The Dollars and Sense of Solar Panels

With 453 watts of solar power in 6 panels on *¿Qué Tal?*, we almost never run the diesel just to charge the batteries. Even though one or two panels are frequently shadowed, having so many panels means that the majority of panels are usually putting out power. Our only maintenance is to wipe them off with a damp rag every few days.

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I'm sitting here, thinking back on our reasons for wanting to go cruising. Nope, nowhere on the list do I find sitting in a gorgeous anchorage, spending hours listening to the engine charge the batteries and having to change the oil instead of going snorkeling with friends. I want to stop this! But does it make sense to install a large solar array??

NOTE: This article was written in 2005. Since then, solar technology has become better and fuel costs have certainly gone up.

My husband Dave and I became full-time cruisers in 2002, and were surprised to find how often – and how long – we ran our engine to charge our batteries once we left the marina. While we have a certain number of "luxuries" aboard our 24-year-old Tayana 37, *¿Qué Tal?*, our power consumption is about average for cruisers we've met in anchorages here on Mexico's Pacific coast. Every other day, we had to run our diesel four hours to meet our power requirements. ***Four hours!!*** To us, that was just too much – too much noise, too much heat into the cabin, and too much wear and tear on the diesel. Sometimes, we even motored from one anchorage to another when we could have sailed, just because we needed to charge the batteries. Outrageous! We had three 51-watt solar panels. Did it make sense to add significantly more??

Many cruisers are surprised to find how much their energy consumption increases in the heat of the tropics. Refrigeration is the big culprit, but water consumption also goes up and watermakers have to run longer. For many boats, solar panels that kept the batteries nicely charged in California or Washington are woefully inadequate in the tropics, particularly for boats with DC refrigeration and watermakers. Boats with engine driven systems don't have this drain on their batteries but have to run their engines to power these and can only partially offset their energy consumption with alternative energy sources. The additional sunshine here just doesn't make up for the extra power used.

Initially, most cruisers run their diesels to make up the difference. Diesels aren't designed to run without a load, however, and using the engine primarily for charging can lead to major engine problems. So cruisers start looking for cost effective alternatives. Many, like us, don't want to install a generator due to space, maintenance and/or noise considerations. The winds here aren't consistently strong enough for a wind generator to be practical. For us, putting an additional 300 watts of solar panels – for a total of 453 watts – was the answer. The cost will be paid back in less than two years, we won't be tied to the boat while the batteries are charging, we'll have a lot less maintenance, we won't be adding extra heat into the cabin and we'll prolong the diesel's life and extend the time between overhauls and other major repairs and maintenance. Not to mention the silence!

To determine whether it makes sense to add more solar panels to your boat, first you need to know how many amp hours per day you need to replace (assuming that your battery bank is in good shape and sized properly – about 4 times your daily usage). Many sources give tables for determining electrical draw and these are useful if you are not yet cruising in the tropics. Be sure to allow sufficient power for the refrigerator – it is not uncommon for the compressor to run 75% or more of the time. If you are already out cruising, the most reliable way to know your energy consumption is with a battery monitor such as the Link 2000 installed on *¿Qué Tal?*. In the tropics, we ran a deficit of about 100 amp hours a day in the winter (even with the energy produced by our 153 watts of solar panels). We knew that it would be greater in the summer, when the refrigerator, fans and watermaker would all run more.

Next, think about where you can mount solar panels and how many you can conceivably install (see sidebar). There are numerous factors to consider in choosing panels and the choices change all the time. There are substantial differences in real world power produced by different types of panels (single-crystal, polycrystalline and amorphous silicon units) and even different manufacturers. Talk to other cruisers about what they have and how they like the panels, and read some of the many excellent articles written by experts. Generally, however, cruisers

wanting significant solar power are looking at multiple panels in the 75 to 120 watt range, and most of these are 36-cell polycrystalline units designed for charging a 12 volt system. After looking at manufacturers' and retail outlets' web sites for size, price and output information, we decided that we could add a fourth solar panel over our dodger (80 watts) and put two 110-watt panels on the rail around the cockpit for a total of 300 watts. To convert panel wattage to real-world amp hours produced in a 12 volt system, various experts say to divide by either three or four. For us, 300 watts should produce between 75 and 100 amp-hours per day. With even the lowest estimate, they would produce 75% of the energy we needed in the winter months. We had been running our diesel about 14 hours a week; needing only 25% of the power, we'd likely have to run it less than 4 hours a week – 10 fewer hours!

Estimating the cost of the installation is next. You can either get a bid from someone who will do the whole job for you, or you can do it yourself. We opted to act more as general contractors, planning the project, buying all the parts and doing part of the installation, but hiring out the stainless work for the mounting brackets and the electrical work. In estimating the cost, don't forget a voltage regulator, all the wire, in-line fuses and connectors, thru-deck fittings, mounting brackets, taxes and shipping. The electrician that we hired helped us make sure that we chose an efficient voltage regulator and large enough wire to prevent a significant voltage drop. Both are essential components of a good solar charging system and the voltage regulator must be compatible with and properly set up for the type of batteries you have (wet-cell, AGM, or gel cell). Solar charging is very sensitive to voltage drops, so it's worth the extra expense to make sure you've got large enough wire and also to make all wire runs as short as possible. We figured that our chosen panels would cost $2000 to $2500, including shipping, import duties, a new charge regulator, fabrication of mounting brackets, installation with us doing part of the work and adding some "Murphy money".

Estimated Cost of Solar Panels	
Panels*	$1305
New regulator*	$135
Shipping to San Diego	$100
Freight forwarding and customs to Mexico	$175
Mounting brackets, wire, installation materials and electrician	$300
TOTAL	$2015

*Panel and regulator prices vary widely – shop around and it's possible to save 30-40% from one supplier to another.

So now you know how much the panels will cost and how many hours of running the diesel are likely to be eliminated. To figure how long it will take for the panels to pay for themselves, next figure your cost per hour of running the diesel. For us, this turned out as follows:

Monetary Expenses	Cost per Hour of Diesel Run Time	
	Low	High
Diesel fuel – 0.66 gallon per engine hour at $2.00 to $2.50 per gallon	1.32	1.65
Oil filter -- $15 to $20 each, changed every 50 hours	.30	.40
Oil -- $15 - $20, changed every 50 hours	.30	.40
Racor fuel filter -- $10 - $12, changed every 200 hours	.05	.06
Biocide -- $20 to treat 1700 gallons of diesel	.01	.01
TOTAL	$1.98	$2.52

These expenses are the top and bottom prices we've paid for items here on the west coast of Mexico. Some items can only be imported from the US and thus include shipping and customs, and others are available locally. Since the cost of getting to the fuel station, generally by taxi or

dinghy, can vary greatly, I didn't include it. But it seems fair to say that on average, an hour of running the diesel costs us at least $2.25 – generally more. And fuel prices are rising again. So, if we save 10 hours a week of running the diesel, that's $22.50 saved in out of pocket costs. At this rate, it will take 90 to 100 weeks of use to pay back the cost, or just under two years.

Now let's look at the amount of time we have to spend on related tasks when we run the engine – leaving aside the hour that we're tied to the boat instead of snorkeling or exploring ashore. Maybe we can't put a "hard dollar" price on our time, but we sure know the cost of missing out on the fun!

Where we're cruising, we can't just pull up to a fuel dock and pour it in. First, there aren't fuel docks in many places and second, we prefer to run all our diesel fuel through a Baja filter before putting it in our tanks. So we have to load the jerry cans into the dinghy, go ashore, hike to the nearest taxi stand and find a taxi who's willing to do a fuel run, go to the fuel station, and then get the fuel on board (ever tried dinghy-ing out through surf carrying 4 jerry cans of diesel?), then hand pour it all through the Baja filter on a somewhat rolling deck (we pick the days with the least swell we can). Sometimes, someone will deliver diesel to boats in an anchorage, but then the cost per gallon goes up and has to be factored in.

We change oil every 50 hours due to the severe wear and tear on the engine when it's run solely for charging. From digging the oil out of the locker to taking the waste oil to the disposal site, an oil change takes about 3 hours of time. Oil filters for our diesel can be hard to find – I spent over an hour on the Internet finding a list of equivalent filters in as many brands as I could, then over 2 hours in taxis going from one parts store to another looking for any of them. I finally found two. Diesel oil isn't available just everywhere, either, and only once have we found our preferred grade. The time spent maintaining the diesel starts to add up:

Time Spent	Minutes Per Hour of Diesel Run Time
Getting fuel – at least an hour to get 20 gallons in jerry jugs, often more (60 minutes/20 gallons * 0.66 gallons)	1:59
Filling fuel from jerry jugs through Baja filter (60 minutes/20 gallons * 0.66 gallons)	1:59
Buying oil filters -- 2 hours to find 2 (120 minutes/2 filters * 1/50)	1:12
Buying oil – 15 minutes * 1/50	0:18
Changing oil – 3 hours * 1/50	3:36
Buying fuel filters, biocide and fuel treatment – Have to get in the US and hand transport down	N/A
Changing fuel filters – 2 hours * 1/200	0:36
TOTAL	9:40

So, for every hour that we run the engine, we spend over *nine and one-half minutes* on related chores.

And we haven't even considered the time involved in going to the ATM or bank to get sufficient local currency as the fuel stations don't take credit cards, the time to dispose of the old oil, the time spent on periodic draining of the Racor and its disposal, the roll of paper towels that gets consumed in the oil change process, or the frustration of trying to work in the tight confines of

the engine compartment and the colorful language that any of this can cause. Then there's the wear and tear on the engine, alternator, raw water pump and associated systems, which can add up to some serious boat bucks if they need to be repaired or placed. Less quantifiable are the pollution from the exhaust (and possibly from oil and fuel spills into the bilge as filters are changed), the question of whether the old oil will be disposed of properly, the heat put into the cabin, the noise and just being tied to the boat as the batteries charge.

Ten fewer hours of running the diesel each week, therefore, isn't just ten fewer hours of having to sit on the boat instead of going snorkeling or exploring ashore, it's also an hour and a half of related chores that we don't have to do. And we sure didn't come cruising for the joy of doing boat chores or listening to the engine!!

Conclusion

We want to live the dream, not specialize in boat repair – or even boat maintenance – in exotic locales. For us, $2000 to $2500 for substantially more solar panels is worthwhile, especially since it will be paid back in just under two years. The panels may help us avoid some major diesel repair bills, too. They take virtually no maintenance and most have warranties ranging from 10 to 25 years, indicating rare failure. To charge the batteries, all we have to do is keep the panels clean. They're silent and don't heat up the boat. In addition to freeing up the time we spent babysitting the boat while the diesel ran, we'll avoid an hour and a half of boat maintenance chores each week, or 78 hours per year – that's nearly two standard work weeks!! I'll be out snorkeling instead of trying to find oil filters; Dave will be helping build a local school instead of filling up the jerry cans with diesel. We'll spend more time at secluded anchorages where diesel isn't available. If our diesel does have a breakdown, we'll still have power for lights, windlass and e-mail to a mechanic until we can fix it – and the refrigerator will be keeping the beer cold to celebrate the successful repair job. And if we decide to make an extended offshore passage, our diesel supply will last a lot more days.

The parts are on order!

Sidebar: Better Than Expected Results

We've now been cruising over a year with the new panels, and we love them. The total cost to add 300 more watts of solar power (for a total of 453 watts) was $2378, including the three panels, charge controller, wire, through-deck fitting for the wire, fabrication of stainless mounting brackets and the associated attachment hardware, shipping, customs and an electrician to do the actual wiring.

We basically acted as "general contractors" on the job – we decided what panels and charge controller we wanted with advice from an electrician and after reading articles, talking to many other cruisers and researching on the internet, ordered all the parts and contracted with a freight forwarder to ship them to us in Mexico; we determined how we wanted the panels mounted and designed the mounting brackets, and found a stainless welder to fabricate the supports at the dock. We then attached the panels ourselves and had an electrician do the actual wiring although we discussed with him where the wires would be run.

The only time that we have run the engine solely for charging was in the days just after Tropical Storm Ignacio and Hurricane Marty, when skies were continually cloudy. Even in the middle of the summer in the Sea of Cortez, when our refrigerator ran for 55 minutes every hour, our energy deficit was only a few amp-hours a day. We easily made this up as we motored in and out of anchorages. This is definitely better-than-expected performance.

One big pay-off that we hadn't anticipated is that our refrigerator runs a lot less. It is right next to the engine compartment. Unless we are motoring underway, we're not heating up the engine compartment and thus our total demand for electricity is down. The cabin is also staying a lot cooler – a big plus in the tropics in summer!!

Without a doubt, we think that this was one of the best upgrades we could have made to *¿Qué Tal?*. We appreciate our solar panels anew every time we hear someone say "I'd love to go with you, but I have to run the engine and charge the batteries" or "We'd like to stay here longer, but we need diesel" or – the worst – "I had a problem with my engine and had to turn off all the electricity on the boat until I fixed it – lost all the food in my refrigerator."

About the author

Carolyn Shearlock and her husband, Dave, have sailed and raced centerboard dinghies since they were teenagers. In June 2002 they bought their first cruising boat, a 24-year-old Tayana 37, and cut the dock lines that November. They are now in the Sea of Cortez, Mexico, where this photo was taken.