functionality of SolarEdge to enhance any installation and reduce time spent on site fault finding. Offer your customer a maintenance contract to ensure maximum performance ratio for their system.



ABB's three phase range of string inverters extends from 7.5kWp to 33.0kWp.

Their inverters have long been a dependable workhorse and are a familiar sight in medium-sized commercial installations across the world.

All three-phase ABB inverters supplied by SegenSolar have built-in DC isolators and string fuses. The largest units, rated at above 20kW also have built-in string monitoring, AC isolators and surge protection, further reducing the costs and complexities of the install.



All ABB three phase inverters have an optimised power point tracking function to ensure maximum yield from partially shaded arrays.

A standard ABB system therefore requires no additional components; the module strings are wired directly into the inverter and on the AC side the inverter is wired directly into the grid connection, with only the 10kW and 12.5kW models requiring an external AC isolator.



Commercial systems usually require significant investment, so it's especially important to ensure that they are performing as they should be. Most PV systems are now connected to some form of monitoring system, either locally in the building on a display screen; or, more commonly, remotely to the Internet.

SegenSolar's range of inverters can be connected easily to the Internet. Here is a quick summary of the products or procedure involved in each case.

## **Solis**

The online Solis monitoring portal helps spot problems immediately.

With real-time monitoring, the owner knows the moment panels have an issue. Installers can quickly pinpoint which part of the solar array has stopped producing, and a technician can come out and fix the issue quickly making sure the owner does not miss out on any electricity gain. Real-time production tracking minimizes downtime, saving money over the life of the system. Tracking software shows daily, monthly, and annual savings at any time.

## **Huawei**

The Huawei NetEco cloud platform allows monitoring of connected solar PV plants from anywhere in the world, supporting remote monitoring, plant performance and automatic alerts. NetEco is a free monitoring service that Huawei offers to its users.

Huawei Fusion Cloud service, available in South Africa, is a solution tailored for utility / large scale plants, with pricing determined on a project-by-project basis.

## **SMA**

Most of the SMA range has Webconnect interfaces built in, so it's a simple matter to connect a single inverter to an Internet source with a network cable.

The SMA Home Manager with Bluetooth collects performance data wirelessly from SMA inverters, stores it and transmits it via the Ethernet interface to the online website Sunny Portal. The Home Manager is very useful for installations with more than one inverter, or where hard wiring the connection is not practical. The SMA Cluster Controller is for large scale commercial installations with multiple SMA devices. Control a large PV installation from one small interface.

## **ABB**

The entire ABB range can be connected to an Internet source easily using the WiFi adaptor card. For sites with multiple inverters, it's also possible to daisy chain units together to get complete communication coverage using only one card.

## **SolarEdge**

SegenSolar offers SolarEdge power optimisers, which are installed one per module linked into one or more inverter units. This provides a high-availability solution with module level power optimisation and monitoring to maximise the long term yield with minimum cost of ownership.

There is greater flexibility to the number or combination of optimiser and inverter components that can be used in a SolarEdge system and the architecture provides freedom with the number of modules in each string linked into each inverter. Multiple sizes of arrays and shading environments are easily supported. SolarEdge inverters have internet-based monitoring built-in so there are no additional items needed for that to be provided.

## Why and when do we need export limitation?

Export limitation (or power management) is controlling the amount of power from a PV installation that is exported to the grid. It is common for there to be some restriction to the amount of power that can be exported to the grid. This could be because of physical limitations of cables or transformers, or because of pending regulations. Whatever the reason, controlling the power production can be the solution, when previously the only options were to reduce the size of the system, consider complication bespoke solutions, or walk away.

Export limitation is more advanced than simply clamping the output of inverters. It is a reactive solution that constantly monitors the energy consumption on site, and only limits the power production if the amount being exported to the grid exceeds whatever the limit is. That means if the demand on site is high, the inverters can be allowed to work to their full potential, maximising the benefit to the site.

Whatever inverter manufacturer you're using in your project, SegenSolar have compatible export limitation products available.

## SegenSolar sell...

### Solis

Solis Export Power Manager (EPM for short) second generation can monitor and control the backflow power that goes to grid by controlling the output power of Solis inverters.

The export power manager uses CTs for current sampling and supports all Solis PV inverters.

Model EPM-3 is suitable for single and three phase inverters.  
SegenSolar recommends a single EPM unit per installation.

A single EPM unit can support up to 6 x units (each of the same model and rating) of any of the Solis range, from the 700W Mini 4G 1-ph single tracker all the way up to the 70kW 3-ph quad tracker. It includes full monitoring capacity and allow recording and display of energy generation, usage and environmental conditions.

### Huawei

The Huawei Smart Logger can be used to monitor a Huawei inverter or plant and can provide detailed generation and consumption reports. The most recent firmware update of the Smart Logger permits export limitation on Huawei inverters, when used with a suitable compatible meter. In South Africa export limitation is a necessity in many cases and SegenSolar has the perfect solution for such projects.

Our SegenSolar Assured export limitation packages include the Smart Logger plus a Janitza energy meter, and are pre-commissioned in the SegenSolar test lab prior to shipping once the order is placed.

### **The pre-commissioning will involve the following:**

- Janitza Meter will be preprogramed (we will request the CT ratio that will be used on site from the customer)
- The Huawei SmartLogger firmware will be updated to the latest version that supports export limitation.

## SMA

SMA has been involved with off-grid systems for decades and most of their inverter range has built in functionality to make power management simple. A simple addition of their energy meter and Home Manager or Cluster Controller (depending on the size of the system) allows you to set whatever export limit is required.

SegenSolar power management packages from SMA include the meter and Home Manager and optionally include 200A CTs for large commercial sites. As well as allowing you to control the export from site, they include full monitoring capacity and allow recording and display of energy generation, usage and environmental conditions.

## Solar-Log

Solar-Log specialises in accurate monitoring and power management for anything from domestic, all the way up to industrial scale systems. Solar-Log is not constrained to working with any one particular inverter brand, it works with almost all of them.

The Solar-Log monitoring devices can be combined with the PRO380 energy meter, to constantly measure values such as reactive power, voltage and currents and adjusting the inverter output where necessary to whatever the site requirements are.

SegenSolar have a Solar-Log power management package that is compatible with commercial systems of up to 100kWp.

## SolarEdge

SolarEdge have been a leader in developing an approved method for export limitation that is now recognised as being reliable and simple by installers and DNOs alike. Simply add the Modbus meter to installations to enable export limitation, right down to a limit of zero if required.

The addition of the energy meter to a SolarEdge system enhances what is already world beating monitoring. The customer can now see exactly what amount of their PV production is being used and what amount is being exported to site. This can be invaluable for increasing awareness and improving self-consumption.

The SolarEdge energy management packages on the SegenSolar portal are compatible with anything up to a commercial size system. There are a range of current transformers CTs available to match whatever rating of supply cable is on site.



In the Gauteng region, there are more than 7 lightning strikes per km<sup>2</sup> each year. Over the course of 25 years of operation, a large commercial PV system is likely to be hit. Why wouldn't you protect your investment?

Thunderstorms are fascinating and frightening and cause both awe and insecurity. They often do not only indicate a change in weather, but present considerable risks for persons, animals and material assets such as buildings and installations. Therefore, in this highly technical age protection from the possible effects of a thunderstorm is indispensable.

## **What is understood by surges and how are they formed?**

Surges are made up of short-time voltage impulses, also referred to as transients, which last less than a second. The following systems may be subjected to the interfering or even destructive effects of these transients:

- Power supply systems.
- Information technology and telecommunication systems.
- Machine and system controllers.
- Heating, air-conditioning and ventilation systems.

## **Protection pays off**

SegenSolar offers a range of purpose-made DC protection and combiner boxes which are ideal for commercial installations. The advantages of the SegenSolar solution includes:

- Peace of mind of using a pre-assembled, wired and tested component.
- Top quality certified components used for manufacturing.
- Better installation planning due to known enclosure sizes.
- Faster installation as Dc boxes don't have to be assembled by the installer, saving time and money.



## Multiple MPPT VS Single MPPT Inverters

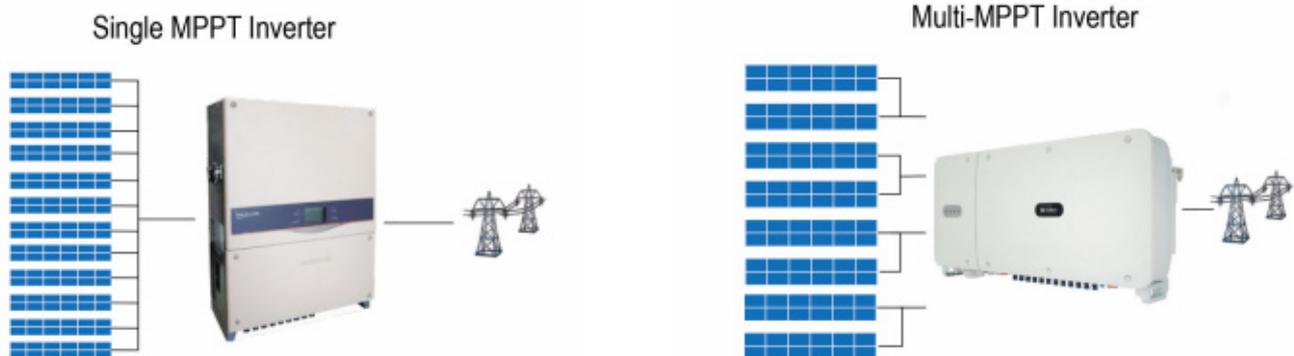
Monitoring and maximising the energy yield of any PV system is critical to the stakeholder that will be benefitting from the production. It might be the home owner, or the PPA owner that will be concerned about the Operations and Maintenance cost as well as the yield of the system. It might be the bank that is financing the system.

Achieving the best possible return on investment is what will matter. Understanding what the possible issues are and how to overcome it will make a difference when designing a system and choosing a solution.

A key consideration is to decide what level of flexibility and control is needed over an array for the given project. This can be achieved by determining how many MPPTs (Maximum Power Point Tracker) are required.

## More MPPT's: Better Yield

- PV inverters were originally designed to have a single MPPT, which means the inverter is capable of maximizing the output for one value of DC current.
- This limits the inverter to getting the best out of one roof face only, or one type of PV module.
- For small and simple PV arrays, that might be adequate. For larger and more complex designs, having the PV array managed by more MPPTs will help to improve the energy yield.



## MPPT: Maximize your modules

The function of an MPPT is to maximize the energy available from the connected solar module arrays at any time during its operation.

**MODULE MISMATCH** - PV modules of the same rating from the same production line do not possess identical current-voltage characteristics, this is called module mismatch.

A series circuit can only have one value of current (which is based on the worst performing module). The function of the MPPT is to extract the best possible amount of power from the circuit. It does this by varying the resistance in the circuit to adjust the voltage and current.

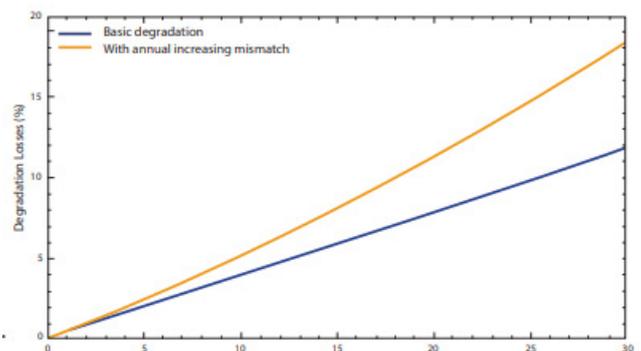
A series circuit works at the lowest current in the string, so the more MPPTs the inverter has, the smaller the number of affected modules by the lowest current.

With a multi-MPPT inverter an increased in yield of 0.5% can easily be achieved by sorting modules prior to installation. The mismatch loss will increase when more strings are combined. On multi MPPT string inverters the goal is to only combine 2 strings ensuring the lowest losses and on single MPPT string inverters the mismatch losses can be more than double.

|                           | 1 MPPT    | 4/6 MPPT | Yield Gain |
|---------------------------|-----------|----------|------------|
| String Length Flexibility | No        | Yes      |            |
| Module Type Flexibility   | No        | Yes      |            |
| Selective Optimisation    | No        | Yes      |            |
| Different Orientations    | Very Poor | Good     | 0,0% - 2%  |
| Mismatch Losses           | Poor      | Good     | 0,5% - 1%  |
| Shading Losses            | Very Poor | Good     | 0,0% - 2%  |
| Degradation Losses        | Poor      | Good     | 0,5% - 1%  |
| Temperature Losses        | Poor      | Good     | 0,5% - 1%  |
| Soiling Losses            | Poor      | Good     | 0,5% - 1%  |
| Low Voltage Start-up      | Poor      | Good     | 0,5% - 1%  |
| TOTAL                     |           |          | 2,5% - 9%  |

Panels degrade at different rates over time and the output will always be limited by the poorest performing module in a string.

The impact of this is difficult to predict, and impossible to measure on day one, but having fewer strings per MPPT means poor performing modules affect others less. With a single-MPPT inverter there is a significant risk that excess degradation in a small number of modules will impact the viability of the project over the long term.



**SHADING** - A shaded module produces drastically lower current, and the current of the whole string will drop down to the value of the affected module. On a multi-MPPT inverter, where there are only two strings per MPPT, that shaded module will cause the current from two strings to drop. On a single MPPT inverter, the entire array current will drop even if only a single module is shaded.

**SOILING** - Soiling can drastically affect the performance of individual modules and more so in low rain fall areas. On average there is a daily efficiency reduction of 0.2% in days without rain-fall in dry weather. Annual losses caused by this trend due to soiling ranges from 1.5% to 6.2% depending on the location of the PV plant. For larger ground mounted systems, the bottom row of the modules can be separated from the rest of the sub-array when using an inverter with multiple MPPTs to ensure the overall performance is not affected.

**MODULE TEMPERATURES** - Modules produce less energy the hotter they are, typically they reduce in output by about 4% for every 10 degrees increase in temperature. Modules on different sections of roof will reach different temperatures due to the amount of ventilation and exposure to even light winds. With a multi-MPPT inverter each area of roof will perform to its maximum based on the actual module temperature and not be affected by higher temperature modules elsewhere on the roof.

**START-UP VOLTAGE** - Every MPPT will have a minimum voltage needed before it starts up and so in the early morning whilst there may be some sunlight on the modules it may not be sufficient to enable the MPPT to operate. To maximize the energy yield it is therefore essential to have a lower a MPPT start-up voltage as possible. E.g. an MPPT with a start-up voltage of 200V will generate energy earlier in the morning and later in the evening than one with a start-up voltage of 600V. With a multi-MPPT inverter each MPPT will individually start up as soon as it can, independent of the others, whereas a single MPPT inverter will only start up when the entire module array produces sufficient voltage.

## Increasing the number of MPPTs improves system performance

**DESIGN FLEXIBILITY** - Only one string length is possible per MPPT, so having more MPPTs means greater design flexibility. With a single-MPPT inverter all strings into one inverter must be the same length.

Only one module type is possible per MPPT, so having more MPPTs allows module types or ratings to be mixed on a roof. With a single-MPPT inverter all modules connected into one inverter must be the same type.

Making installations possible on multi-faceted roofs with different pitch angles. a multi-MPPT inverter fully utilizes the modules with higher current as it could use both current values of different pitch angles. A single MPPT inverter would output power based on the lower current value.

## Balancing the benefits of more MPPT with the costs

It is important to consider whether the project viability really depends on having MPPTs on every module.

In commercial plant design, where the roof spaces are typically very large and unshaded, tracking each module is often not necessary and tracking individual string performance is sufficient.

It's less likely that modules will experience very different light conditions to their neighbours, so having MPPTs managing a number of modules within the array is sensible. Similarly, if there is no reason to think modules will behave differently from each other, there is little benefit in having module-level monitoring. For the majority of commercial installs, monitoring each module string is sufficiently accurate, and it avoids the cost of full optimisation.

Another important factor in the financial viability of a system, apart from using multiple MPPTs to extract the highest yields, is the capability to monitor the system closely and to react quickly if things go wrong. A system with more MPPTs will allow more accurate monitoring of each section of the system enabling better targeting of issues.



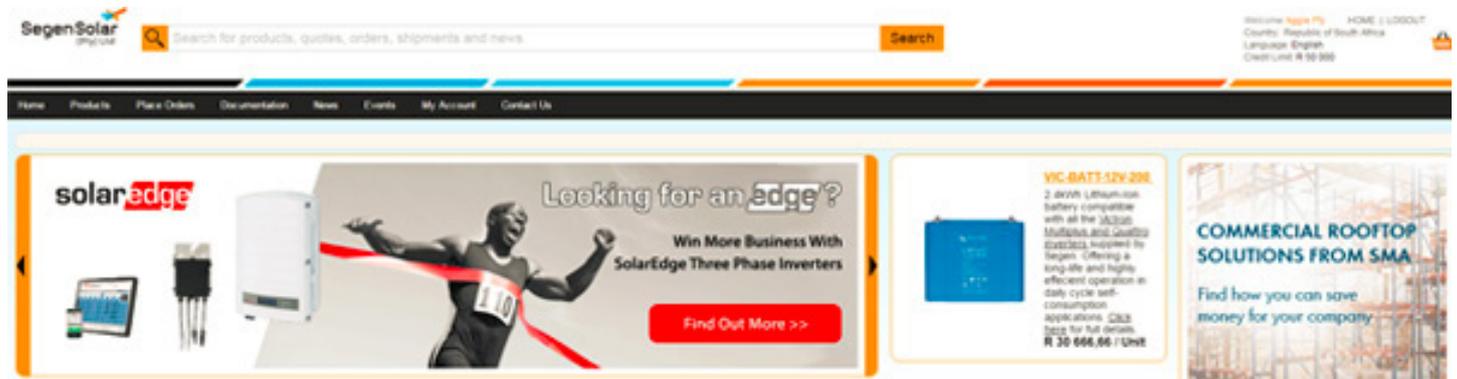
With the different types of roof and surface on which a commercial scale Solar PV system can be installed including tiled, metal, concrete, flat and ground mounting - Renusol has solutions to suit all roof types.



**FLAT ROOF** - On suitable flat roofs, solar PV panels can be mounted on metal racking systems which are angled at between 10 and 30 degrees to improve the energy capture. These systems are quick and simple to install and following a detailed site survey a suitable system can be selected depending on the type and strength of the roof. SegenSolar can also supply non-intrusive trays that are ballasted with concrete slabs or gravel, or an interlocking system suitable for lighter weight roof structures.

**METAL ROOF** - The Renusol "MetaSole" mounting system provides the most cost effective method of mounting solar modules onto a suitable metal IBR or corrugated metal roof. The system does not need mounting rails (which are traditionally the most expensive part of a mounting system) just screwed directly into the roof and standard module clips to match your chosen module.

SegenSolar’s revolutionary online portal provides a platform to help you design and purchase a commercial scale solar PV system.



## Products

All of SegenSolar’s products are listed under the products tab on the portal homepage, displaying price, stock availability, compatibility matches and arrival date of incoming stock.

Within the products tab there is a Commercial Products page, highlighting products that are suitable for commercial installations, e.g. polycrystalline modules, three phase inverters, high rated switches and cables etc.

Many products can achieve an additional 2% - 4% saving when purchased in larger commercial scale quantities, full details are shown under Products/PV Package Offers page.

- Majority of modules are sold in pallet quantities (typically 27 modules per pallet) at a further 2% discount.
- 50kW-250kW module and inverter packages are available at a further 3% discount when purchased together.
- The majority of three phase inverters are sold in 50kW - 500kW packages which can see savings of up to 4% less than individual quantity prices.

## Commercial PV Packages

All Inclusive Cost Effective Packages To Suit The Needs Of Commercial Installations

**30kW**



**COMMERCIAL**

**100kW-500kW**



**COMMERCIAL**

**50kW**



**COMMERCIAL**

## Quotations



SegenSolar's comprehensive quotation facility allows you to quickly produce a quotation for a commercial scale Solar PV system of up to 500kWp. The QuickQuote tool (in Place Orders tab) allows you to specify the size of the required system in kWp, the range of module and inverter manufacturers you wish to consider and your chosen mounting kit range.

Selecting PDF against a module and inverter combination will generate an instant quotation for the selected system including all the required components. The discount on the system is automatically set to the higher of your current volume discount or a discount applicable to a single system order of the size specified. All products which can be purchased in bulk packs will have their prices set to the appropriate bulk pack price.

Selecting Design will enter the Segen designer tool with the default values set up appropriately for the selected system type and size, but enables you to customise the quotation for any site characteristics and individual customer needs; mounting kit, cables, switches and system monitoring and other accessories.

## Orders and Deliveries

To achieve the best possible discount, an order for a commercial system should be placed on a single order.

SegenSolar will allow stock to be allocated to an order for a reasonable period of time providing the expected schedule has been discussed and agreed with your Account Manager.

Phased deliveries should be planned as far in advance as possible and individual shipments scheduled as required by the installation project requirements.



## Training Courses/Academies

Although there are not currently any certified training courses available within the market, there are companies and academies offering courses that will allow you to build on existing knowledge, discover new products or learn more as a beginner into the PV industry.

### Maxx-Solar Academy

Maxx-Solar is a non-profit training centre for solar PV which offers courses across South Africa. The courses available are divided into 2; beginners and professionals, and you can expect the following topics when you sign up;

**Qualification - Installer of PV Systems**

Solar Power Sunrise Intermediate + Solar Power Technician

**Qualification - Engineering of PV Systems**

Solar Power Sunrise Intermediate + Solar Power Designer

**Qualification - Manage PV projects & Businesses**

Solar Power Sunrise Intermediate + Solar Power Technician + Solar Power Designer



To find out more visit their website <http://maxx-energy-academy.org>

### PQRS - Power Quality & Renewable Services

PQRS trainer Carel Ballack offers 1, 2 and 3 day training courses which are tailored to your knowledge base and requirements and CPD approved.

Visit their website to find out more <http://pqrs.co.za/>

## Useful Reading and Websites

**SAPVIA:** The South African Photovoltaic Industry Association (SAPVIA) is a not-for-profit organisation that reports on industry news, updates and guidelines.

Visit their website here <http://www.sapvia.co.za/>

South African Government-Energy: <http://www.gov.za/about-sa/energy>

Engineering News : Industry news and updates <http://www.engineeringnews.co.za/page/renewable-energy>

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