

13. Off Grid & Your Own Mini Grid.

A Guide to the Basics ...

This chapter is for a friend, Richard, he helps us here at Le Vivray. Richard has absolutely NO knowledge of Renewable Energy, its terminology, its distribution and handling and its use in a normal domestic household.

For newcomers like Richard, this Chapter is the present state (March 2019) in achieving and supplying your own electrical power, ie, Off Grid.

Off Grid is always going to be difficult to fully understand, as there are so many variable's with your own particular situation. The World is changing, and folk see generating and using their own created power as a big step forward.

I will give costs in Euros/US Dollar, and Items that I mention can/are purchased in Europe. Please remember that the costs do not include Installation charges and the Installer charges, both of which can be very excessive, and make the project not cost effective.

For a normal Domestic property.

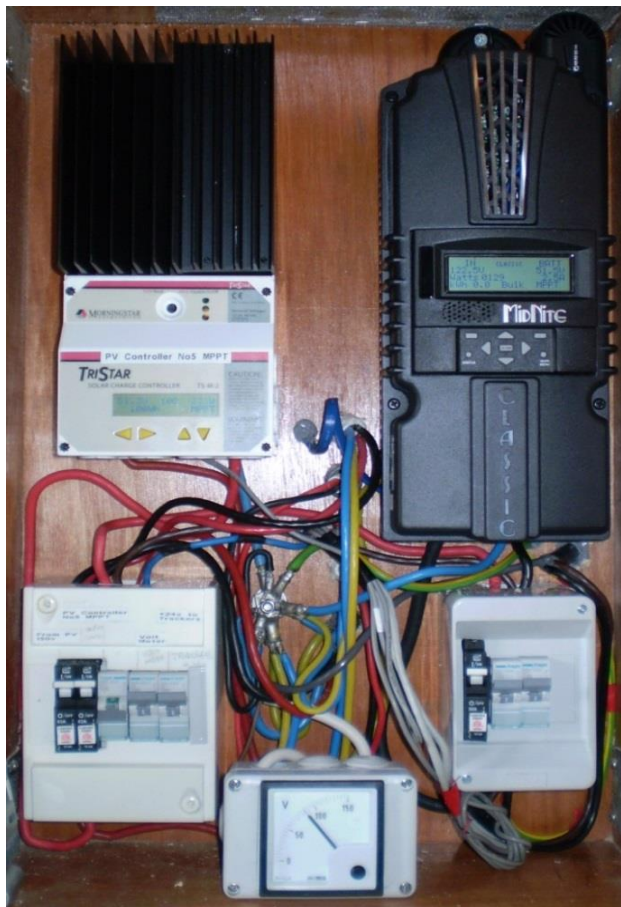
1. A renewable energy supply , eg, **PV**, Photovoltaic Panels.
2. Controlling the energy supply to charge the batteries, **Charge Controllers**.
3. **Batteries**, power storage.
4. **OzInverter**, converts a low voltage 48vDC to a 240v/120vAC & allows AC to back Charge and create a low voltage DC.
5. **Standby Power supply** .

1. **PV**. On average 15kW is about correct, and amounts to a required space/size in your garden, of a the PV array of between 20 meters by 5 meters, 60 panels each 250w, (1.6m x 1meter each) and 18.5 meters by 5.1 meters for an Array of 46 panels at 330w, (1.7m x 1.2m each). 15kW of Mono crystalline PV from **4,500 to 9,200 Euros**.



2. **DC Charge controllers**. Photo left. Either PWM or MPPT type. Also, it is possible to use AC coupling using second hand/used **GTI's (Grid tied Inverters)** and connect the GTI into the mini grid created by the OzInverter. Each DC Controller **200 to 850 Euros**. You will probably require up to 5 controllers. AC coupling, used GTI's, for 15Kw of PV approx. 5 off , from **150 to 300 Euros each**.

3. **Batteries....** Economically /cost effectively batteries are a problem, I and many others stick to tried and tested lead acid. Over the past 5 years I have been using SLA, Sealed Lead Acid, Ultra deep Marine type leisure batteries, or Golf cart type batteries as 'Oztules' calls them, bolt stud terminals are best.



Batteries continued;- 48off, 12v 110amp SLA, wired up in series of 4 for 48volts, and paralleled up strings to 1300amps or about 62kW. Life expectancy depends on rate of discharge, but 5 to 15 years is approximate, even longer if you really care for your batteries. A good tip for longevity is not to allow the voltage on each battery to drop below 12.23volts. Approximate cost for 48off 12v 110ah batteries **Euros 5,200**

4. OzInverter, 6Kw rated with surges up to 50kW. The 48v batteries get the OzInverter going, once it has a stable 240vac output at 50HZ, the Grid tie Inverters will connect to the Mini Grid created by the OzInverter. Once this happens then the GTI's will feed the Mini Grid and you can use that 15kW of PV power on the Mini Grid. However if you are not using all the power then some of the 5 GTI's will shut down as they see the battery voltage rise. I personally recommend a Mix of Charge controllers with say 5kW of PV going to DC Charge controllers, and the 10kW feeding GTI's that are AC coupled to the OzInverter created Mini Grid. Cost of materials for the OzInverter, all new parts, **800 Euros**, scavenging cores, copper etc, **350 Euros**.

5. Standby Power supply. In most instances we are talking about a 5kW diesel, Petrol or gas generator. The generator output is normally very unstable in both the AC voltage and the HZ sine wave. It is highly unlikely that it can directly connect and synchronise with the OzInverter. So its either a heavy duty Change over switch, or the generator is so arranged to DC charge the batteries direct through a dedicated 48v DC charger. Generator **500 to 1500 Euros**.

Conclusion Using the above approximate costs we are looking at about **12,800 Euros** for the basic installation parts for a 15kw PV and 6kW of available 240vac. Please remember there will be other costs, brackets, PV rails, cables switches etc.

Remember that in ambient light when the sun is not shining the PV can still be generating 20% of the 15kW, and that is handy in those grey and gloomy winter days.

So if at present you are paying your electricity supply utility company **3,000 Euros** per year, then as a rough guide your initial installation costs will be recouped within 5 years, being fair then 10 years is a more realistic payback time. However, you may need to run the generator and its cost, and don't forget to put some money aside for batteries replacement in 8 years or so. One thing for certain, you will change your life style, ie, when the sun shines do all that washing with the washing machine, heating the hot water when the sun shines, etc, etc.



Totally Off Grid With Solar.

2018..... The below is a very good , up-to-date, synopsis of the state of Renewable Energy for the normal Domestic Household that is very realistic and achievable.

John Tulloch, Flinders island, Australia, ('Oztules' on good World Renewable Energy Forums)

"There are a few installations down here now that came in around the \$15000 dollar mark. They use 10kw of solar, home brew inverter, home brew solar controller, and 35kwh battery banks.

They have no other form of power except they do have generator change over if necessary.

So far the generator has never been required but for one exception... out on one of the islands parks and wildlife had a rat eradication team over in the worst sort of solar weeks we have ever seen 10 days of heavy rain... and 15 people... this was a bit much, and the genny (5hp with modified car alternator) ran for a day..... thats it... power was rationed after that as the 15 city folk had no idea of conservation, and left the shearing shed lights on all night (600w for 14 hrs before the sun comes up), 15 ;lots of phones and ipads, and coffee urn all day and night etc... it was not a fair go really...

Apart form that event, there has been no generator support that I know of on the other sites.

As a rough rule of thumb at 40 degrees south/north, if you normally use 15kwh/day then use 15kw of solar panels.... if that includes hot water, maybe a few more.

If you don't go silly on the very dark days, (not just overcast, but dark) you should only use the genny for maintenance starts.. just to see if it still starts.

I find that 10kw will generate about 8-10 amps in truly terrible light (48v system), and more than you can choke on when it is light cloud or sun.... thats 400-500w.

If the heavy cloud brightens up even a little bit, your suddenly up in the 20-40 amp and more but still 8/8 cloud and pretty heavy... 8/8 cloud of single layer, and your back up in the 40-80 amps range... so it takes a miserable day to pull you down.

If you go up to the 15kw arrays, your making more than normal quiescent current no matter what the weather is, and should get 6-7kwh at the very worst... you can live with this as a generality... ie fridges, freezers, lighting and most other stuff except for heating and cooling and hot water.

With the cost of solar panels now, particularly second hand 250 watt panels, that 15kw array is cheap as nuts.... probably in the \$7000 range, which leaves \$6000 for batteries... and thats too much really, and a few thousand for inverter and controller and fixing materials.

Lets be clear, there is no need for a monster battery or an expensive battery, better to use golf cart ones that will last 5 years, and replace them every 5 years.

6x220ah American batteries can be found for \$200, so a 24 battery bank will only be \$5000 (you will probably get more years than that as they will rarely be discharged beyond 25%... and that should give 3000 cycles)

Stylish expensive cells (whilst I like them very much) are not necessary to produce a better system.

Panels are key and the only thing that is critical, charge controllers are of little interest if you make your own, and mppt is next to useless for this setup... simple 150amp pwm will do fine... maybe \$100, inverter around the \$300 if using old aerosharps or inspires.... point the panels any where you have access too. N, S, E, W.... east is particularly useful to get the recharge going early, so a 3-4 kw looking east is a good thing, a few kw west, the rest can be almost flat... just enough to self clean, pointing any place.

If really is cheap to go off grid if you ignore the experts, and their fancy add on's.

You only need expensive add ons (auto generator support and fancy software in your inverter) if your system is inadequate to start with, and now that can be solved with panels..... and you can build 2 of everything for next to nothing so redundancy is a given.

The world has changed simply because power is easy to get now panels are cheap. Thats my 2 cents worth, and it is working on installations down here.

OzInverters are now only about \$100 to build the electronics now, so I have plenty of spare change over units now. (oddly, non have failed yet... I felt sure the island ones would as they are the hardest to get to... but no..)

When the name brands fail (and they do), it has taken weeks for the owners over here to get back on line.... no fault of the Australian manufacturers/agents, but remoteness is everything, and real inverters are not trivial to transport off island and back... could build half a dozen for just the cost of freight alone if we use air freight.

All kinds of things become irrelevant, such as cooling for panels.. we don't want any, so you can clamp directly to the roof if you want, as ventilation is a waste of effort.. we actually want attenuation when it gets hot... coz that means the suns out, and we have probably 7 times the power we actually want then... some losses would be more than welcome. Line loss is a good thing now for the same reason.. when there is lots of current, there is actually way way too much, so losses are irrelevant too, and when the light is poor, the losses will be tiny/non-existent.

Mppt is useless for the same reason, may help when the light is poor, but that will be very rare for the complicated electronics that that brings, and the thousands of dollars that will add to the system.. for what? (15kw of mppt is not cheap... 15kw of pwm is a hundred bucks or so)

But I am a bit different in my views too.oztules

Flinders Island.