BEGINNER'S GUIDE TO GOING SOLAR

FRUGAL SOLAR

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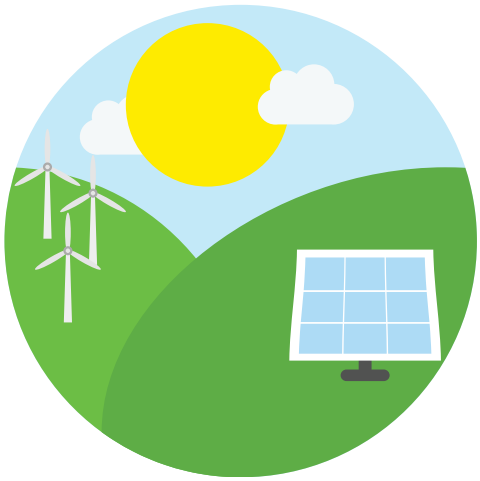
Getting our electricity from the sun is an amazing opportunity! Our family has been enjoying $0 electricity bills and spreading the word about the benefits of solar energy. I made this guide for two reasons:

1) I want to help you learn more about solar energy and how it works

2) I want to help you learn if getting solar panels is right for you.



Whether you are a do-it-yourself kind of person or you want to hire a contractor, the goal of this guide is to help you get started with solar. So if you want to see if saving money and learning to do a big project like this yourself is possible, or if you want to evaluate the solar quotes you are getting from installers, I want to help.

This guide is not meant to be exhaustive and certain aspects may only apply to people living in the USA. But that said, the overall basics of solar energy are the same no matter where you live.

Please send me any feedback on this guide to solar@frugalrepair.com. I would love to know how I can make it better or how it has helped you.

Thanks,
Reese

FrugalRepair / FrugalSolar

EVALUATE SOLAR SUITABILITY

If you want to get solar panels then you need to figure out your solar suitability as a very first step. Here are some steps you can take to get started.

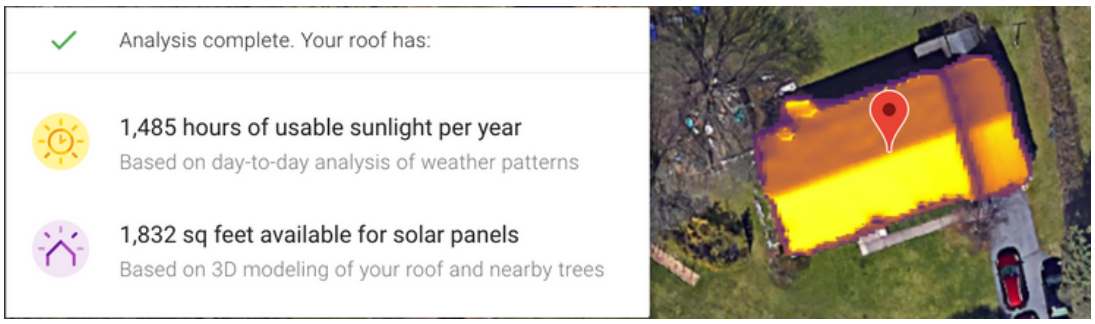
PROJECT SUNROOF

Google has been working on a project to help homeowners get a quick analysis of the suitability of solar panels for their roof. They use satellite imagery and weather data to make a prediction of the yearly solar radiation on your roof. Their algorithm also seems to do a good job estimating the shading your roof might get from nearby trees or buildings.

Check it out here and enter your house address to get your first estimate:

https://www.google.com/get/sunroof

Here is the report of my house that I ran on Google's service. We live in the middle of Pennsylvania. The brighter color of yellow indicates more solar radiation. Though it says we have close to 1,800 square feet available, really only the most southern facing portion (about 1,000 square feet) should be considered for the placement of solar panels



Map data ©2020 Google

SELF EVALUATION

At the end of the day you are the one who knows your property best. You know where the sun comes up in the morning and what path it follows during the day. You know where trees, buildings, and other obstructions (even on your own roof) shade the area where you might put solar panels or avoid putting them.

If you are not planning to get solar panels soon then start a written or mental log of where the sunlight hits your roof and take note of how many hours of sunlight without shade you get at the solstices (assuming you don't live on the equator). The solstices are in June and December.

The orientation of your solar panels to the sun, both the angle toward the equator and the angle compared to the ground are **VERY** important. You can use your smartphone's compass app to figure out these values.

If you are in the northern hemisphere ideally you want your solar panels to face south (180 degrees). This is the opposite if you are in the southern hemisphere.

The orientation to the equator is perhaps the most important factor for your year round solar production potential. If you only have a northern exposure (in the northern hemisphere) then due to the current cost of solar, it may not be wise to consider getting panels.

In the next step I'll show you how to use a free program to get a good solar production estimate.

PVWATTS TOOL

The National Renewable Energy Lab (a US government agency) has some helpful solar estimators on their website. One of the easiest to use is one called PVWatts. In order to use PVWatts and get the most out of it you need your address and at least the following information:

- ✓ **Area of your roof (see next page)**
- ✓ **Orientation of your roof (with respect to the equator)**
- ✓ **Angles your panels would tilt (with respect to the ground)**
- ✓ **An estimation of the percentage of shading. This is hard to guess. The program has a default of 3% shading.**
- ✓ **An estimate on the total wattage of solar you plan to evaluate.**
- ✓ **The latest copy of your electric bill. This will help you see what your rate ($/KWH) is and how much energy you use in a year.**

GO HERE → https://pvwatts.nrel.gov/

ANSWERING QUESTIONS RELATED TO PVWATTS

Do I need to go on my roof to get the dimensions?

No, actually. There are 2 ways you can make estimates. One is to use the "Draw Your System" feature on PVWatts. It is on the page on the right side after you enter your address. You can resize the points to cover the area you plan to put the panels. This is very quick but also will give you a more conservative estimate.

The second way is to use google earth to measure your roof. Go to https://www.google.com/earth and type in your address. After you see your property then you click on the ruler icon on the left. Now tap on the four corners (one tap per corner) and you will get a very good roof estimate.

Measuring your roof with a tape measure will be the most accurate but it is not necessary for a solar estimation.

How can I estimate how much wattage to enter?

If you don't use the "Draw Your System" feature in PVWatts, you will have to make a guess of how many panels will fit in the area you specified above. In my case, I chose the main area on my roof (about 800 sq ft) and a portion of my garage roof (about 200 sq ft).

Next find the size of the solar panel you want to use or use an estimated size 39x65 inches (990x1651 mm) for a standard 60 cell panel. If you see a solar panel for sale that you are interested in, search for the "datasheet" for that panel in order to look up the specifications (size dimensions are one of them). Once you have the dimensions then use your grade school math abilities and take a guess how many panels can fit in that area. Say the answer is 20 panels.

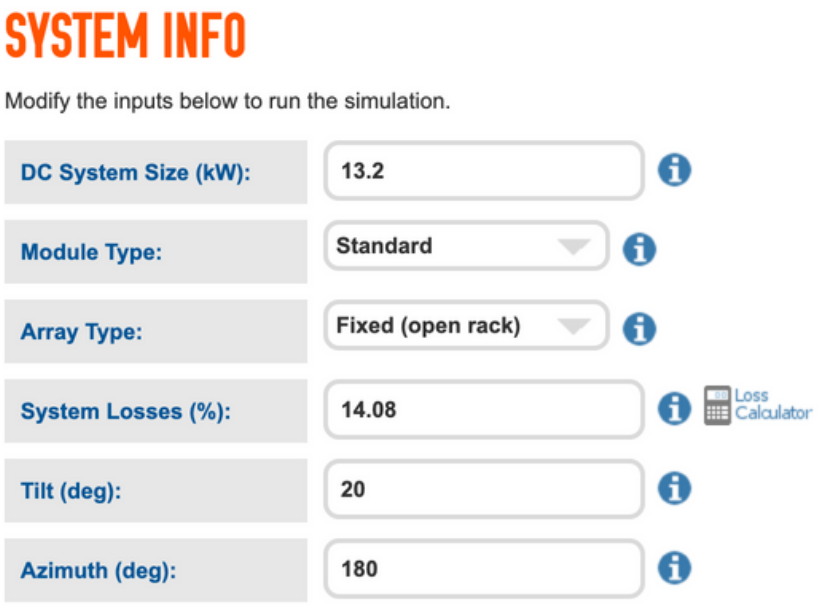
Next you need to figure out the wattage of the panel you might use, if you don't already know. Sample wattages of common 60 cell panels might vary from 280-380 watts. You can shop around online but if you are going to put on solar panels that will last for 25+ years, you may want to choose the highest wattage panels that fit your budget. Let's go with a 350W panel for this example.

So multiply 20 panels X 350W = 7,000 Watts (or 7kW) of DC power.

Enter this number in the box labeled "DC system Size"

What about the other categories on PVWatts?

After you input your address, PVWatts will find the weather data for your area and then you need to input data on the "System Info" page. Here are six data points to fill out:

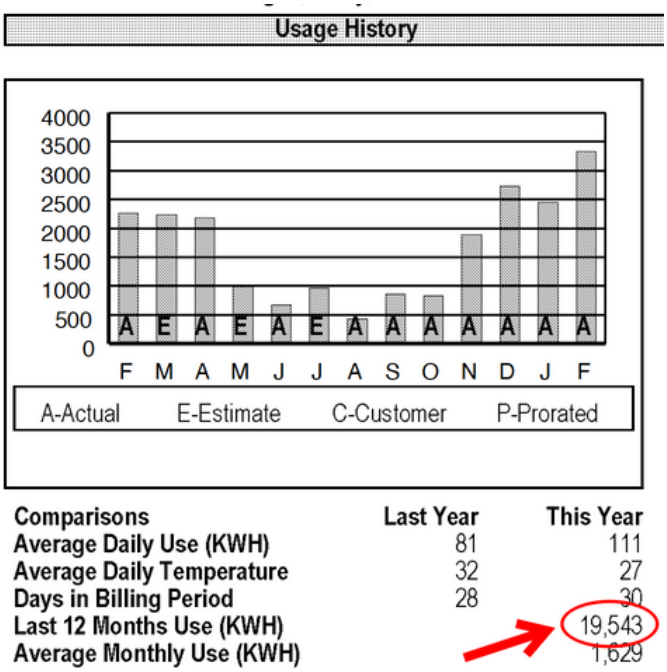


If you are unsure what each category means then click the letter "i" icon for a full explanation.

For the "System Losses" category, you will most likely want to keep all of the standard values. This is where you would want to change the percentage of shading if you think you have more (or less) than the default of 3%. Use the "Loss Calculator" for this.

How can reading my electric bill help?

There are two pieces of information that you want to be aware of on your electric bill. The first is the annual KWH used. And the other is how much you are paying per KWH. If this price is not provided for you on your bill (sometimes it may be listed as a "Price to Compare"), make sure to add up the generation and distribution charges to find a true price per KWH (kilo-watt-hour). If you live in an area that has TOU (time of use) rates, you may want to use the rates that correspond to the daylight hours.



If you have your annual KWH usage then you can compare it to the value given on PVWatts. This will help you know how much your solar install can offset your annual energy usage.

You can also use PVWatts to give you an estimate of how much money you would save by inputting your retail electricity rate ($.12/KWH for example). This entry is at the bottom on the System Info page.

OTHER RESOURCES

PVComplete

Get an account on PVComplete to do detailed modeling with specific panels and solar equipment. This is a program that solar installers and salespersons use but you can use it for your DIY project, to double check what a solar installer might quote you, or to model different solar equipment and see the predicted results.

https://pvcomplete.com/pvsketch/

Solar Pathfinder

If you really want to be serious about modeling shading on your roof/location, you could consider using a device called the Solar Pathfinder. It is mostly used by solar installers and is expensive to purchase new. You may be able to get a used one and then resell it after you are finished if you feel the need to get that level of modeling.

https://www.solarpathfinder.com

Demonstration video:
https://www.youtube.com/watch?v=DJc4pGwZh-c&t=44s

UNDERSTANDING SOLAR EQUIPMENT

Whether you are buying the equipment yourself or a contractor is, it is helpful to know what the key components are to a solar PV installation and what they do. There are many different options but here is an overview of the main parts to a solar (photovoltaic) system:

SOLAR PANEL

These are where the magic happens. Photons hit a semi-conductor and induce an electric current. Solar panels come in many different physical sizes and output capacities.

INVERTER

The inverter is what converts direct current (DC) (the panels output) to alternating current (AC).

An inverter can come in one of three popular forms.

1) Central inverter - the solar panels are directly connected to the inverter and it outputs AC.

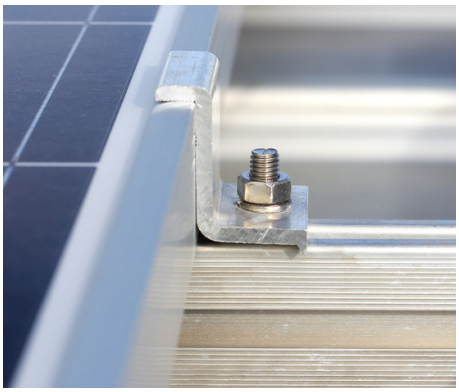
2) Micro-inverters - These devices are paired with each solar panel and produce AC. They usually are mounted on the rail underneath each solar panel. Some manufacturers even sell a combined panel and micro-inverter in one.

3) Power optimizers with a central inverter - Each solar panel is paired with a power optimizer that manages the power output and aims to hold a steady line voltage. A central inverter is still needed to convert DC to AC.

MOUNTING

Many solar panels are mounted on aluminum rails. These rails can sit on the roof of a building or on a ground mount. The rails are held up by mounts. (An example L shaped mount on is the right).

The solar panels themselves are attached to the rails by a few bolts (usually two per side) or a bracket (photo below).



PRODUCTION METER

Just like the regular electic meter that measures how much electricity your home is using, a production meter is used to measure how much energy (KWH) your solar array produces.

BATTERIES

Getting batteries for your solar installation could add considerable cost to your investment. In many situations, unless it is an off-grid application, a homeowner may not need batteries.

If you do get batteries in your solar installation you will also need equipment to manage the charging and discharging.

GRID-TIE LOCATION

Unless your system is purposefully designed to be off-grid, then you will need to figure out where and how you will be connecting to the power company's power source. The two main places are inside your house electrical panel and inside your electric company's meter.

CONDUIT, BOXES, & ROUTE

The majority of the wiring associated with your solar system will most likely need to be enclosed in a metal or plastic housing. This housing is called conduit.

The conduit can be flexible or it can be rigid. It can be metal or plastic. It can also be rated for indoor or outdoor locations.

The conduit will typically connect into junction boxes at various points. These can help provide a place to splice wires and keep them weatherproof.

You will want to consider the route your conduit will take and the aesthetics of the installation.

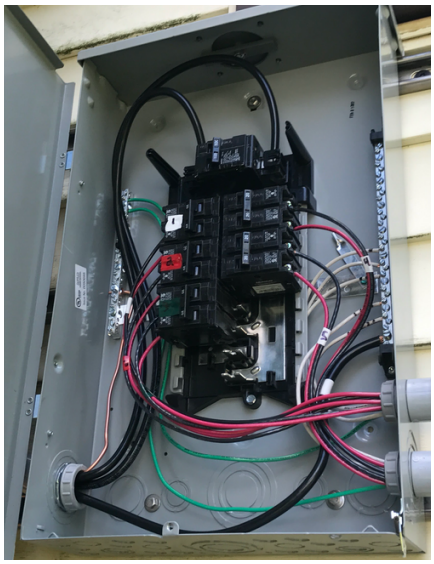
On my house (above) I tried to keep the conduit at the transition between the brick and the siding so that it wouldn't be as noticable.

DISCONNECT SWITCH

Almost all solar array systems need to have a disconnect switch. This is usually on the AC side of the inverter and must be accessible in case of emergency.

This switch will typically have fuses inside in case of a short circuit and will be located near the power company's meter.

AC COMBINER / CIRCUIT BREAKER



On the left you can see the four wires exiting the box. All of the wires on the right are from the micro-inverters on the roof.

Depending on how many wires (AC) are coming from your inverters, they may need to be combined into fewer thicker gauge wires before going into the disconnect switch. This can be called a combiner box though it really is just a regular AC circuit breaker panel setup.

There would typically be four wires that would come out of the combiner box (for 240V AC): Two AC wires, one neutral, and one ground wire.

OTHER SOLAR CONSIDERATIONS

When you are considering solar make sure to research these items:

NET METERING

Research to see if your utility offers net metering. This means that you will get credit on your bill for any excess electricity your solar panels produce. This is one of the biggest reasons why grid-tie solar makes sense financially. Basically, it means that the electricity generated in the summer months get banked up to pay for the electricity needed in the winter months.

If your utility offers net metering and you don't have TOU (time of use rates) then it may not make financial sense to get batteries, unless you are concerned with power outages.

SRECS

SRECs stands for Solar Renewable Energy Credits. In the USA many states offer credits that your system can generate that then can be sold on an open market. One renewable solar credit is generated for every 1,000 KWH. These credits are in addition to any credits on your bill.

MANUFACTURER WEBSITES

Many solar equipment manufacturers have tools and guides on their websites. Companies that make solar racking might have widgets that help you know how much racking to get depending on how many panels you need. Or an inverter company might have a tool that helps you choose what inverter to purchase based on a model of your array.

RECOMMENDATION FOR SOLAR QUOTES

If you are in the USA and are looking to get solar then here are some businesses to consider for DIY, hybrid, or turnkey solar options. All of them offer free quotes.

(Disclaimer: I am an affiliate for these businesses. This means if you end up purchasing from them I might get a referral commission):

DIY Option:

Solar Wholesale - Save thousands by installing solar yourself. They make the complex plan set, get engineering approval, help you each step of the way, and more. Use my link to get a **$250 discount** off your custom DIY solar kit:

https://geni.us/SolarWholesaleDIY

Hybrid Option:

Project Solar - If you want to explore DIY solar with certain add-ons to get help with your project check them out:

https://geni.us/ProjectSolarQuotes

Turnkey Option:

DroneQuote - Get multiple solar quotes and be able to choose a turnkey solar installer (in select US regions):

https://geni.us/DroneQuoteSolar

CONCLUSION

Getting solar panels can be a wise choice when you have enough exposure toward the equator and not too much shade. If you research solar hours per day in North America, for example, you'll see that even in Canada there is enough sunlight to justify getting solar panels. A friend of mine who teaches photovoltaics (solar panels) at a university says that when you see green on the trees, there is enough sunlight there for solar.

I hope this guide has helped you get started understanding solar energy and see if it can work at your home.

Please give me any feedback on this guide on how I can make it better. If you have found it helpful, I'd love to know that too.

I want to keep adding more information online about solar energy, how it works, how to install, etc. Please consider following me on social media for the latest updates. And if you are interested in solar consulting or advice shoot me an email.

You can email me at solar@frugalrepair.com

Thanks,
Reese

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