

Realistic guidelines to install a Home Solar System

Written by Herbert Teubner General Manager Sinetech 05/09/2012

There is much talk about solar at this time and many 'want to be users' are often confused or unsure if they should install a solar system or not. There is an enormous amount of information available in magazines, newspapers, advertising, the Internet and TV which can be very confusing.

Firstly, users have to make it very clear to themselves what they want to achieve. In the first instance we have to differentiate between solar water heating with a mechanical solar panel or producing electricity with a PV (Photovoltaic) Panel system. The two systems have nothing to do with each other with the exception that both systems need the sun to operate. The water heating system is normally purchased and installed by a plumbing company and the PV solar system is normally purchased and installed by an electronic/ electrical company. Some plumbing companies also offer PV solar systems but I believe, in the majority of plumbing companies, the knowhow and experience on the electronic side, is lacking, which could lead to serious design flaws and problems at a later stage.

The user should be very selective when appointing a company to install his PV solar system. In the end, the system should be designed for a 25 year lifespan and should operate for at least that long to recover the high initial installation cost. Efficiency and yield are major considerations. It is no good to use cheap components which have to be replaced after 2 - 3 years. Consider a company with at least 5 – 10 years' experience and which is well known in the industry and can present some reference sites and happy customers. All systems will work for a short while but only professionally engineered systems will last 25 years and generate the yield you have paid for.

It is also vital to understand and establish what you really looking for:

1. Are you looking for a 'Stand- Alone' solar system to provide power as you have no Eskom connection and to lay new power lines to your Dwelling/Farm is to costly?
2. Are you looking for a 'Stand- Alone' solar system to provide power as you have no Eskom connection when use your hunting or game Farm only on the weekend?
3. Do you want a 'Grid-Tie' solar system which provides you with your own produced power, feeds excess power back into the grid and which can save and make you money in the long run?
4. Do you want a 'Grid-Interactive' solar system which provides you with your own produced power, feeds excess power back into the grid and provides some minimum back-up.
5. Or do you just want a Back-up system that provides power when there is no utility power available or there is load shedding involved.
6. Or do you just want a small 'Stand Alone' system which provides you with solar power just for lights and a cell phone charger?
7. Or do you just want a small 'Stand Alone' system which provides you with solar power just for lights and a cell phone charger, Fridge and TV with decoder?
8. Do you want to start a solar farm (IPP) and want to sell commercial power back to Eskom?

As you can see these are just a few examples but there are many variations and every one of these systems is different and used for specific applications, so spend some time, do some research and establish exactly what you are looking for. This will save a lot of time for you and the supplier.

In this article I would like to concentrate on smaller domestic/ business PV solar installations. If a PV solar system should be selected, we first have to understand that there are many different versions of PV solar system available and any one of them has a specific task. There are also many subsystems available. You need many years of experience and a good electronic/electrical knowledge to choose the right system for the right application. Therefore a trustworthy, knowledgeable and experienced supplier is absolutely vital.

I have selected three major systems which are explained here :

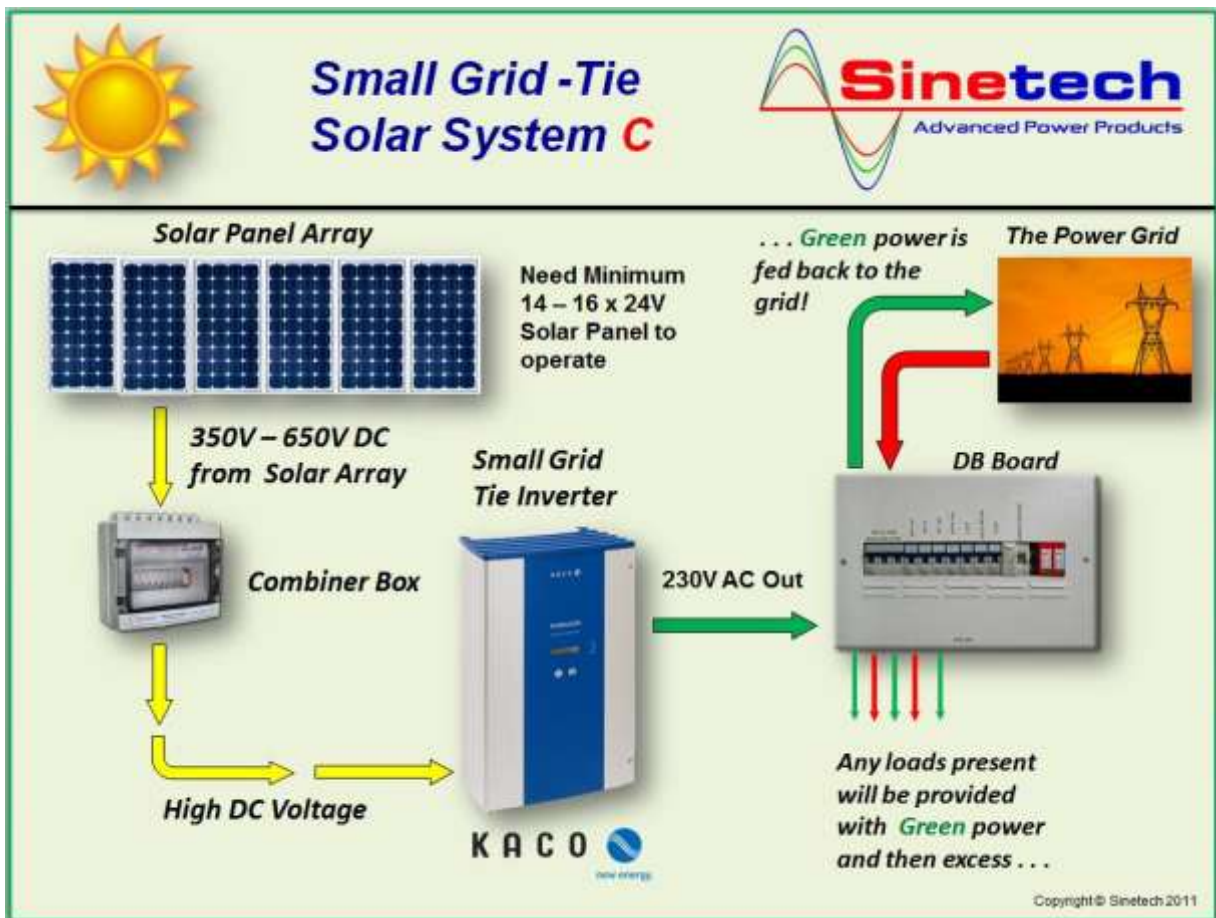
STAND ALONE SOLAR SYSTEM:

A stand-alone system is typically used when there is no public electricity power available. This type of system is fully independent of the power grid and therefore there is no interaction whatsoever with the power grid. The size of the solar array, other system components and the battery reserve capacity is dictated by the electrical usage of the property, the amount of reserve for periods of little or no sun and the climatology of the area. These systems start at about R25 000 for a relatively small, but expandable system. This type of system has no restriction and can be installed practically anywhere. This system is known to be extremely reliable and provides high inrush current capabilities to start pumps, electric motors for Farm equipment, Fridges and Deep freezers and is manufactured in Switzerland.



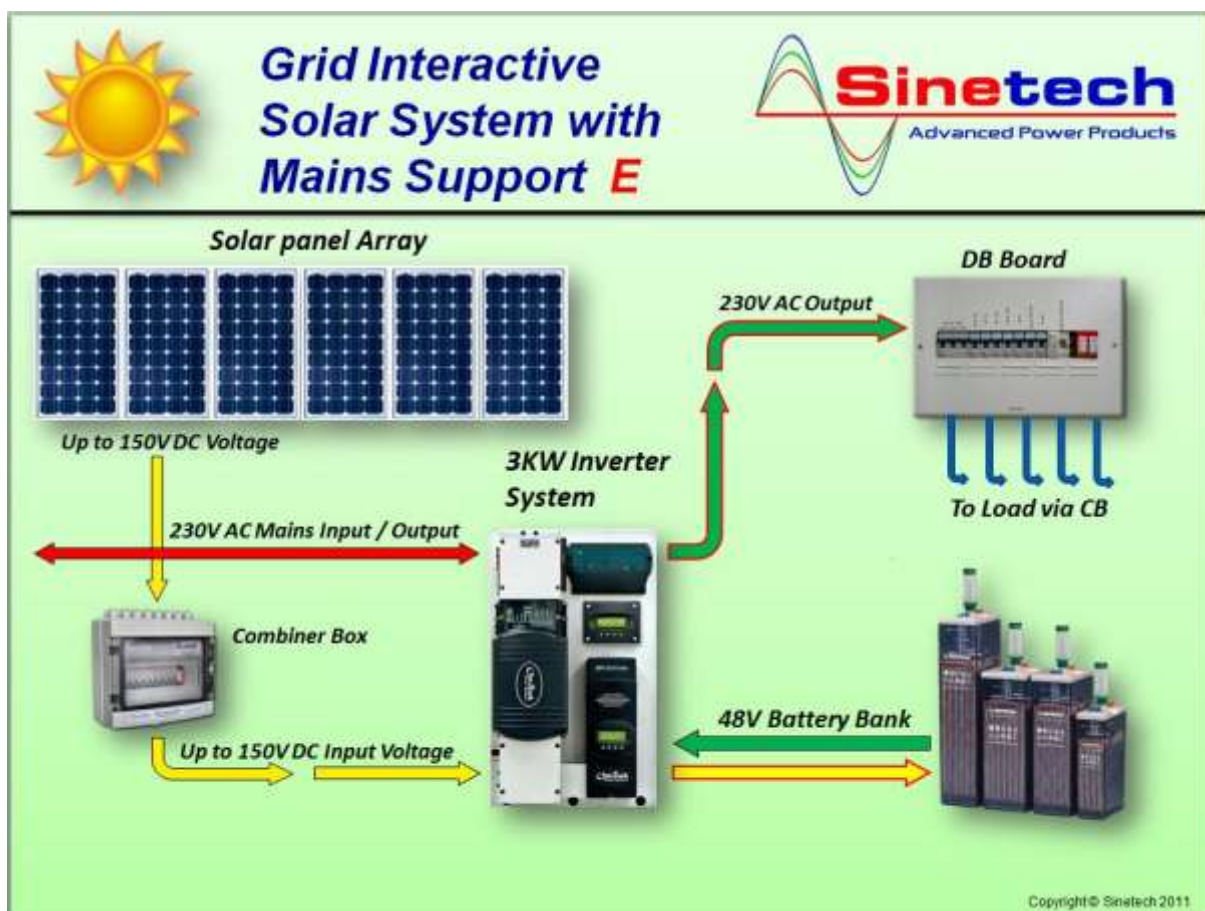
GRID - TIE SOLAR SYSTEM:

This is the most popular solar system installed in Europe. This system does not have a battery or related battery equipment. It has one function only. It feeds all possible electric power generated by the sun (solar panels) through a mains synchronized high quality sinewave inverter and offsets the power you would normally consume from the electricity company. It slows, stops or reverses your electricity meter depending on the time of day, the loads present and the size of the solar system installed. If the system is correctly balanced, it is possible to offset your entire monthly electricity usage and end up not paying anything or just a few rand to your electricity provider. This is an extremely popular system because there are no batteries to replace and the system costs less than its "grid-interactive" counterpart which has a battery backup bank. For areas where you have stable power and there are only seldom electricity power failures, this is an ideal system. These systems are expandable and available in single phase and three phase applications. They are simple in nature and comprise primarily of solar panels and mains synchronized high quality sinewave inverters with integrated MPPT controllers (Maximum Power Point Tracker to maximise the yield of the solar panels – up to 30% higher yield). If there is no mains present the system will not operate and if you should have a power failure the system will immediately shut down and will automatically restart after the mains returns. This highly intelligent system can provide a great amount of data for example: PV Voltage, PV current, instant power generated, daily yield, etc. This data can be displayed on your computer, I-Pad, laptop or cell phone via a network or satellite. Some of the communication software is available free of charge from Sinetech's website, some more sophisticated software is chargeable. This grid-tie system is designed and manufactured in Germany and uses the latest up-to-date technology. Germany is the leading country in the world for grid-tie inverter systems.



GRID - INTERACTIVE SOLAR SYSTEM:

This system is basically a combination of the above two systems and includes a battery bank and additional controls. It can provide power for your own usage directly, feed excess power via your electricity meter to slow or in some cases reverse it (depending on the meter and the solar power installed) and it also can provide back-up power during power failures. Depending on the size of this system and the appliances or devices requiring power, it can support an entire home/ business or just the items that are considered the most necessary during power failures. These systems are more expensive because of the battery back-up and the additional controls required in the system. Typically, depending on the amount of battery reserve, these systems can cost up to 50% or more than a comparable Grid-tie system. However, in areas with frequent power failures (as in South Africa), these fully automatic, silent solar powered supply and backup systems are a must. These systems can start at relatively small PV capacity which can be expanded as finances allows, to a fully-fledged solar system making the user totally independent of their power producer. The battery size must be determined at the beginning of installation as it will be difficult to add more or larger batteries in a later stage unless you install a brand new battery bank when you expand the system, as you should not mix old and new batteries. This system is designed and manufactured in the USA and is known for its reliability and ruggedness and can be installed in basically any harsh environments.



To calculate and recommend, or design a Solar System your supplier would need to know the following:

- 1 . What is your **Peak KW Power** consumption at any given time?
- 2 . What are the **Total KW/Hrs** in a 24 Hr period?
- 3 . What is the **Total Autonomy** you would prefer?
- 4 . Tell us in **how many days** you want to recharge your Battery bank?

TO ESTABLISH YOUR PEAK KW POWER CONSUMPTION :

Look at the rating plates of the appliances you have to, or want to, operate at the same time in a power failure situation. Most appliances have their Watt, VA, KVA or Amps displayed on a label or in the manual. List them in a spread sheet or in our **Rating Calculator** with the maximum values in Watts, VA or Amps.

ESTABLISHING YOUR TOTAL KW/Hrs POWER CONSUMPTION :

To establish your power consumption you can check your electricity bill over the last twelve months, adding all KW/h together and dividing it by 12 months. This will give you an average KW/h figure over the last 12 months and incorporates the difference between winter and summer; divide by 30.5 to get your daily average consumption, or you can download our **RATING CALCULATOR** on the main page at our Website www.sinetech.co.za which you can also use to help calculate your peak power consumption.

It is sometimes worthwhile considering a pre-calculated solar system (sometimes called 'solar-kits') but bear in mind you will have to adapt your lifestyle to what the system can provide and the system may not suit your specific needs and may not be expandable. On the contrary, a more convenient route is for your supplier to design a customised system for you which caters exactly for your needs and lifestyle and can be expanded as the family grows.

Remember the more accurate you are with your ratings, the more money you can save, so take a little time to investigate the rating plates on your appliances.

ESKOM FEED-IN TARIFFS EXPLAINED :

At the moment Eskom offers three individual types of feed-in tariff structures.

1. Solar parks from 5MW to 75MW.
These solar parks require approximately five different permits (mining rights, water rights, etc.) and an EIA (Environmental Impact Assessment) before an application for one of these solar parks can be made. It can cost up to R100 million to obtain these preliminary licences before you can actually apply for the main feed-in tariff licence from Eskom. This whole process can take 2 – 3 years. Once obtaining the five permits, there is no guarantee that Eskom will still offer the IPP licence. This scenario is very risky and some people will lose a lot of money.
2. Small solar parks from 1MW to 5MW. (to a total of 100MW Available)
These smaller park licences were made available to accommodate smaller operators but still have certain conditions which have to be met and there again, there is no guarantee that a licence will be granted automatically. This could also be a risky investment.
3. Experimental small solar systems from 10kW to 1MW (a total of 10MW Available).
After meeting Eskom's requirements and a licence is issued, Eskom will pay R1.20 per kW/hr for the next 3 years. At this time they would issues licences for standalone system only and the power usage is for your own use only.

TO ESTABLISH THE TOTAL AUTONOMY :

Tell your supplier for how many hours/days the system has to operate without sunshine i.e. when you have a few days of rain or cloudy weather. Here, a standby generator could also be a good additional safety measure for the “just in case” situation. Remember every additional day would run from your battery bank and could nearly double the cost of the solar system.

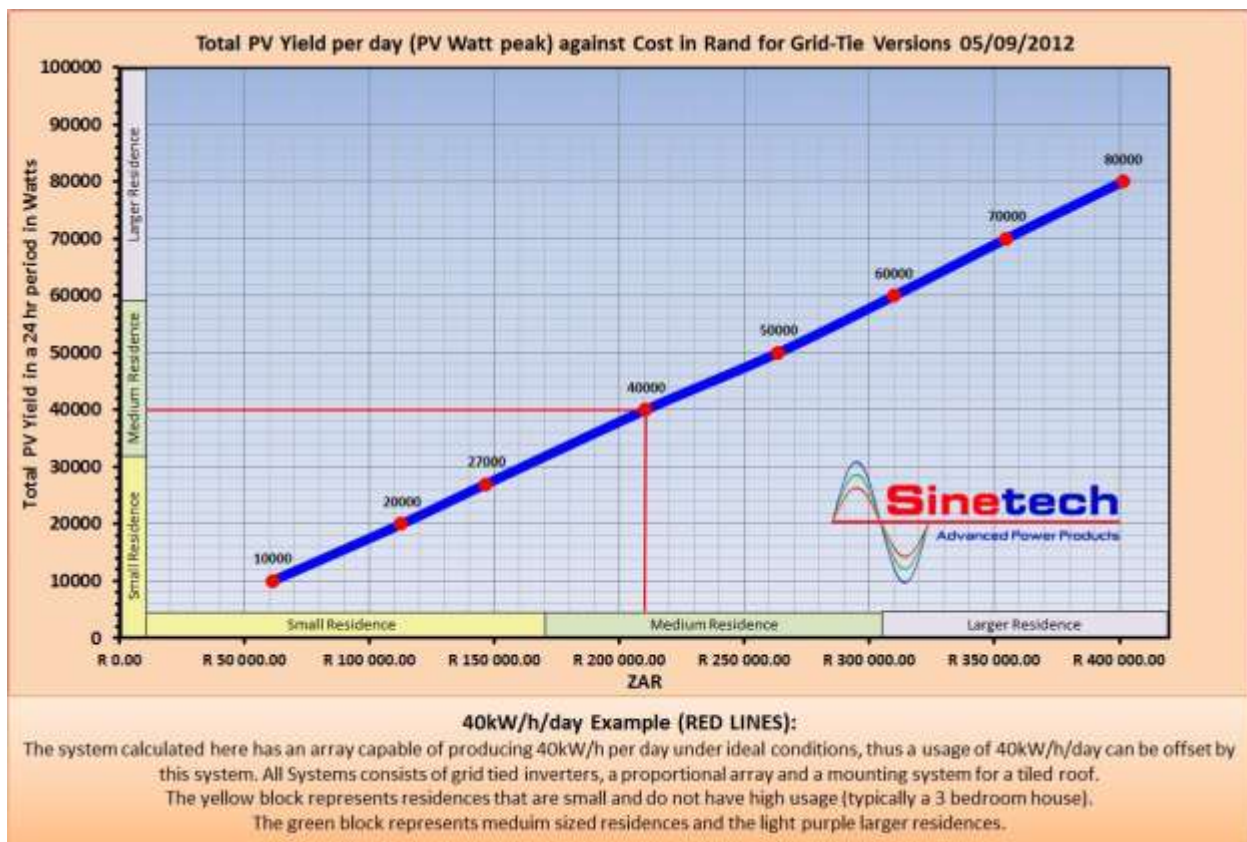
IN HOW MANY DAYS DO YOU WANT TO RECHARGE YOUR BATTERY SYSTEM :

Normally it takes 1 -3 days to recharge the battery system. This depends entirely on how much energy you used the day or days before. If you want to recharge the battery bank faster, the supplier has to drastically increase the amount of solar panels and regulators which can be an additional major cost exercise.

After you have established the relevant numbers and presented these to your supplier, they would then be in a position to generate a rough costing for you. If the costs are acceptable to you and you are willing to purchase such a system, indicate this to your supplier/ installation company. They will than hopefully organise a site visit and discuss all details of the design and installation with you. They can now start to design an accurate solar system and are able to give you a more accurate costing. This detailed design service is normally charged for upfront as in some cases customers will decide not to go ahead with the installation after they see the real cost implications, but the work for the design has been done. There is no standard solar system you can buy off the shelf that meets all needs. Each user has different requirements and therefore each system is somewhat different.

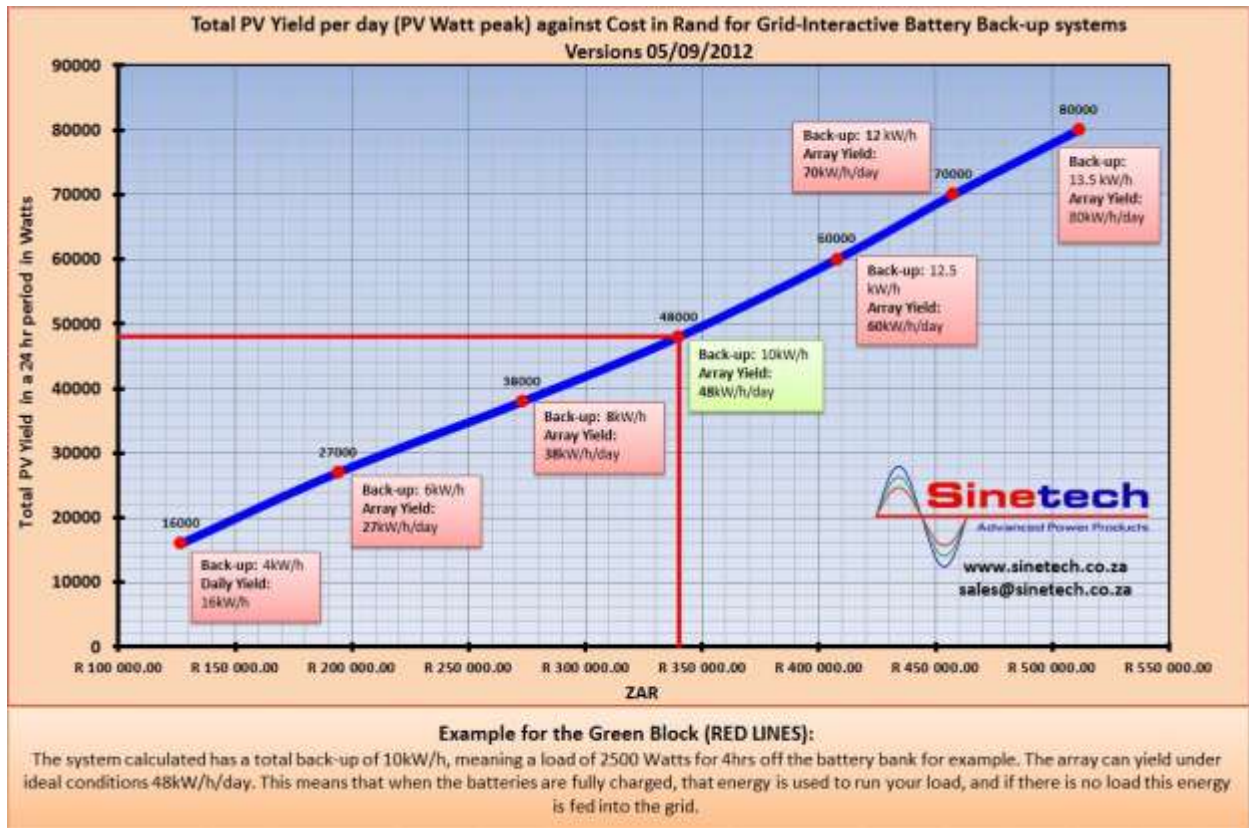
COST IMPLICATIONS:

Let’s have a look at a graph which can indicate the cost of such a straight forward Grid-Tie system: In this calculation we used real and, as accurate, figures as possible at the date indicated below.

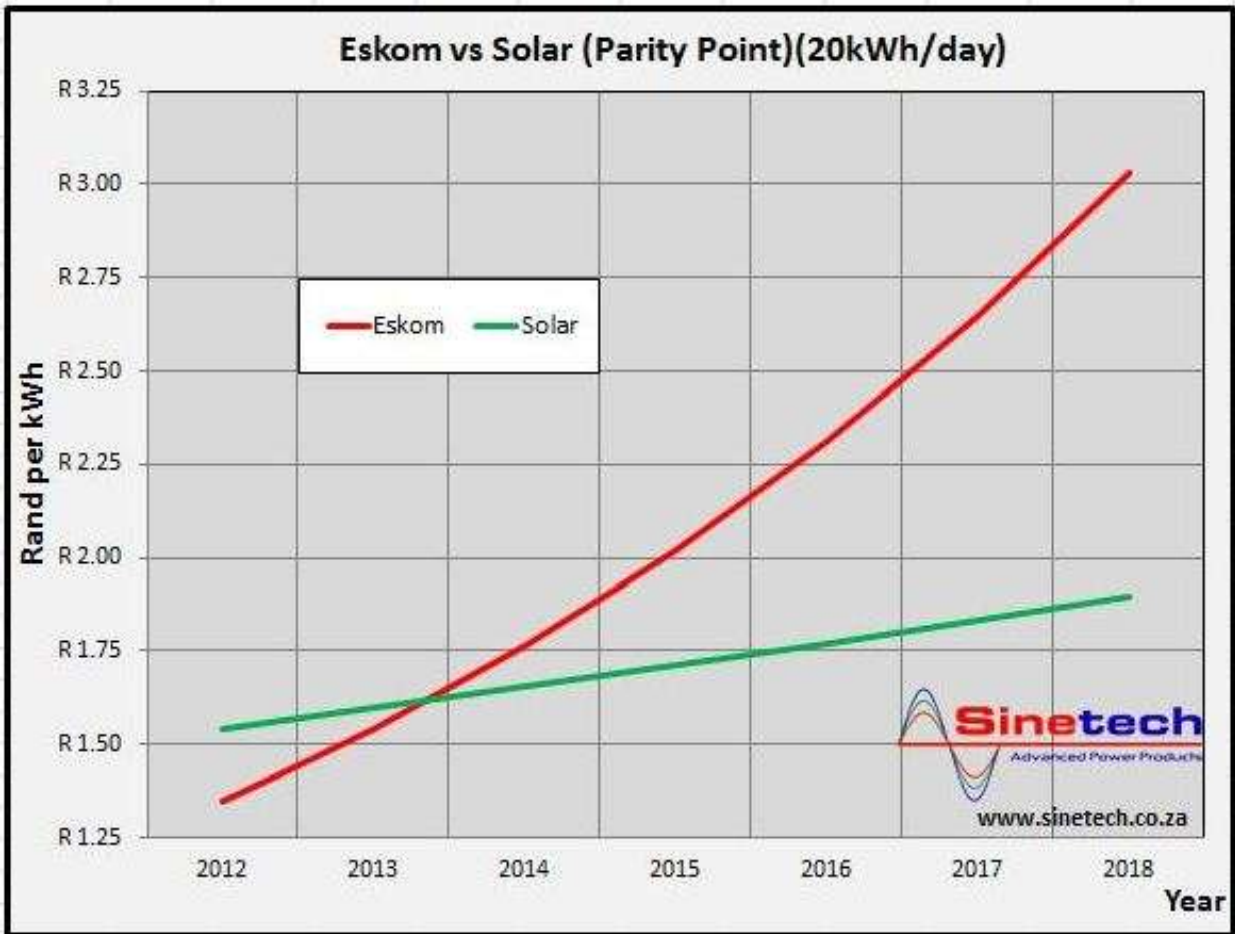


Establish what KW/h ratings you want to use per day. The figures are indicated on the left hand side of both graphs. From the value you choose, go horizontally to the right until you hit the blue line. Then go vertically down to read your approximate cost of the system in South African Rand.

The Graph below shows a Grid- Interactive system with a reasonable back-up capability.

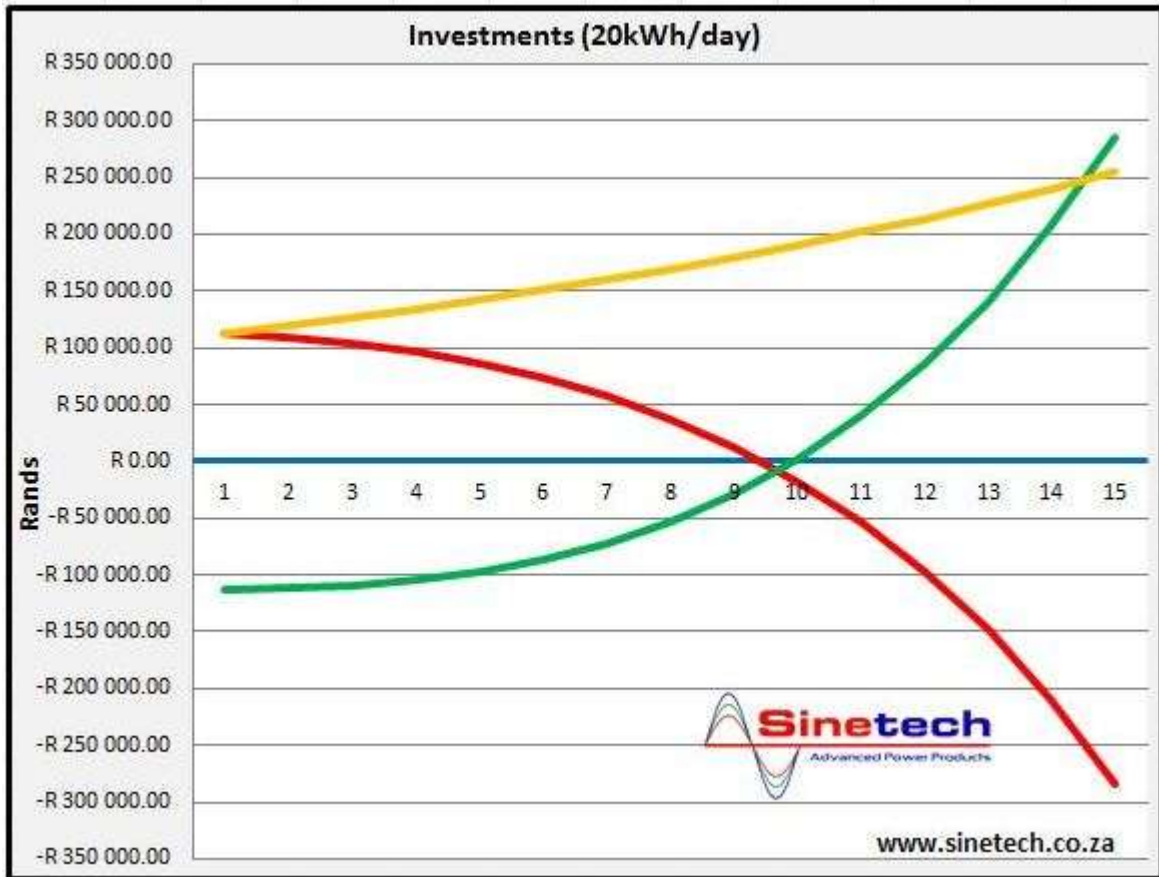


Establish what kW/h ratings you want to use per day. The figures are indicated on the left hand side of both graphs. From the value you choose, go horizontally to the right until you hit the blue line. Then go vertically down to read your approximate cost of the system in South African Rand.



The graph above shows the difference in the kWh cost of a solar system compared to Eskom. Eskom currently charges R1.3459/kWh including VAT (based on 30kWh usage per day) and plans an annual increase of 14.5% for the next five years. For the purpose of simulation this increase rate by Eskom is assumed to not exceed 14.5% per annum over the next 25 years. The solar system price per kWh is dependent on the size of the solar system and the pay-back period. A 10 year payback period is expected to terminate the initial investment of **R112 710**. The kWh price of R1.55 which has a payback period of 10 years is obtained from the system cost and is expected to increase at a rate of 3.5% per annum.

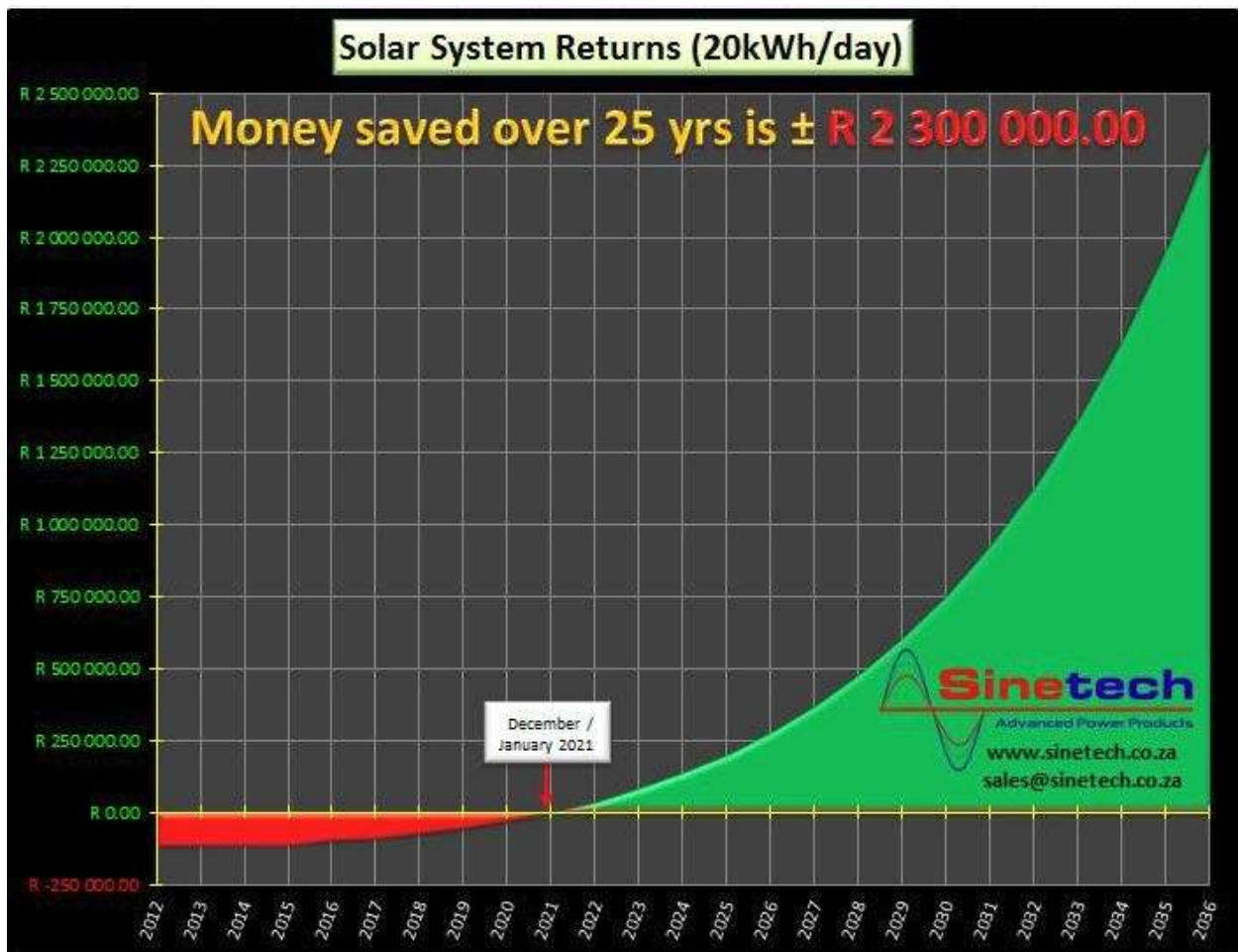
As an example your investments in different ways invested: Invested Amount R 112 710.00



Yellow Line : Indicates the investment return of the equivalent amount of a solar system in a bank account with a 6% compounded interest over a 15 year period.

Green Line : Applies to a solar system with money borrowed at 9% compounded interest, until zero balance is reached. After 10 years you would earn 6% compounded interest by investing the avoided monthly Eskom payments.

Red Line : Applies to investing the cost of a solar system in an investment account with a 6% compounded interest over a 15 year period. Concurrently you are still paying your monthly and ever increasing electricity account to Eskom. After approximately 9.5 years, your investment will be depleted.



The graph above depicts the payback period and system returns for a 20kWh/day system, initially paying off the loan by the amount of money saved, by avoiding Eskom payments. Once this loan is terminated, all further savings from not paying Eskom, are invested at 6% compounded interest. Accumulated savings after 25 years is ± R 2.3 Million. Condition: Eskom's annual 14.5% increase is not exceeded.

Real and accurate figures where used in our graphs and calculations. This cost exercise should be seen as a guideline only and figures can differ substantially from supplier to supplier.

GENERAL COMMENTS:

It is generally known that PV Solar Systems are still relatively expensive to install but the immediate future looks quiet promising. Solar panel prices where plummeting in the last year to the lowest level there are now. The USA installed high import duties to counteract dumping of cheap and often low quality solar panels from the east protecting their own solar industry. Europe is in the process of following suit. Most European countries either dropped or lowered the 'Feed-In tariff drastically last year. The solar markets suffered instantly and today many solar companies are on the brink of collapse. In Germany alone, which is without doubt the leader in the world, 11 large solar product related companies went belly-up in 2011 and some more will follow in 2012. Many Taiwanese and Chinese solar related companies are in deep trouble and desperately trying to find new markets. The price for Solar panels has now reached the lowest cost level ever. Many low quality Solar panels are dumped, or willingly imported into South Africa. As most solar panels looking very similar, it is very difficult for the non-technical user to differentiate between buying a good quality panel which will last for 25years, or not.

Our recommendation is to stick with suppliers which have a good reputation are known in the industry, at least for 5 – 10 years, and sell only good and proven brand names. Most systems will probably work for 1, 2 or even 3 years. But what happens if something goes wrong? Most suppliers now offer a 5 – 10 year product warranty and a 20 - 25 year performance guarantee. We have seen cheap panels from the east which lost over 25 % power in 1 ½ years. Will your original supplier still be there and adhere to his promised guarantees?

If you were to now invest in a PV Solar system, you would basically guarantee that you electricity bill will be fixed at approximately R0.65 per kW/h for the next 25 years. Don't miss this window of opportunity.

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