DIY OFF-GRID SOLAR MADE EASY

by SolarLaserProductions.com.au

Updated 18/09/2020 (email us for latest version)

Hi from the SolarLaserProductions team! We hope this 1hr read will inspire you enough to make the leap to an off-grid life style. Best is to read it quickly in one go, without delving into the details to much. This will give you an overview where you will then know where to reference parts for further detail and more importantly, know which questions to ask us. Feel free to call or email us any time, we are always happy to help.

Let's get into it!

Since 2005, we've designed and built many solar generators to power our LASER show events, sound systems, walkway lighting etc.

The aim was to build the most affordable, robust mains like power unit possible, with ease of set-up and portability in mind.

With many people asking us about which technology we found to be most reliable, we decided to write this short DIY booklet, showing what we have come to rely on, where to buy at discounted prices and how to set things up easily.

Over the years, after each newly improved generator was built, before we dared to used it on our sensitive and heavy duty show equipment, we would first stress tested it for several months on a 4 bedroom house with workshop and office where we had a variety of sensitive and heavy duty appliances such as computers, a washing machine, air-conditioner, pump, electric cookers, oven, shed tools, air compressors, etc.

As you can probably imagine, years of testing has left us with a workshop full of broken electronic devices, failed batteries, dodgy solar panels, burned out water pumps, blown LED lights and failed computers,.. all of which were imports.

Finding it hard to get warranty on most items, having electronics capabilities, we often tried to fix things ourselves. Upon seeing how badly (cheaply) many items were made, we often gave up, did more careful research and bought new.

After continuous disappointment, we eventually saw that **the specifications of many imports were wildly exaggerated,** as most didn't even live up to half of what they were rated for and even if some did, they usually didn't last long under "real world" conditions.

Some devices lasted a year or two but then for no apparent reason, suddenly failed. This made made us increasingly suspicious of the so-called "**programmed obsolescence"**, where a microchip decides when it's time for a device to go to landfill.

The up-side to this long and costly journey is that we also came across ultra robust devices which no matter how we treated them, **never failed us.**

Interestingly…. these devices are manufactured in Australia. They are probably so durable because they are designed for our harsh environment which is probably only second to Mars! Unsurprisingly, these devices are also **"dumb devices" or "dedicated devices",** which means that they just do the one job they are made for and don't have any bells and whistles, like LCD screens with micro processor programmable parameters or smart capabilities like Bluetooth, WiFi or internet connectivity, all of which increase the chance of being hacked or losing the plot when exposed to radio frequencies and static caused by wind, solar flares, distant lightning, microwave ovens, phones, cell towers, WiFi, etc.

To further enhance power security we also **avoid combo devices** which have regulators, inverters and mains chargers all in one, because if one element fails, we would have to send the whole combo away and be left with nothing to work with.

Also, the chargers are often the wrong size for the battery bank at hand and even if they were right, as soon as the battery bank is down or up sized it may no longer match,.. and to rely on a LCD programmable settings just felt to precarious to us, especially as we have experienced customers using wrong settings, microprocessors not halting a charge and cooking the batteries, or not charging at all until turned off and on again.

As such, **we have found the dedicated units with no settings to play with, a most reliable way to go.** For further power security, we use 2 devices with a smaller power output instead of one larger one. That way, if one should ever fail, we can keep functioning. Having said that, in all these years we have not experienced a failure.

Eg: We use 2 x 60A regulators instead of one 120A unit or 2 x 10A AC inverters instead of one larger 20A unit to run 2 x 10A appliances at once.

Also,… being Aussie made, we don't have to send a device overseas and wait for 3 months (or forever) to get it back.

When thinking about it, having withstood the decades of the unfair assault of the cheaper falsely advertised imports, any surviving Aussie manufacturer today should be given a medal. Maybe even two for now also weathering the present chaotic economic situation.

From all this, one can only conclude, that their service and product must be of exceptional quality, if not be the best in the world. After all, with temperatures ranging from -15 to +50, humidity ranging from 5% to 95% and with impressive lightning and dust storms to boot,... this country is a perfect testing ground for the making of the most robust products possible.

We have also become disillusioned by some of those once respected Australian manufacturers, who now just relabel cheap imported products. With all their corner cutting, they are only contributing to the erosion of our Aussie manufacturing and skill base. It's time to turn this around.

We have all seen how the **cheap and often dangerous electronic imports have ruined thousands** of good Aussie businesses. One of the many tragic stories we personally know of, being a top Aussie manufacturer which took over 25 years to grow a proud 75 skilled employees, suddenly crashing down to a skeleton crew of around 9 people within a just a few short years of the cheap imports flooding our markets. Where did all those well trained engineers and technicians go? Doing menial tasks somewhere? On government support? The word "tragic" doesn't even come close to labelling what has happened here.

As such, SolarLaserProductions has become a big fan of true "Aussie Made" and we hope to see more local businesses re-establish the production of quality goods and services in the future. With that, we should then also see a huge reduction in the mindless landfill situation Australia has been enduring for years.

And so we don't end up in a cloud of pollution like many other countries, how about we power our factories with solar along the way? Maybe super-subsidise businesses who set up in our sun-kissed outback. After all, many factory processes are heat related and could use the 80% efficient raw solar heat for brick, plastics, metal manufacturing etc., without using the far more precious 20% efficient solar electricity.

And do we really need coal or nuclear to turn water into steam to run power stations when every football field area of sunlight can provide around 10,000,000 Watts of raw solar energy per hour? Even after turning 20% of that into electricity, there would still be 80% left over for steam and hot water production, which could be reverse cycled into refrigeration and air-conditioning with the lovely side effect of air to water production and waste water sterilisation to boot!

Going by solar scientist calculations, **such a field could provide enough energy to comfortably run several large factories or even a town with over 3,000 eco homes.** Then if the solar panels were set high enough to act as shade covers for controlled environment vertical food farms, using air to water production, each football field size farm could sustainably produce the equivalent of what 30 football fields of standard farming could do,.. and with just 10% of the water consumption.

Such an oasis, could also supply households and fish farms with endless water and food, with households and fish farms providing compost and fish fertiliser to the oasis.

Extrapolating this thought,.. a square km would produce 100 times that abundance and a few hundred such blocks could cover all of Australia's energy, water and food needs.

This all sounds like big tech, but here's what we as individuals can do to secure a part of this solar production for ourselves, and help Australia shift quicker into the coming solar era...

SUPPORT AUSTRLAIN MADE AND D.I.Y!

To support Aussie Made we buyers need to look at labels and see where products come from. We also need to spend a bit more money up front, to get the quality we deserve and not fall for the trappings of the "Cheap 'n Cheerful – Made For Landfill" products, which ultimately cost us, our economy and environment, dearly.

A sign that people may be turning to quality again, is that some of the surviving Aussie manufacturers are now no longer free falling, but either bottoming out or even experiencing growth again!

To help with the turn around, several years ago, we at SolarLaserProductions started to market Australian-made solar products via our eBay shop. **(Made-2-Last)** www.ebay.com.au/str/made2last

At first, it was hard to get others to understand why they should spend more on what seemed to have the same specifications as cheaper imports, but after much explanation, discerning customers started to buy.

Now, after many years of sales, **as proof of product quality, we are pleased to say that we have had virtually zero warranty claims** and have also managed to hold a 100% rating for over a decade with only a single complaint of a $1 book never arriving.

Coming back to the DIY solar generator, **as much as recent high quality devices have made the building of a solar generator more reliable,** it wasn't until ultra long-life, safe batteries came along, that DIY solar generators became truly viable.

We hope that this booklet help you make the brave leap into a clean sustainable, off-grid life. A life which will help support our ailing Starship Earth and hopefully create meaningful jobs along the way!

Profits generated through product sales are shared with the you (the buyer) in the form of discounts and also put towards the ongoing development of solar ideas. Ideas which when ready, you'll be the first to find out about.

Disclaimer: *Please be aware that your DIY system is your responsibility and that we cannot take on any liability for your build. The information here is a guide only and it is recommended that you do your own research and use an electrician if required.*

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Abbreviations used:

- **CD=CloudyDay** (the total daily output on a cloudy day)
- **SD=SunnyDay** (the total daily output on a sunny day)
- **kW=Kilowatt** (the power rating of a devices usage, or panel output strength)
- **Ah=AmperHour** (battery capacity rated in Ah. Another way to show capacity is Volts x Ah = Watt hours or kilowatt hours - kWh)
- **C = Capacity.** C10 is the rating used to work out the total capacity of a battery when it is drained over 10 hours. The slower the drain the more capacity the battery will provide. Many battery manufacturers promote higher Ah ratings by using the C20 or C120 rating. **So be aware** of this when calculating your solar system size. We find the heavier drain of C10 the most realistic one to use for solar setups.
- **Eco-conscious house** means only using heavier appliances when the sun is out.

Can a household reliably run Off-Grid?

We've all heard the off-grid stories where people have to be careful with their energy usage and when it's cloudy or rainy, their systems often weaken or fail and they then have to run a back-up generator.

This is true for three major reasons

1) **The solar generator they bought was not large enough** to cover their basic household needs through **cloudy days**. This under-sizing is largely due to the once immense cost of a well sized system, starting at $30k for a moderate system and going up into the hundreds of thousands, for a large family/farm sized system.

2) **Because sluggish lead acid battery technology** needs 8-15 hours to fully charge (saturate), a series of cloudy days can progressively weaken them to the point where only several straight days of sunshine can saturate them again, and we all know how rare such a straight run can be. The result is a constantly limping battery bank, which eventually sulphates (coating on the lead plates), weakens and then fails permanently.

3) **Being undersized for the task at hand, batteries also get cycled** too deeply and this further accelerates their demise. Lead acid batteries, whether the flooded, AGM or GEL type, don't like being cycled at much more than just 10% of their capacity, so if a house had a 10kW battery bank (eg: 24V 400Ah), in order to make the batteries last as long as possible, one should only draw 1000W per night from them. As an example, an eco-conscious house generally draws 1.5-3kW per night, which would be up to 3 times more than such a bank should be supplying.

With this kind of treatment, it's no wonder that batteries only last 5-7 years and sometimes only 2-3, especially if they are cheap AGM or GELs, which dry out if charged and discharged too fast or to heavily.

With a larger amount of panels and the arrival of new batteries which can be cycled much deeper without damage and still **last 15-20 years** or more, the answer to the above question is “YES”,... a household **can** be reliably run off-grid. Not only that, if there are enough panels, it can be powered through cloudy days and even most patchy rainy days without the need for a backup generator, or a large costly battery bank.

The best part is that the cost of a high quality Aussie Made DIY system which is big enough to power an eco-conscious house with all white goods, lights, pumps and tools, can be assembled for as little as $8k-$15k and outlast many of the more expensive imported systems.

More on this below, but lets look at some more interesting info first...

Is cooking with electricity feasible?

As mad as it sounds, cooking with solar electricity can actually be better than cooking with gas because it's clean and it's free. All you need are appliances with the lowest possible power and the highest possible efficiency. Most cookers with built in thermal elements like frying pans, ovens, kettles, toasters etc. have around 80-90% efficiency. Electric cook plates only have around 60% and gas 40% because the heat races out and around the pot instead of being trapped inside the base. Halogen air ovens are also quite good and heat up quickly. Microwave ovens and induction cookers are efficient but because they create insane amounts of EMF (Electro Magnetic Frequencies), we avoid using them altogether.

Electric frying pans however,.. RULE! They are the most economical and versatile cooker of all.

Here is a great method to produce a large meal for around 5 people with only 5 minutes of preparation time.

Put 1mm of water in the pan and adjust the cooker to a very low level, where the water only intermittently boils as the thermostat clicks on and off. Then put fish or meat (can be frozen) and whole unpeeled uncut washed veggies in the pan and put the lid on.

As the water turns into a steam cloud, it then gently hermetically cooks everything to perfection at a constant 100 degrees C, without ever burning things. Being sealed in their jackets, the flavour stays trapped inside the veggies, and the fish or meat juice becomes a tasty gravy, especially if some cut tomatoes, herbs and garlic are layered on top of the meats and allowed to slowly seep through. Islanders did a similar kind of cooking by burying their banana or palm leaf wrapped food in the hot ground of a fire for ½ a day.

1-2hrs later, with the kitchen smelling inviting, a succulent meal is ready to be served up and if you had plates propped up against the pan during cooking, they'll be warm to go. Because nothing gets burned, the pan is easily cleaned, even if it it's not a non-stick pan. Hermetic steam cooking is one of the tastiest and healthiest ways to cook, with no added oil, butter or fats required and the **energy used is so low** that even on a cloudy day, just 600W of panels can cover the power used.

Well insulated slow cooker pots are another great way to economically cook a meal and if ever any meal requires roasting, just stick the pre-cooked meal in a desktop oven or halogen cooker for 20 minutes to crisp it up. An additional 700W of panels will cover that, on a cloudy day.

That's a total of 1.3kW of panels to cook and crisp a meal on a cloudy day. Add another 1.5kW to power a standard sized fridge, some lights and a small music system and you have a functioning house capable of electric cooking through cloudy weather, with under 3kW of panels, and that's without touching the batteries! When the sun is out and your panels are producing 6-8 times that energy, you can then run

extras like a washing machine, vacuum cleaner, bread maker and shed tools or even a lightweight (400W-600W) air-conditioner, whilst still charging your batteries.

Is solar electric hot water boosting feasible?

An effective way to make hot water on cloudy or rainy days when solar tubes don't provide much heat, is to electrically boost a small 25-50 litre hot water tank which draws its lukewarm water from the larger solar hot water tank. The smaller electric boosted tank can then quickly top up the heat whilst using little battery power. It's a bit like boiling a kettle which even though uses a lot of power, only stays on for a couple of minutes, hardly taxing the batteries. As a rule of thumb, a moderate shower uses around 10-15 litres of hot water, so a 25l tank can provide a couple of showers in one boost session.

When using an inverter to boost the water, because the hot water element usually draws 15A or 3600W (which is way too high for a single phase mains like inverter) we either use a 3kW 240VAC to 110VAC step-down transformer (under $100 on eBay) to reduce the draw down to around 750W, or we exchange the heating element for a 1.2kW element and run it directly from the inverter without stressing it. It will take longer to heat the water but if the incoming water is somewhat pre-heated (cloudy day), it may only require a few minutes to top it up. Naturally, on sunny days, the booster will not switch on at all, as the water from the solar hot water system will be hot enough.

Alternatively, we have also successfully heated water using a quality 1kW DC-DC converter which boosts the 24V battery power to 96V DC, which we connected via a fuse directly to the heating element. This takes the load off the inverter altogether. When using this method however, it is best to use a 3600W heating element as at 96V, it will only produce around 600W of heating power.

NOTE: 600-750W power can warm up a completely cold 50 litre tank in a couple of hours and because a hot water tank, if mounted outside, can lose up to 300W of heat per hour during a cold night, it is wise to mount the tank inside.

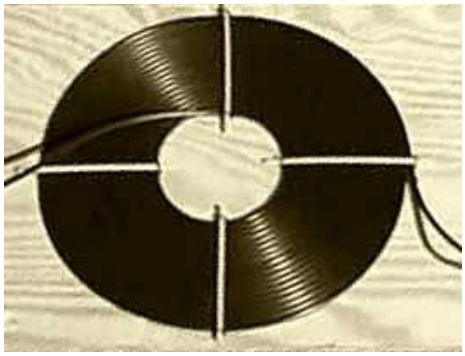
For highest energy efficiency, put the boost tank under the sink where the pipe to the sink is shortest. Kitchen sinks require many short hot water shots throughout the day and the short distance keeps heat losses at a minimum. A longer pipe to a shower is not a problem as it runs less frequently and for longer periods of time with a fast flow.

NOTE: With washing machines, it is best to only do cold washes or to only use solar hot water when the sun is out and avoid using electric water heating altogether (unless you have a huge solar system). The same applies for dishwashers.

To not tax the battery during the night with the hot water booster, we use a timer to turn it off after the last shower and then only turn it on again around 10AM, giving the battery 4 hours of cloudy day energy to somewhat recharge before boosting. When combing the weakened battery with the solar panel energy as of 10AM, the booster can then heat the water tank without draining to much from the battery.

TIP: During extreme cold nights if the tank has lost much of its heat, it may need around 1kWh to top it up again. If you find this often the case, it is a good idea to get an extra 1kW of solar panels to cover that energy for cloudy day situations.

IDEA: A cheap DIY hot water solution we have successfully used on the house, is made by mounting a garden hose in a spiral on plywood to the back of solar panel. This works exceptionally well on sunny days and to trap more heat on cloudy days, we put a clear sheet of poly-carbonate flute-board on top of the solar panel and seal the flute ends so that the hot air stays trapped. Poly-carbonate also provides for better hail protection and disperses the shadow of a leaf, which can result in a better panel output when compared to a leaf which is directly stuck to a cell.



When linking 4–6 panel hoses in series and then pumping the water out every ½ hour for around 5 minutes into an insulated holding tank, over 100 litres of warm to hot water can be produced per day, with less than 100Wh of power consumption.

Another way to collect heat from panels is to run a 1-2 inch pipe along the apex of a row of solar A-Frames. More on Solar A-Frames below.

Reasons to go Off-Grid

- With batteries lasting 15-20+ years, **Off-Grid is now cheaper than On-Grid!**
- Calculations show that **one day solar reaching Earth is enough to power the planet for 30 years.** Makes one wonder what we are doing, doesn't it..
- **Everyone on the planet is "online"** with free sun power – why not use it?
- **Off-Grid doesn't suffer from over and under voltages** like grid connect does and if the panels are ground mounted, they can be much more wind and lightning resistant than roof top systems.
- Also with Grid-Connect systems, when the sun comes out and everyone is feeding the grid, the mains voltage often goes so high that **the panels click off and free-wheel, not even benefiting the household.** That could explain why many keep paying for electricity even with a larger grid feed systems.
- **If solar panels are mounted flat on the roof they become roof heaters** making more work for air-conditioners. They bake in the brutal Aussie sun and can eventually bleach & crack and also can easily break in hail storms. Ground mounted off-grid A-Frames are much more resistant to such problems.
- **On-Grid connects a house to thousands of kilometres of wires,** which are essentially huge antennas. Every time the sun fluxes or flares, the power-lines surge with additional energy which can ruin appliances. The grid is also being increasingly bathed in mobile and Wi-Fi signals which are similar to the frequency a microwave oven uses. An ever increasing amount of signals are also being injected into the grid and used for internet, smart meter and smart equipment communication. All of this so-called "dirty electricity" is essentially turning house wiring into a live antenna cage. When doing research on the "dangers of microwaves" or the "dangers of EMF", Barry Trower and Lloyd Burrell may be worth listening to.
- Some claim that if the world switched to solar energy, all **wars would come to an end.** Not so hard to imagine.
- This statement sums it up nicely: **"To power their needs, primitive beings fight over things to burn, whereas enlightened beings use stars to power their civilisations."**

Let's face it, we are but passengers on Starship Earth and we are travelling through space accompanied by our own power provider. If we want to use our short life to help create a better world, then going off-grid is a great proactive move and done right, a long lasting legacy!

The following information makes the urgency even more obvious: So far, only 1% of the world's energy is powered by solar. Nearly 1/3 of the world's energy is being burned up by refrigerators and air-conditioners. Computer consumption is not far behind that, with most energy being burned up by SPAM and viruses!
Then what about the coming tsunami of electric cars, bikes and aircraft? Shall we burn more stuff to power them as well, or shall we become pro-active and build our own solar generators instead?

How easy is it to build a Solar Generator?

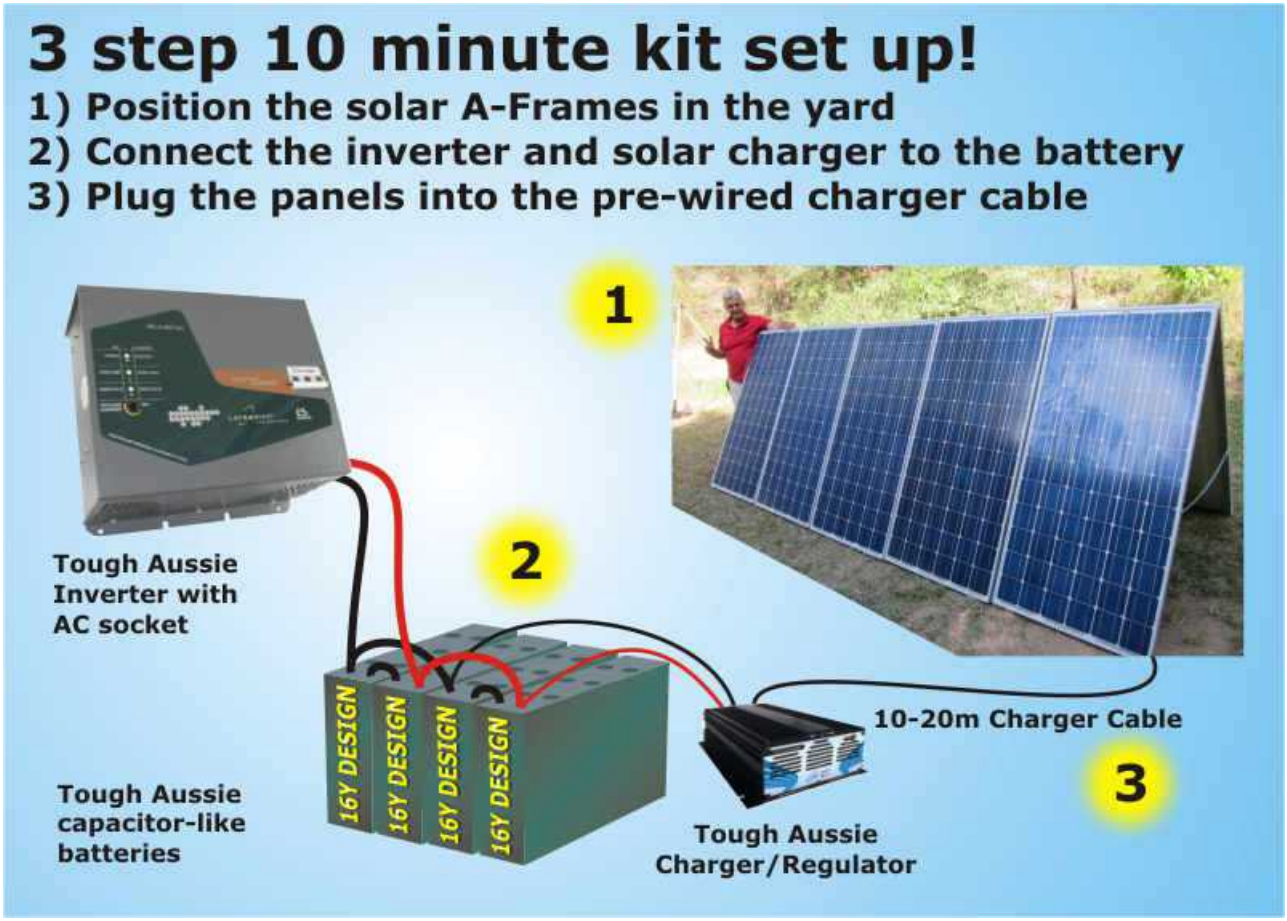
In the past, the expense and complexity of Off-Grid solar together with the risk of wires burning and batteries exploding made it quite inaccessible. Also, the replacing of costly batteries every 5-7 years made it non-viable from the onset.

Long-life, safe, sealed batteries, quick to set up **ground based A-Frame panels,** together with **quick connect, pre fused regulators and inverters** have now made building a solar generator a simple and safe task.

Also, because inverters up to 10A come with a built in mains socket, AC power can be instantly accessed without the need for an electrician.

If you want to hard-wire your inverter to your house fusebox however, you will need the help of an electrician.

Here's an overview of how we quickly set up a powerful, durable solar generator....



In a nutshell, a solar generator is made up of two sections:

One is the **battery + inverter** which produces AC power (the generator) and the other is a **panel set + regulator,** (the charger).

For safety, the inverter and regulator have built in DC fuse switches.

To keep things simple and the cost down, as well as to reduce the risk of electronics failing, we avoid using unnecessary parts like meters, programmable displays, remote controls, bluetooth or automatic fuel generator starters, etc. as they may all be susceptible to failure.

If we occasionally need to check the battery voltage or the charging current, we simply use a portable clamp-meter, which is supplied with each kit for free. Charging current is measured by simply putting the clamp around a positive or negative wire to the battery. To work out the power, the current is then multiplied with the battery volts.

Eg: a current of 60A going from the regulator to a 24V battery bank means that the regulator is producing 1440W (60A x 24V) which as an example, could cover much of the the power draw of a desktop oven, toaster or kettle without taxing the batteries much at all.

We find that a well proportioned solar generator, rarely needs a back-up fuel generator because even on rainy days, an oversized panel set can quickly recharge the batteries with each parting of the clouds. Only in the rare case of a few heavily rained out days would a backup generator be needed and because fast charging batteries can be bulk charged in just a few hours, even then, very little fuel will be required.

TIP: As you will rarely need to fire up a back-up fuel generator, a problem can occur with **petrol or diesel becoming stagnant**. As such, we recommend to get a 3KVA or larger gas powered generator as gas can be stored for many years without a problem.

It is even easy to convert standard petrol engines to gas, using conversion kits and DIY bio-gas is also easy to make.

Here is one of the many cool videos on DIY gas:

https://www.youtube.com/watch?v=pKZgnXQCp98

Now let's look at the exact solar equipment we use...

The best equipment and where to get it

When looking for quality, we focus on things like:

- Work durably under "real life" 24/7 loads
- Low heat generation
- Usability between -10 to +45 °C
- Efficiency across all loads, not just peak efficiencies, which most brands only choose to promote
- Lowest energy loss when on standby, which is particularly important for mobile and small battery systems
- Weather resistant electronics with coatings which block moisture and oxidation
- Low EMF radiation. Eg. clean sine wave for lowest human and animal irritation
- Good warranty with ability to have repairs done
- Aussie made and/or serviced where possible
- If imported, then only from proven high quality manufacturers
- Good price value, calculated against life span

The 4 basic parts of a solar generator are:

1) Inverter – (makes 230VAC – heavy duty electronics needed)
2) Regulator/charger – (charges the batteries - heavy duty electronics needed)
3) Batteries – (must be near incorruptible, ultra robust and long lasting)
4) Panels – (must be built to last for decades)

Of these, the parts which have stood the test of time for us are the following:

The inverter we have come to trust...

(Larger and smaller versions available)

We absolutely love Latronics inverters because:

- **They actually work as specified** and are **built in Australia** to **Australian safety standards** with tough casings and robust electronics. Their durable design is the result of years of German / Aussie engineering. (German owners).

- **We've never had one fail on us** and the only rare stories of failure we hear about are due to lightning strikes. So far, almost no one we know, with a ground mounted panel set has experienced lightning failure. As tough as these inverters are however, we avoid using them them for welding and if we must weld, we use an inverter welder and get a 4kW or larger Latronics inverter or a 4kW or larger fuel generator.

- **Unlike pure digital switching power supplies** which can send high frequency signals crawling all over your wiring and appliances, low frequency Latronics inverters use highly efficient toroid transformers to deliver a **solid clean calm sine wave** which better protects sensitive appliances and is also likely to be better for human and animal health.

A Latronics fan has posted an insightful build quality video here: https://www.youtube.com/watch?v=1xHwbwtV2ZI

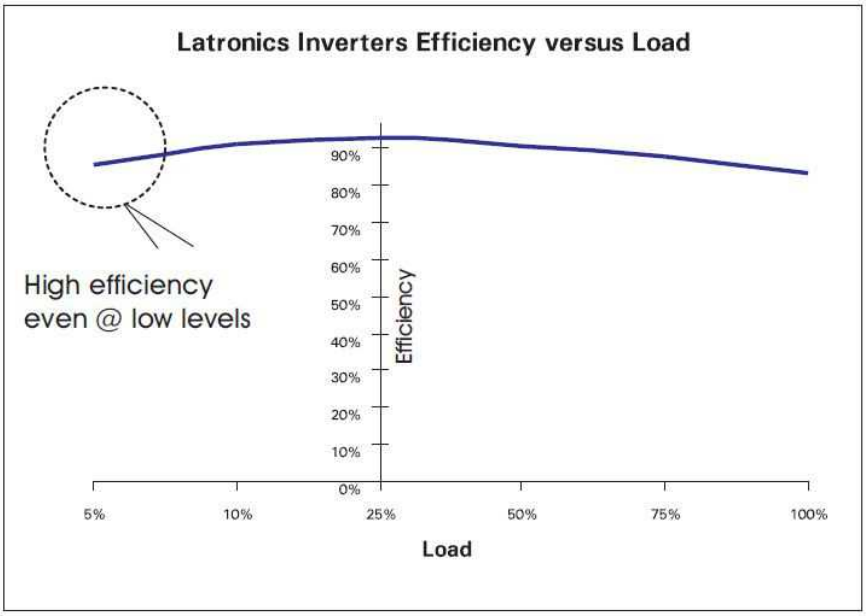
- **The toroid transformer also acts like a shock absorber** which when hit with a heavy surge, protects the DC electronics. Compact digital high frequency inverters don't have this luxury, which is why they break ever so easily.

- **The heavy and well insulated windings of the transformer also provide a more robust and safer battery to AC separation.** Latronics wind their own transformers and they are amongst the best in the world. Tiny transformers found in digital High Frequency (HF) inverters may be more at risk of burn-out and AC leakage, which can lead to electric shock. We have long decide that the savings made on cheaper AC devices is not worth the risking of a life.

- **Unlike many other brands** which only provide a power surge for a fraction of a second, **Latronics inverters surge for up to 5 seconds long.** That's why even a small 12 volt 500W inverter can start a full size fridge or even run a standard washing machine, where other brands with much higher specifications, often won't even start a bar fridge or a small AC water pump!

See this entertaining HF inverter fails video: https://www.youtube.com/watch?v=D-swPzh6u2Y. Even the ones which worked, we wouldn't trust to last for very long.

- **Latronics has high working efficiencies of around 90-94% across all loads** which gets a lot more out of a battery set than cheap brands can. Cheap brands often only show their short term peak efficiencies but waste a lot of battery power when not in peak mode. We tend to be suspicious of brands promoting efficiencies much above 94%, as this seems almost impossible when considering the losses across wires, transistors and transformers on the way from the battery to the AC output.



- **At under 80mA, they have amongst the lowest standby currents in the world.** This stops battery drain when no appliances are being used. Other brands, (even good ones), can draw 1-3 amps when on standby, which can amount to a good 1/2kW loss overnight which is not so good for camp-sites or small battery set ups.

- **Latronics inverters are built to order only**, which ensures that you get the freshest versions with all the latest upgrades.

- **They have a solid "no fuss" 2-3 year warranty** (depending on model) and can be repaired even after decades of use.

- **Latronics has over 30 years of good track record** with 70,000+ units sold and very few warranty comebacks.

- **They are "Industrial Grade"** which is why government and heavy industry use them.

- **Electronic boards are coated** to protect parts from salt air/moisture and dust. Coatings also slow the drying out of capacitors and stop oxidisation from eating away at the electrics, both of which are among the prime causes of early failure in other brands.

- **They are also designed to take knocks and bumps** and as such can be used in campers. (Extra rouged 4x4 and boat versions can also be ordered)

- **The inverters we have made up for our use we call "X" inverters.** These are "e**X**tended voltage" inverters. They will run down to a lower than average battery voltage, providing extra emergency power when needed. "X" inverters should however only be used with batteries which cannot be ruined when occasionally flattened. (More on this later).

Where to get a factory fresh "X" model at a discount:
https://www.solarlaserproductions.com.au/SHOP.htm

The regulator we have come to trust

We found that the big secret to a good regulator is its ability to reliably **convert all of the panel power into battery power** with the least amount of loss and heat build up. Many low cost regulators waste a lot of energy, even if they are the more efficient MPPT types.

As much as MPPT gets the maximum power out of the panels, that's only half of what makes a good regulator. The other half is the **DC DC converting electronics** which converts the higher panel voltage down to the lower battery voltage without losing much energy along the way.

This DC DC part is rarely found in cheaper MPPT regulators and even if it is, it often burns out. We've also found that regulators with programmable LCD screen microchip controllers can lose the plot and either stop charging until reset or don't stop charging at all, which eventually cooks the batteries. Overcharging can also be dangerous, as it can cause some batteries to explode or catch on fire.

Over the years, we've filled boxes with broken regulators which failed due to undersized transistors, inadequate cooling or electrical spikes caused by the bright light of a lightning flash or the sudden surge of an appliance. Distant lightning strikes can also cause regulators to fail because like antennas, solar panels pick up static and pulse it through the regulator electronics. If a regulator is to withstand these various assaults, it must be built like a tank.

When we started to use the Australian made GSL regulators, all our regulator problems came to an end. Like Latronics, they use **robust electronics and have a built in toroid transformer.** They are also only **built to demand,** which ensures fresh electronic components. (Old stock has deteriorating electronics)

They have highly efficient robust MPPT DC DC electronics with a cooling fan to keep things working comfortably on hot days. They come in 30 and 60 Amp versions and where higher amps are required, several can be used in parallel when hooked up to independent panel sets.

To make connections easy, they come mounted and pre-wired with breaker fuses, lugged battery cables and solar panel input plugs.

Get a factory fresh version at a discount here:
www.solarlaserproductions.com.au/SHOP.htm

The best batteries

NOTE: Up until Xmas 2019, we had been using and selling Solid Lead Crystal batteries but as they are now no longer being imported, we have settled on a battery technology which we believe to be even more durable. See below...

When searching for the best batteries, we look for types which...

1) **are maintenance free** (no topping up of water)
2) **are resilient to sulfation** (build-up on the plates causing capacity loss)
3) **can work well with partial charge** (which is typical of a solar situation)
4) **can be occasionally drained to near zero** without being damaged
5) **don't suffer from dry out** when in hot climates like the Australian outback
6) **have an ultra low gassing design** and are **non explosive** when in a fire
7) **can last a minimum of 15-20 years**
8) **can be charged quickly** so that short breaks in cloud can fast boost them
9) **have a good company track record** and are 100% recyclable!

After assessing all of the latest quality deep cycle batteries on the market, we have come across what might very well be the best battery in the world, particularly when comparing life span to price.

SunGel from Battery Energy Australia (30 years track record).

SunGel is amongst the most evolved industrial grade battery in the world. With factories both in Australia and China, the supply chain is guaranteed. SunGel is designed to work tirelessly in our extreme environment and found in the communications, mine and rail industries as well as in maintenance free outback solar set-ups where they need to work unattended for years. They come with a solid 5 and 6 year warranty + a further 5 and 6 year pro-rata warranty, where the buyer pays an increasing excise towards a replacement as the years roll on.

Such a long warranty is a sure sign of manufacturer confidence.

The battery technology is based on **thick, ultra pure, long life lead plates** with integrated **sulfation suppressing carbon.** The ultra pure electrolyte is locked into the battery using an advanced **heat and dry out resilient GEL.** The 2-8V versions have a massive **20 year design life** and the compact 12V versions a solid 16 years.

Being capacitor-like, they can charge faster than standard lead acid batteries and provide fast, harder surges which is required for starting pumps, fridges, air-compressors, air-cons etc. This hardness can also increase an inverter's lifespan. The opposite is the case with softer standard batteries, which can drastically shorten an inverter's life span. Battery **capacities range from 74-1332Ah** at C10 drain (drain over 10hrs).

TIP: If you have the spare cash, go for 2V cells, as each cell can be individually optimised and in the rare case of a failure,...replaced. With 12V, the whole battery block has to be replaced.

ADVANCED ULTRAGEL - THICK PLATE ADVANCED CARBON TECHNOLOGY
TEMPERATURE TOLERANT – LONG SERVICE LIFE – PROVEN RELIABILITY

Developed by Battery Energy with the collaboration of CSIRO.
For the highest level of reliability for RAPS, and solar applications.

Key Features

- Superior life under extreme temperature conditions.
- Thick plate technology giving 20 years design life.
- Advanced Carbon Technology.
- Specially designed corrosion resistant alloys.
- Unique GEL formulation to prevent 'dryout' of electrolyte.
- Features extremely low float currents and high operating efficiency.
- Excellent recovery from deep discharge.
- Complies with AS 4029.2, IEC 60896 21&22, IEC 896.2 design standards.
- 100% cell testing to ensure reliable performance.

Specifications

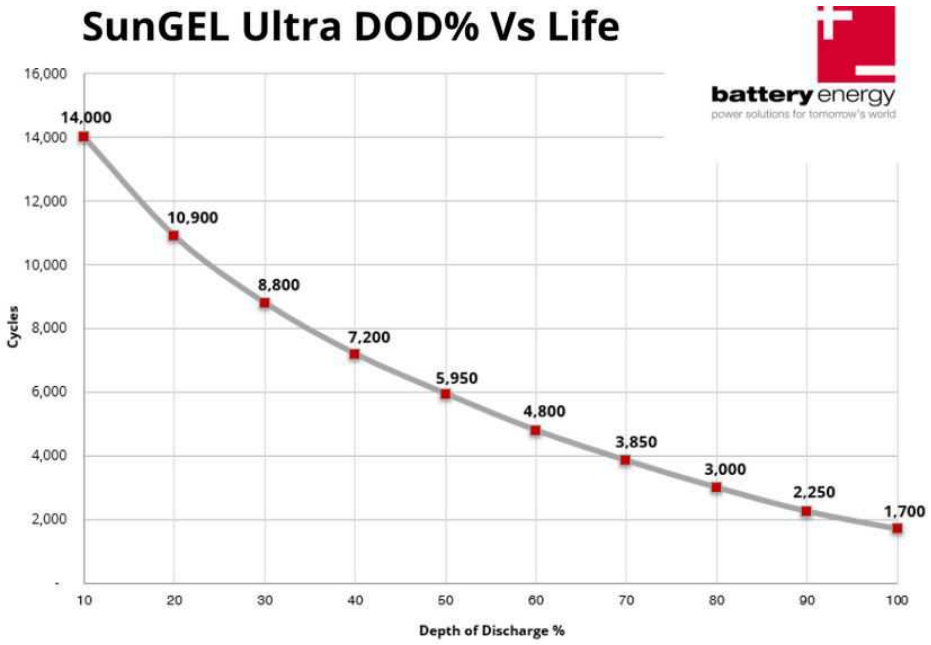
Nominal voltage	12 Volts
Rated capacity (C/120 to 1.80 Vpc at 25°C)	205 Ah
Design life at 25°C	16 years

Mechanical Characteristics

Height	325 mm
Length	560 mm
Width	125 mm
Weight	58.5g
Terminal	M8
Torque	8-10 N m

Operating Conditions at 25°C

Capacity	C/120 to 1.80 Vpc	205 Ah
	C/10 to 1.80 Vpc	166 Ah
	C/1 to 1.80 Vpc	104 Ah
Internal resistance		4.5 mΩ
Maximum discharge current		380 A
Short circuit current		1625 A
Charging (constant voltage)	Boost	2.40-2.45 Vpc
	Float	2.25-2.275 Vpc
Capacity temperature dependence		0.6% per °C
Self-discharge		2.5% per month
Operating temperature		-20°C to 55°C



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- Complies with AS 4029.2, IEC 60896 21&22, IEC 896.2 design standards.
- 100% cell testing to ensure reliable performance.

Specifications

Nominal voltage	2 Volts
Rated capacity (C/120 to 1.80 Vpc at 25°C)	262 Ah
Design life at 25°C	20 years

Mechanical Characteristics

Height	265 mm
Length	184 mm
Width	109 mm
Weight	13.5 kg
Terminal	M8
Torque	8-10 N m

Operating Conditions at 25°C

Capacity	C/120 to 1.80 Vpc	262 Ah
	C/10 to 1.80 Vpc	175 Ah
	C/1 to 1.80 Vpc	96 Ah
Internal resistance		0.85 mΩ
Maximum discharge current		380 A
Short circuit current		3000 A
Charging (constant voltage)	Boost	2.40-2.45 Vpc
	Float	2.25-2.275 Vpc
Capacity temperature dependence		0.6% per °C
Self-discharge		2.5% per month
Operating temperature		-20°C to 55°C

ADVANTAGES OF SUNGEL CARBON

- **They can do around 14000 cycles** at 10% cycle depth and around 7200 at 40% depth (40% being a more typical household usage for a budget battery setup). At one cycle per day, 7200 cycles would equate to a massive 20 year life span. As an example, 4 x 12V 166Ah C10 batteries at 40% cycle depth would provide up to 3.2kWh/night cycle power, which would cover electric cooking, lights, TV, laptop, communications, and a water pump.

- **They are 100% recyclable**

- **Made with advanced moisture trapping, GEL and gas re-combining caps,** they gas far less than standard batteries do. A little known fact is that cheap sealed AGM and GEL batteries can gas quite heavily if charged to fast or high and if drained quickly. As such, they shouldn't be used inside campers or confined spaces unless they are well ventilated.

- **Carbon batteries are sulphation resistant** and don't suffer from the problems standard lead acid batteries do, where sulphates end up covering the lead plates or even grow from one plate to the other, shorting them out and potentially causing fires and explosions. This has also been a danger with lithium batteries where cars, phones and toys which have suddenly exploded for no apparent reason. To see what we mean, do a search on "lithium explosion" and click on the picture view. In fact, anything lithium in a bushfire would pose a serious risk. This can even be the case for the newer "safer" LTO batteries.

  See destruction test of various Lithium types:
  https://www.youtube.com/watch?v=Qzt9RZ0FQyM

- **Carbon batteries can be repeatedly deep cycled without damage** and can even offer a staggering 1700 cycles (nearly 5 years) when fully flattened each day! At full discharge, almost every other type of lead acid battery, would fail within just a few hundred cycles.

- **Being capacitor-like, they can charge 2 x faster** than classic lead acid batteries and as much as fast charging can quickly ruin standard battery types, carbons can handle sporadic charge bursts of around 20-25% of their Ah rating. This is great for those short breaks in cloud, on rainy days.

Battery capacitance vs. runtime

24V 330Ah = 8kWhr = 3-4 days fridge, lights, communications.
This size also provides up to 3.2kW/night drain for up to 20Y life span

24V 660Ah = 16kWhr = 5-6 days fridge, lights, communications.
This size provides up to 4.8kW/night drain for up to 20Y life span

24V 1330Ah = 32kWhr = 6-8 days fridge, lights, communications.

NOTE: 32kWh could be an overkill if your area only rarely has longer than a week rain, as it would cost less to get a decent fuel generator with 60A-120A charger.

Get discounted carbon batteries here: www.solarlaserproductions.com.au/SHOP.htm

CHEAPER DIY HYBRID BATTERIES – Another interesting long life solution

Hybrid Super Capacitor batteries can be made up of cheaper Carbon GEL batteries and paired with a super capacitor which reduces the erosive impact the high surge currents have on the lead plates. As such, capacitors with their millions of cycles can make standard batteries last 1.5 – 4 x longer than normal, making this budget combo a very interesting way to go.

Hybrids are not commonly found in solar systems because the super capacitors are very expensive (>$3000). They are mainly used in buses, trains and mining vehicles, where huge currents are needed to accelerate a vehicle and where ultra fast recharging is required.

These high acceleration currents can in a smaller way, be compared to the surges of a typical solar system when a fridge or pump starts or when a washing machine rotates to a fro. Throughout the day there can be hundreds of "micro-surges" chewing away at the battery plates and because a super capacitor blocks the surges from reaching the battery, battery life span can be dramatically increased. CSIRO and other have released interesting reports on this phenomena.

With low cost, used super capacitors now entering the market, the DIY hybrid has become a reality. All one needs is a quality low cost battery and a super capacitor of the right size. One of the life budget batteries with the lowest warranty returns, is the heavy plate, dry out resistant German GEL Maxon Carbon battery, with it's **10 year design life and 2 year warranty.**

The plates are so thick that a 160Ah C10 6V battery which weighs ~30kg, compares to the same weight and power of the high-end Aussie Carbon SunGel. **NOTE: Maxon specs state a 204Ah capacity** at C10 (10hr drain) but our tests find the reality in a solar setup to be more like 160A.

Get discounted Maxons and capacitors here:
www.solarlaserproductions.com.au/SHOP.htm

TIP: Apart from using capacitors, to **increase the longevity of batteries,** it is recommended to never put batteries on cement or cold floors. This is because they need to have a homogeneous temperature on all sides to reduce the formation of electrolyte stratification, which can cause uneven lead plate erosion.

To add years to the battery life, lay the batteries on their sides on wood beams so that air can get underneath them and with the shortest side of the lead plates standing vertical enabling quickest cooling and lowest scarification. Put the batteries 1cm apart and if stacking is necessary, use a rack with a minimum of 1cm spacing between the levels. Tilt the batteries up slightly to the front so that the air flows up and out quicker.

Sizing the battery set

To save the most amount of money possible on a solar generator without forfeiting quality or longevity, we up-size the panel set so it provides enough power to cover all basics through cloudy days without taxing the batteries and then downsize the batteries to as small as just one night cycle capacity.

If you work it out, there is a point where more batteries become costlier than buying a back-up generator with charger and because you will always need a back-up generator of some kind anyway, you may not really need more than just a few rainy days battery capacity. Besides, more than a day or two of solid rain is generally quite rare in many places in Australia and even on rainy days, there are often breaks in heavy cloud, enabling battery recharging.

The main thing to watch for when sizing batteries is a high enough Ah rating to cover your maximum 30 minute inverter current. For longevity, this should be within 1/3 the Ah rating of the battery. With carbon batteries, you can go as high as 2-3 times the Ah rating for short surges, so surge calculations are rather unimportant. For example, a 166Ah 12V carbon battery can provide surge currents of 380A.

Eg. A mains like 1800W Latronics inverter, can deliver a 30 minute maximum load of 2200W at 230VAC = 92A battery drain at 24V. Optimal for that inverter would then be a battery set with at least 3 times 92Ah capacity = 276Ah.

4 x 12V carbon 166Ah batteries (332Ah 24V) would be a perfect match, and also provide 8kWh of usable emergency energy. This should keep a fridge/freezer, lights, communications and a pressure pump going through 2-3 days of solid rain.
A 40% nightly drain would then be around 3.2kW usable energy, which can even cover eco electric cooking.
A 12 x 2V 315Ah set would do similar but 2V batteries are a lot more expensive. They do however have a 4 year greater design life = 20 years.

The 20% max charge rate of a 332Ah battery would be around 66A, which is around what the larger GSL regulator does. 60A at 24V requires around 1440W of solar power which on a sunny day will then do most of the heavy lifting of 2200W drain. This then relaxes the battery drain down to 30A which is just 15A per 24V set. At that rate, a battery could support the inverter at full power for a good 10hrs before it was empty. That's why **one should only ever run heavier appliances for longer times on sunny days** and not at night or on cloudy/rainy days.

Saving money with the "Cloudy Day Solar" Concept

Much of the time, the sky is either cloudy or hazy and because panels only provide around 10% power on such days, we find that if we size a panel set so it covers all basic energy needs through a cloudy day, we rarely need a back-up generator, even for days with patchy rain.

To keep the price of a larger set of panels down, we buy them used. **Panels are an element of a solar generator that we recommend buying used** as they can last decades if set up on a steep angle. Just make sure that they are tested, quality brands with like new output and come with a minimum 1 year replacement warranty. We often have stock of good quality used panels with a 2 year warranty, if you need some. We also have new panels with full warranties going at good discounts. So check our website shop before buying panels.

Because panels lose as much as 30% of their output when they get hot, it is wise to tilt them steeply (45 degrees and above) so that the high summer sun can better sheer off the surfaces. What you lose in output by tilting, you gain back to some degree through cooling. Being steep, they are also less likely to bleach, crack or sustain hail damage. As such, panels should then last 30 to 50 years instead of just 7-10 in our extreme Aussie summer sun.

Getting the longest life from a solar panel is important, because they are hard to recycle and quite toxic. With such a long lifespan ability, getting used panels then makes a lot of sense and to get more to boost cloudy day output, is a wise investment. What one saves on panels and a reduced battery bank, one can then put towards new, high quality batteries, inverter and regulator. As such, balancing a long life compact battery set with a large used panel set is the best way to build the most economical solar generator possible.

NOTE: Used panels are fine but... we strongly recommend to only ever buy electronics new! Here's why...

Electrolytic capacitors slowly dry out over time, causing electronics to do strange things or even fail as they approach the 10-20 year mark. Cheaper electronics can even fail well within the 5 year mark with computer boards in the early 2000's lasting just one year due to cheap capacitors. The same goes for standard batteries, which are in a sense, large capacitors. Over the years, we have found that used AGM and GEL batteries are always sulphated to some degree and don't last much longer than 2-4 years after installation. So we now avoid them completely.

This does not apply to used crystal or quality carbon batteries however, because typically, they don't sulfate or suffer from dry out. As such, slightly used batteries can still have long life spans and are also recommendable. When buying used crystals or carbons, make sure you get a 2 year minimum warranty. We occasionally have good quality warranted used crystals and carbons, so let us know if you are interested in such.

Panels in parallel versus panels in series

Working in parallel makes it easy to mix and match various common panel types with same voltages and different amp outputs. To do this, we just group the panels of the same voltage together in parallel (eg. 37V) and put them through a dedicated regulator. If there are other panels with a different voltage (eg. 44V), they are put through another dedicated regulator. Both regulators can then charge the same batteries at the same time. The different amps of the different aged or sized panels then simply add up to one collective output current and the regulators regulate the current and charge voltage. Not all regulators respond well in parallel, so it is advised to get the right kind. We use the robust Aussie GSL.

When working with a 24V battery set and using a MPPT regulator, you can use any panel which puts out around 36 or more volts under load. Commonly, the 180-200W panels have this voltage. Even 2 x 12V panels in series can add up to 36V under load and can even be put in parallel with the 195W panels.

250W panels tend to put out around 31V under load and are better suited to 12V batteries when using an MPPT regulator but can also be used effectively on a 24V bank in conjunction with a good PWM regulator, as it doesn't need much voltage overhead to function well. Just make sure that the voltage after panel extension line drop is above 29V at the regulator. PWM (pulse width modulation) generally only pulses the full panel current straight through and as the battery fills, to reduce the current, the pulses become smaller in width or lower in frequency. For this reason, avoid using a PWM regulator if you have a higher input than a few volts above the full battery level, as you would then waste a lot of energy. Alternatively, you can also use 2 x 250W 31V panels in series to get around a 62V load voltage into a GSL MPPT regulator. Then put multiple sets of 250W pairs in parallel to increase the current.

Another advantage of parallel is that if there is shade or a leaf on a cell, only that panel will lose power and not the whole panel string, which is a big disadvantage with grid connect systems where panels are strung in series to make hundreds of volts. People sometimes go for years without realising that a single under-performing panel is bringing the whole system down. Series also generates lethal voltages of 400-600V DC or more. Touch that and you could cramp up and die, as has happened to fire-fighters and solar panel cleaners.

Ground based parallel solar, doesn't have these problems and also provides more stamina through a wider range of situations. When panels are mounted steeply, leaves generally slide off and the panels self-clean with every rain fall, whereas with flatter roof installs, the dust accumulates at the bottom end of the panels, sometimes covering the lower cells, drastically reducing panel output.

A rough rule of thumb formula to size your panel set, is to get as many watts in panels as you need to cover your 24hr minimal energy need. Cloudy day power drops to around 10% of what the panel is capable of but being ambient light, the panels can produce that power for around 10 hours per day.

E.g. If you need 2.4kW for a 24 hour cycle, then get at least 2.4kW of panels. 2.4kW should run basics like a fridge, lights, communications and a pressure pump over a 24hr cycle.

Take into account that the more you tilt the panels, the less output you will get and you will need some more panels to make up for the shortfall. As wasteful as this may sound, the more you tilt, the longer they will last and for a few hundred dollars extra, this once in a lifetime investment is a very economical way to go.

Here is the rough calculation of angle versus power output, for a cloudy day.

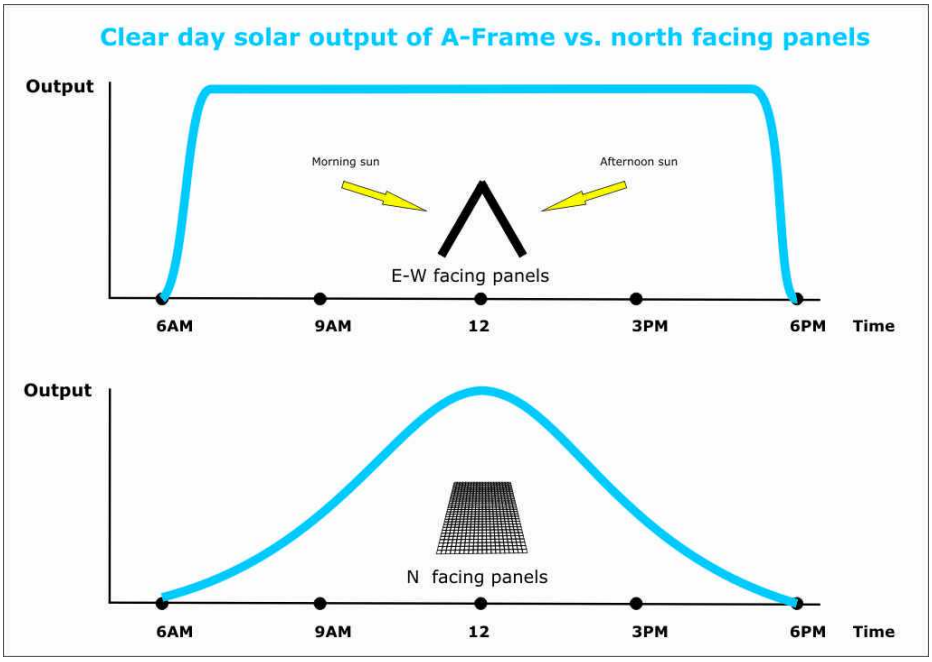
If you take flat facing the cloudy sky at midday as 100% output, then

45 degrees tilt = 80%
60 degrees tilt = 70%
90 degrees tilt = 60% (this is then a vertical panel)
and even facing the ground at 45 degrees will still give you 40% output!

We have found that the best way to set up panels is as 60 degree A-Frames, with one side facing east and one west.

This effectively captures the first and last of the sun which quickly charges the batteries in the morning when they need it most, then relinquishing the panels to run much of the house during the day and then maxing the battery charge right up until dusk where the batteries need to be as full as possible for the evening.

At midday, being so steep, each side of the A-Frame will only put out half its potential power, which collectively adds up to the same as when the sun shines on one side only. This keeps the power output more even throughout a sunny day, reducing the stress on all elements of the system and providing a more usable power where needed.



A-Frames made up of 185-195W panels generally put out around 300W per cloudy day. This makes calculating the amount of A-Frames required, an easy task.

Examples based on 195W panels:

1=300W (Enough for LED lights, phone charging and 2hrs laptop)
2=600W (Add a DC pressure pump)
3=900W (Add a small washing machine)
4=1200w (Add a bar fridge)
5=1500W (Enough for a mini eco-conscious house or solid camp site)
6=1800W (Enough for a mini eco-conscious house or solid camp site)
7=2100W (Enough for a mini eco-conscious house or large camp site)
8=2400W (Enough for an eco-conscious house) – **MOST POPULAR SYSTEM**
16=5800W (Add electric cooking and shed tools or day air-conditioning) **POPULAR**
32=11600W (Add a granny flat and day air-conditioning – or use as a farm set up)

A-Frames made of 250W panels put out around 375W per cloudy day.
A-Frames made of 300W panels put out around 450W per cloudy day.
A-Frames made of 400W panels put out around 600W per cloudy day.
(Formula: 1 x panel power x 1.5 = A-Frame cloudy day output total)

To make your A-Frames storm resistant, you can order them with aluminium feet which you simply screw onto the panel frames using the supplied self drilling screws. The supplied 40cm long gal plinths are then used to peg them to the ground.

Where to get used or new panels & feet at a discount:
See the Shop at www.solarlaserproductions.com.au/SHOP.htm

ROBUST CABLES FUSES AND CONNECTORS

This is a very important part of the jigsaw puzzle and if not done right, can cause losses and heat build up which could even lead to fire. We have seen too many connections oxidise and burn out to trust "off the shelf" connectors.

As such, **we have all of our cables made to our specifications**. The cables are industrial grade and over specified for the job. When hit with the highest loads for long periods of time, they barely change in temperature. This is due to the increased cooling area of a 4 strand cable compared to a thicker one strand cable.

All plugs and lugs are not just round crimped (like with most suppliers) but for the longest and most reliable life possible, are flat crimped to increase surface area and then soldered to guarantee optimal contact.

All joins are then sealed with heavy shrink covers which have glue sealant on the inside. To add to security, we limit the current flow per cable to around half of what it's capable of.

To avoid losses over longer cable extensions from the solar panels to the batteries, we tend to limited lengths to 10m and if longer is required, we double them up. The other option is to double the voltage of the panel by putting 2 in series and then paralleling the pairs for collective current.

Where to get robust cables at a discount:
www.solarlaserproductions.com.au/SHOP.htm

Here is an example of 16 A-Frames made from 190W panels, shading and powering a container house with electric kitchen:

Specs:

16 x 300W CD A-Frames = ~5kW/cloudy day output
~35kW/sunny day output.
24V batteries with 13kW capacity.
4000/4500W 24V Latronics inverter.
2 x GSL 60A MPPT DC DC regulators.

The electric kitchen has:

- toaster
- kettle
- electric cooker
- 3kW built in oven
- large fridge freezer
- blender
- mixer
- etc.

Here is an example of a double sided solar fence, generating around 1kW/cloudy day and around 4kW/sunny day, for a cottage with a small DC fridge, lighting, stereo, chargers for tools and a sewing machine.

On a sunny day, it will also run a washing machine or slow cooker.

The ultimate Compact Cloudy Day Solar Box.

Here we have a prototype of the most powerful compact "Origami" solar box capable of producing around 5kW/ Cloudy Day and up to 15kW/ Sunny Day with a size of around 3x3x3m.

It is made up of 36 x 195W panels in parallel, charging 24V 320Ah batteries made up of 8 x 6V 160Ah Maxon Electric Vehicle batteries coupled with a super capacitor.

The batteries are running a house and shed via a 4000/4500W Latronics inverter.

This unit can also be made in a trailer version with folding panels.
(See trailer versions below).

And now let's have a look at some typical kit examples.

All of the following examples are based around the use of AC inverters but if you buy DC only appliances, **you could also run an entire house on DC.**

This can be a cheaper way to go if you only want to run a tiny house but **can be more costly if you want to run standard household appliances** on DC.
NOTE: full size DC fridges are very expensive when compared to AC fridges.

Hybrid systems with DC for most appliances and a smaller AC inverter for white goods can be a good way to go if planned carefully. Eg: a 24V 750W inverter can power a full size fridge and washing machine as well as chargers and many low wattage power tools.

If this interests you, ask us for more information and we will recommend various DC appliances and the right sized mini inverter for your needs.

Solar Kits

Being modular, kits can be up or downsized to suit exact needs. If you are unsure of the size you need, you could start with a basic kit and add to it later. The sky is the limit and there is no reason why you could not ramp up to a size which could run a house plus a shed and even charge an electric car, and down the track even your personal one seater drone!

Here are a few examples based on 12V carbon batteries.
Ask for advice and a quote, before making a final decision.
We are happy to help.

1.2KW/CD MINI SYSTEM – FOR LOW ENERGY APPLIANCES UP TO 750W

1.2kW power generation per **cloudy day** will run the following:

Bar fridge, 4hr Laptop or TV, 3 phone charges, 5hr 2x LED light, 1hr 50W pump


90Wh
0.6kW/D


60Wh
0.24kW/D


60Wh
-


20W/chg
0.06kW/D


5Wh
0.05kW/D


50Wh
0.05kW/D

On a sunny day, 7kW power generation with the fridge on, can also run an additional device or devices with up to 600W total consumption.

E.g. a washing machine, a slow cooker, shed tools, a vacuum etc.


300-600W


300-600W


400-600W


600W

PARTS NEEDED TO RUN THE ABOVE

2 x carbon batteries 12V 166Ah (C10) = 4kWh capacity x 40%= 1.6kW/night
1 x 600/750W 30min 24V Latronics inverter (will run a standard washing machine or fridge)
1.2W Solar generation through cloudy days = 4 x 300W A-frames = 1.2kW/CD
1 x 30A Regulator/Charger with battery cables, lugs and fuse switches
10m of solar extension cable with crimped and soldered panel plugs.

See the Shop at www.solarlaserproductions.com.au/SHOP.htm for discounted prices

As small as this system is, it packs a mighty punch and can provide enough power to run many low wattage household appliances. It is perfect for anyone on a small budget, with little space or living in a camper-van. If you are renting, you can even transport the whole kit with a small car when you move. The A-frames can be folded down to 160x80x8cm each and stacked on a roof rack with the batteries, regulator and inverter in the boot. The total weight is around 280kg which as much as 4 x 70kg passengers.

UPGRADES: If you need more cloudy day power, simply get some more A-frames.
Want to double the night and rainy day capacity? Double the batteries and add another 30A regulator or get 4 x 166Ah (C10) batteries and a single 60A regulator, with a bigger panel set from the start. **Want to go up to the next level** then get the following kit:

2.4KW/CD SHACK OR MOTOR HOME SYSTEM FOR APPLIANCES UP TO 1.6KW

EXAMPLE: 2.4kW power generation per cloudy day will run the following:

Standard fridge freezer, 7hrs Laptop/TV, Toaster+Kettle, 5x phone charges, 5hr x 4 LED lights, 2hr DC pump, 4hr moderate sound system or other low energy units


200Wh
1.5kW/D


60Wh
0.42kW/D


1200Wh
0.2kW/D


20W/chg
0.1kW/D


5Wh
0.1kW/D


50Wh
0.1kW/D


5Whr
0.02kW/D

On a sunny day, (13kW/SD) with the fridge and computer running, you can also run an additional device or devices with up to 1400W consumption.

E.g. standard washing machine, a mini oven, shed tools, a vacuum, bread maker, etc.


600Wh


1400Wh


1200Wh


1200Wh


1400Wh

PARTS NEEDED TO RUN THE ABOVE



2 x carbon batteries 12V 166Ah (C10) = 4kWh capacity x 40% = 1.6kWh/night


1 x 1200/1600W Latronics inverter


2.4kW Solar generation through cloudy days = 8 x 300W A-frames = 2.4kW/CD


30A Regulator/Charger with fuse/switch, crimped & soldered battery cables and lugs


2 x 10m solar extension cable with crimped & soldered plugs

See www.solarlaserproductions.com.au/SHOP.htm for latest discounted prices.

This larger system will provide enough power to run most common household appliances. When you buy toasters, kettles and mini ovens etc, make sure they use under 1400W max. The lower the better. This system is perfect for anyone with limited backyard or camper bus space.

The kit can be folded up so that you could transport it with a car which can take 200kg roof rack weight plus 160kg in the boot. That's about the weight of 4 x 90kg passengers.

For a little extra money you can extend this system in capacity and output power.
See below:

Upgrade to run a freezer for a few hundred dollars extra: If you add 2 more A-Frames, you will have the extra power to run a top-loader freezer and extend to 12hs of Laptop time, or run a modem without extending laptop time. Total cloudy day power = ~3kW

Upgrade the inverter to run most any single phase appliance for a few hundred dollars more: If you ever have tradesmen working at your place, you'll need to get at least the 1800/2200W inverter. It will run all kinds of single phase tools, including an air compressor. If you generally stick with low energy household appliances, you could also run a 400W single phase room air conditioner on sunny days without taxing your batteries.

To run an larger eco-conscious house with an eco-electric kitchen and electric solar hot water booster as well as a shed with single phase power tools, you will be better off with a 5kW cloudy day (22kW/SD) system with 16 x A-Frames, a second 60A regulator and a total of 8 x 166Ah batteries = 16kWh storage capacity.

PARTS NEEDED ARE:

8 x carbon batteries 12V 166Ah = 16kWh capacity x 40% = 6.4kW/night
1 x 24V 4000/4500W Latronics inverter or 2 x 1800/2200W inverters
5kW Solar generation through cloudy days = 16 x 300W A-frames = 4.8kW/CD
2 x 60A Regulator/Charger with fuse switch, battery cables and lugs
4 x 10m of 6mm2 solar extension cable with crimped and soldered plugs

This larger system will provide enough power to run a built in oven a hot water booster or 2 heavy single phase appliances at the same time.

This system can be folded up and transported with a 1 ton UTE. (500kg panel weight + 500kg battery, inverter & regulator weight).

To help you decide which configuration would be best for you, feel free to contact us either by phone or email.

The delivery of parts is usually within 10 working days after payment has cleared.
See the Shop at www.solarlaserproductions.com.au/SHOP.htm for the latest prices.

PRE-WIRED KITS IN BOXES BOLTED TO TROLLEYS

If you don't want to get involved with the wiring up of batteries, a solar charger and inverter etc., and you are happy to spend a few hundred more for the luxury of a click and connect boxed system on wheels, then this is for you.

The boxes,.. which have the batteries, solar charger, inverter, fuses etc., built in and wired up, are wheeled into position and simply clicked onto the solar array extension and switched on. It's that easy. The boxes can either be used in an upright space saving position in garages or small rooms, or laid down and pushed under floors, shelves, into the back of larger campers or under the solar A-Frames.

Mobile trailer solar generators

Solar generators on trailers, with mains like power are also available, in various sizes.
Here is one which can power an eco-household and folds to a 3m tray length.
The weight is around 650kg total.

Tow your grid like power around the farm or to a camp-site where you can power a standard kitchen size fridge freezer, a laptop, communications devices and a large set of camp-ground lights.
You can also run a river pump and an osmosis unit to make drinking water.

Here are some other uses:

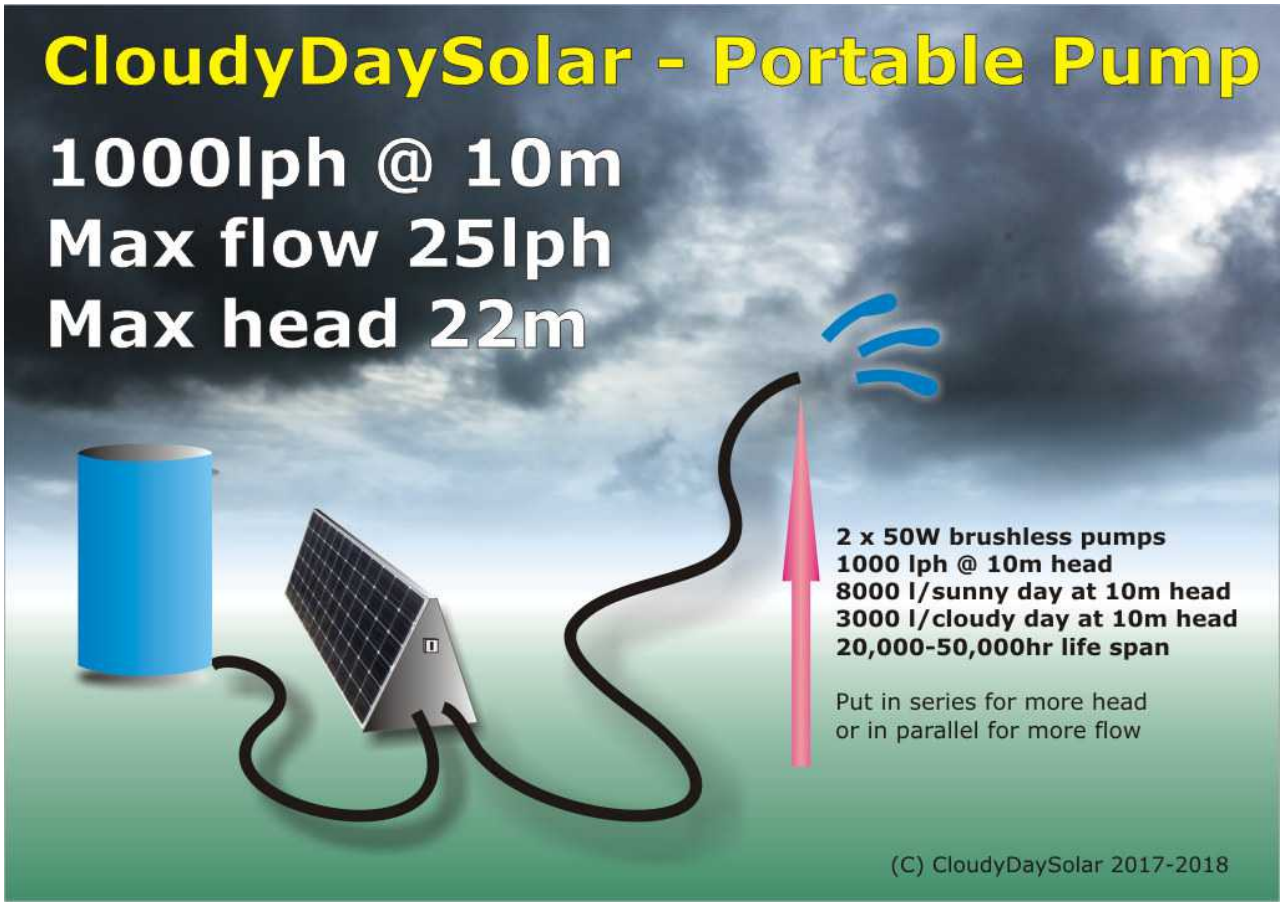
1. run an electric fire fighting or irrigation pump
2. run an emergency kitchen and communications setup
3. run a mobile tradesman workshop
4. run festival sound systems and grounds lighting

Solar Pumps

Stand alone solar pumps can be used for house pressure systems, tank or dam transfer pumping, irrigation, aquaponics etc.

They come packaged as A-Frames with built-in long life batteries, pressure sensors, bladder tanks and an optional automatic priming pump if you need to pump up from an underground tank, river or bore.

Here is an example of a stand alone long-life water pump



To avoid any solar energy waste, multiple water proof, high quality, food grade brushless micro pumps are assembled in series or parallel to meet the exact flow and pressure needs of a specific application.

Eg: Right is a 96W 3000lph dam to dam pump output.

For high pressures and volumes (e.g. 80m head and 5m3/h flow), a large brushless surface pumps can be used. Also, highest efficiency, long-life DC submersible well pumps are available with A-frame solar generators.

Here is a 25lpm, 20m head pump with primer suction pump, pressure switch and bladder.

2 x 195W panels, a regulator and a 100Ah battery provide the energy.

Nursery pump. 3000 lph at 30m head

This first-of-a-kind robust pump system collects enough power on a cloudy day to run the inbuilt 600W DC pump for 3.5 hours without taxing the battery.

This pump has replaced an existing 2400W 240VAC pump which was a bit excessive for what was needed.

This system is set to run by itself for 10-20 years through cloudy days with little to no maintenance.

Air to water units - SunWater

Making a couple of litres of water from the air even on the driest of days is easily done with as little as one A-Frame panel set-up, a battery, a small inverter and a compressor dehydrator.

The reason for the battery is that **during a dry day, the humidity is only at around 20%** and it's not worth running the dehydrator at that low level, but as soon as the sun goes down, the humidity shoots up reaching over 50% by early evening and can max out at around **80% by 3 in the morning**.

So it makes sense to absorb suns energy during the day and then to release it at night when the air is saturated with water.

2 litres may not sound like much when looking at the need for a litre per day per square meter for veggie irrigation, but when irrigating via underground wicking mats where just 10% of the water is needed, suddenly 2 litres can keep a 10-20 square meter veggie patch going through a drought.

We are working on even more efficient, lower energy systems for the future but this compressor system is available now.

Night air conditioner which uses next to no power

Use a small top loader freezer and to more effectively store energy in the form of ice, fill it with salt water bottles (salt lowers the freezing temperature of water).

Because small freezers don't use much power (typically 80-110W) they hardly take power away from an existing solar system, even on cloudy days. When the freezer gets warm on one side where it tries to cool itself, a spiral hose of water can collect the warmth and store it in a holding tank for showering. This collection also increases the efficiency of the freezer.

After a day of freezing up the bottles, using a timer, turn the freezer off and then blow fresh outside air through the freezer and up a poly pipe from the cold bottom up out and over an elbow into the room you wish to cool. As a side effect, in the morning, the freezer will have several litres of water in the bottom which can be drained via the bung to the veggie patch or water filter and sterilised for drinking.

The gravity fed Berky filter with embedded silver, is a good gravity water purifier offering filtering almost as fine as an osmosis unit.

Let us know if you are interested in such systems.

Battery Charger

Mains or generator run battery chargers are sometimes necessary when heavy rain goes on for days.

As we found that **most high current chargers are very expensive** and the cheaper ones quickly burn out or don't even deliver half of what they are promoted to do, we now assemble our own chargers, based on a select brand of low cost yet reliable 20A digital chargers.

When run in parallel, they can comfortably put out very high currents.

Eg: To fast charge a 12V 320Ah carbon battery set at 20% of the Ah rating, a charge of 60A would be required. That would be 3 x 20A 12V chargers in parallel.

If there was a 24V bank to charge, a second 60A charger set would be used.

That's 6 x 20A chargers in total.

We supply 1 x 12V or 2 x 12V 60A chargers built into a solid carry case. Depending on how many chargers are switched on at one time,... 20, 40 or 60A continuous currents can be achieved.

Adapter leads wired for fixed 20, 40 or 60A capabilities for different battery types can be also obtained.

Get a charger at a discount at:
www.solarlaserproductions.com.au/SHOP.htm

Incorruptible Low EMF Solar Computers



In early 2000, we developed an Incorruptible Computer which for years has proven to be the most robust computer we have ever used. These computers are now available as low EMF, low energy, incorruptible Windows computers in laptop, desktop or portable workstation form. They can be packaged in solar briefcases so that they can work Off-Grid. All computers come with the select best free office, PDF reader, Zipper, music/video player apps etc.
Optional high grade, free music/video/CAD/3D and more editing software is also available.

Advantages of an Incorruptible Computer

Incorruptible Computers practically nullify repairs and maintenance because they boot up from a locked "frozen-in-time" clean system. This enables them to recover from hacks, attacks, errors, blue screens and stay like new with each restart. Upon each shut-down, all changes to the system are dumped.

The "My Documents" folder is the only place where personal files can be permanently stored. Unlocking the system to add new programs or to do occasional browser update is quick and easy, using a password.

Incorruptible Computers also come a with fully automatic backup software installed. The minute you plug your dedicated USB backup drive in, it quickly tops up any difference between the MyDocuments partition on the computer and itself. Backing up couldn't be easier.

Because a snapshot of the entire Incorruptible system is also stored in the MyDocuments folder and then backed up to the USB drive, if ever you had to run from the house in an emergency, all you would need to take is the USB drive. From there the entire computer system with all programs, settings and personal documents can be quickly and exactly reconstructed onto a new hardware.

Incorruptible Computers are the most robust computer solution available. Great for banking, where all traces are wiped from the system at each new start, leaving nothing for hackers to swipe.

Available as:
New or pre-used units
Hire units from as little as $49/mth.
Get your existing PC upgraded to an INCORRUPTIBLE for $650 including lock
General computer repairs are also available via remote accessing only.
Call for further information. Looking forward to helping you! The SLP team.