

# Using solar power in a Tiny House

BobolinkSolar





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## On or Off Grid (Boondocking)

Four Topics:

What can solar do for my buck

What is the technology

What's required to build a solar system

Tiny House considerations



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## What can solar do for the buck

Camp / small : \$1k +

- ◆ lights
- ◆ internet
- ◆ charges devices
- ◆ stereo
- ◆ fan

A 3 season system: \$4k +

- ◆ All of the above +
- ◆ Fridge
- ◆ microwave
- ◆ induction cooktop
- ◆ dishwasher, kettle and much more
- ◆ Just not all at once





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## What do I get for the buck

Full time system : \$10k +

- ◆ Everything
- ◆ Pellet stove
- ◆ Heat pump
- ◆ Appliances
- ◆ Table saw
- ◆ Maybe go propane for hot water and stove



- ◆ So why solar for your tiny house?
- ◆ Because you save money
- ◆ Save the planet from CO<sup>2</sup>
- ◆ Mobility



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## Specifically



A look at the  
types and kinds  
of equipment  
we'll need

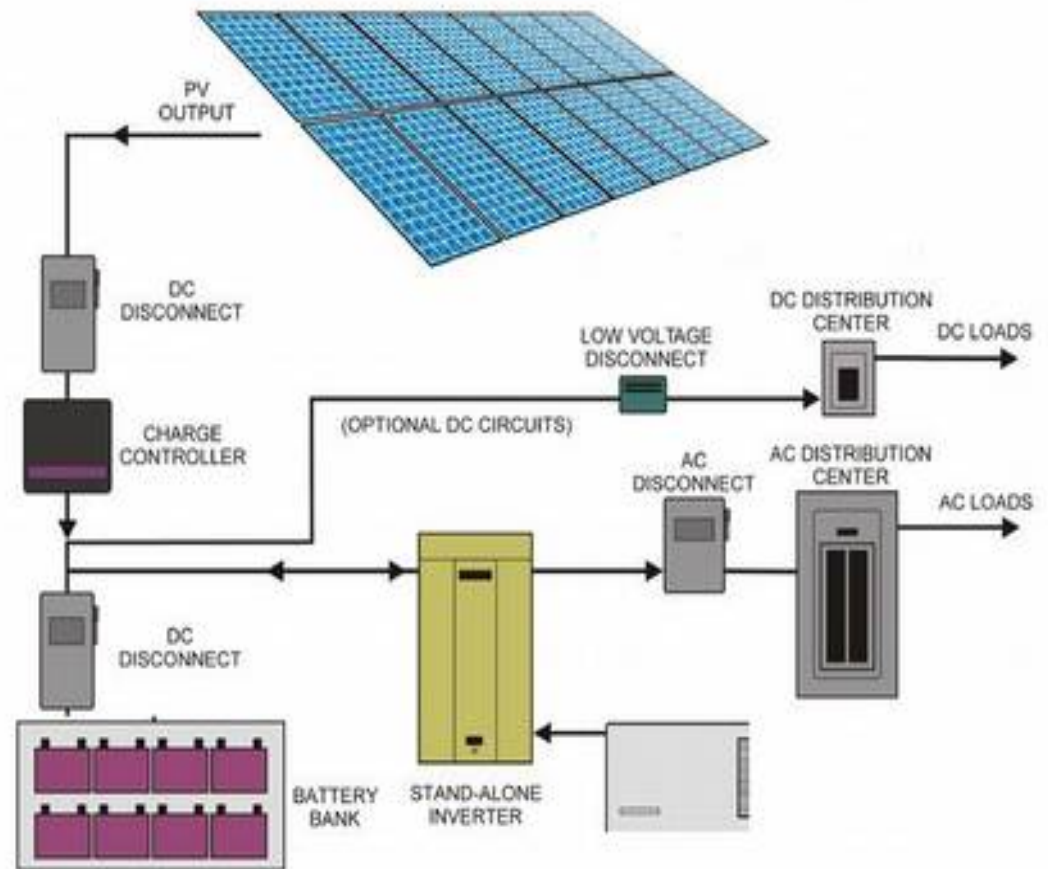


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## What do I need?

- ◆ Solar panels
- ◆ Charge controller
- ◆ Battery bank
- ◆ Inverter
- ◆ BOS
  - ◆ Disconnects
  - ◆ Distribution box
  - ◆ Fuses
  - ◆ Cables
  - ◆ Charger
  - ◆ Generator





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## Solar panels

What kinds of solar panels  
are there and  
how do we use them?



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## Solar panels

- ◆ There are two basic kinds of solar panels:
  - ◆ Mono & Poly
    - ◆ They both do the same thing. Turn sunshine into power
    - ◆ Newer ones of either are more efficient than older ones
  - ◆ There are also different sizes; both in voltage and watts



- ◆ What about thin film or?
- ◆ Newer, lighter technology is emerging. Keep an eye out.





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## Solar panels

- ◆ Panel voltage can be described by class:
  - ◆ 12v
    - ◆ Usually around 18v these panels are useful for lights, small devices.
  - ◆ 24v
    - ◆ Usually around 35v, these panels are considered useful for larger installs, like tiny homes.
  - ◆ 48v
    - ◆ These panels are 50+ volts. Very large systems.



- ◆ Cost? The bigger the panel, the cheaper the cost per watt. A large panel will be cheaper to buy per watt than a small one. Often dramatically so.



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## Solar panels

◆ They can be described as cell count:

- ◆ 36 cell: in the >100w
  - ◆ Varying sizes. Useful for small installs
- ◆ 60 cell: 200-300w
  - ◆ Usually around 40 lbs
  - ◆ 40\*65" 992\*1650\*40 mm
- ◆ 72 cell: 300w and up
  - ◆ Usually 50 lbs
  - ◆ 40\*75" 982\*1954\*40 mm



- ◆ Typical pricing in 2018 is between .65 and 1.20 / w
- ◆ What do you get?
  - ◆ More \$ = higher efficiency
  - ◆ Cool factor



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To harvest our solar panel **Watts**  
take the Voltage by the Amps

$$\text{Watts} = \text{Voltage} * \text{Amps}$$

For that we need a solar charge controller



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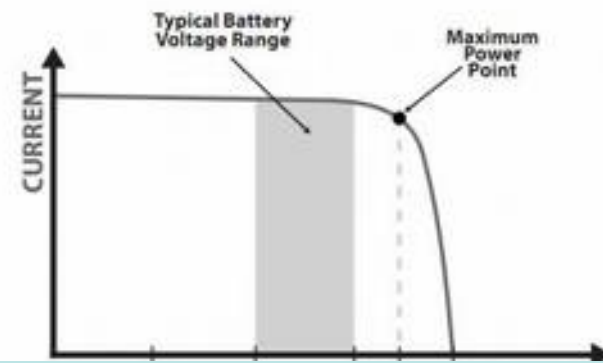
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## Solar Charge Controllers

- ◆ PWM vs MPPT
- ◆ MPPT makes solar controllers more efficient and more useful
  - ◆ MPPT converts higher voltage to more current (Amps)
  - ◆ New MPPT is faster, smarter
  - ◆ Higher voltage panel strings =
    - ◆ Thinner cable = less \$
    - ◆ Longer runs



Current vs. Voltage





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## Specifically

The solar controller takes our watts and  
converts it to current, or Amps,  
at the battery voltage  
allowing us to store the power for later use



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## Battery technology

- ◆ Lead Acid
  - ◆ Flooded
  - ◆ AGM
- ◆ New technology
  - ◆ Lithium
    - ◆ Smaller / lighter
    - ◆ Safer
    - ◆ Higher energy density
    - ◆ Low self discharge
    - ◆ Longer lifespan
    - ◆ Easier to use
  - ◆ Lithium makes your whole system 20% bigger for free



- ◆ Lead is dead



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## Specifically

From the batteries  
we take our **DC power**  
and with an **inverter** provide  
**AC power**  
to let us use modern appliances

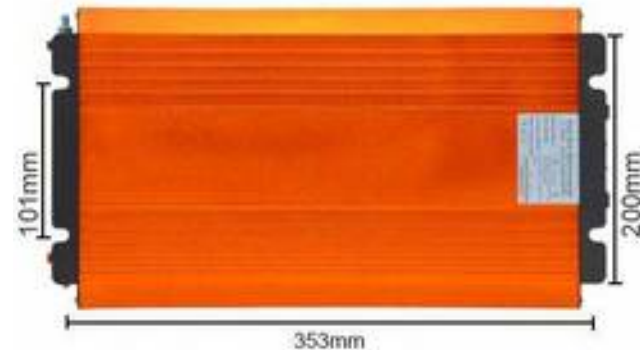


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## Inverters

- ◆ Modified vs Pure Sine
- ◆ Pure Sine
  - ◆ Wave form same as grid
  - ◆ Runs motors cooler
  - ◆ Won't damage electronics
  - ◆ Runs clocks and timers
- ◆ Other considerations
  - ◆ Idle consumption
  - ◆ Surge power
  - ◆ Appropriate sizing
- ◆ Do I need a charger?
  - ◆ Cost
  - ◆ Flexibility; seasonal







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## Balance of System (BOS)

- Disconnects
- Fuses / Circuit breakers
  - Distribution box
    - Cables
    - Chargers
  - Generator



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## BOS

- ◆ Safety First
  - ◆ Disconnects
  - ◆ Circuit breakers
  - ◆ Fuses
  - ◆ Bus bars
- ◆ Budget appropriately
  - ◆ BOS is the hidden budget inflator





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## BOS

- ◆ **Safety First**
  - ◆ Cables – match amps!
  - ◆ Chargers – voltage?
  - ◆ Fuses
- ◆ **Generator**
  - ◆ Watch for oversizing
  - ◆ Integration can include
    - \* power balancing
    - \* load sharing





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## Implementation

- ◆ Considerations
  - ◆ How much do you need?
  - ◆ How long between charging?
  - ◆ What size loads

Build to the load *or*  
Load to the build?





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## Sample build

- ◆ Solar panel
  - ◆ One panel system
  - ◆ 310w poly panel
- Note:
  - ◆ Max Power 37v
  - ◆ Current 8.4
  - ◆ Temp compensation
- ◆ More panels
  - ◆ Parallel (more amps)
  - ◆ Series (higher voltage)



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Franco Traverso  
SLG310P

ELECTRICAL SPECIFICATIONS  
mesure faite dans les conditions normales de température et d'humidité

1000W/m<sup>2</sup> irradiance, AM 1.5 spectrum, 25°C cell temperature  
CARACTÉRISTIQUES ÉLECTRIQUES  
mesure dans les conditions normales de température et d'humidité

Maximum Power (Pmax) Puissance Normale Maximale	310 W
Maximum Power Voltage (Vpmax) Tension en Fonctionnement Optimal	37.1 V
Maximum Power Current (Ipmax) Courant en Fonctionnement Optimal	8.39 A
Open Circuit Voltage (Voc) Tension en Circuit Ouvert	45.7 V
Short Circuit Current (Isc) Intensité de Court-Circuit	8.90 A
Maximum System Voltage Tension Maximale du Système	1000 V
Series Fuse Série Fusible	15 A
Fire Rating Classement au Feu	Class C

For lead connections use min 12 AWG wires suitable for a minimum of 90°C. Use proper wire only.  
Pour les connexions de bornes utilisez des fils appropriés pour un min de 90°C. Utilisez des fils de votre équipement.

ETL  
Conforms to UL Std 1703  
Certified to ULC/ORD Std C1703

TO DOWNLOAD INSTALLATION MANUAL OR DATASHEET, SCAN QR-CODE OR GO TO: [www.bobolinksolar.com](http://www.bobolinksolar.com)



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## Sample build

- ◆ Circuit breaker
  - ◆ 15a min
- ◆ Solar controller
  - ◆ Voltage and amperage appropriate
- ◆ Ergo: 75v with 15a
  - ◆ MPPT 75/15
  - ◆ This is a very small controller. It will be useful for 12 and 24v systems only.





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## Sample build

- ◆ Battery disconnect
  - ◆ Suitable amperage
- ◆ Battery
  - ◆ Voltage?
  - ◆ Amperage?

The voltage controls the sizing of all your inverter. In this case, due to the small size of the system. We will build a 24v system.





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## Sample build

- ◆ **Battery**
  - ◆ Fuse sizing
  - ◆ Bus bar?
  - ◆ Cabling
  
- ◆ **Cables**
  - ◆ Match the cable size to the amperage

Amperage draw indicates the sizing of your cables.







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## Sample build

- ◆ Inverter
  - ◆ Fuse sizing
  - ◆ Bus bar?
  - ◆ Cabling
- ◆ Cables
  - ◆ In this case the inverter is 500w. The voltage is 24 so the amperage is 20a.
  - ◆ Checking our wiring chart we find 10 gauge wire is 30a. Perfect.





## Tiny House Specific

- ◆ How much \$\$\$?
  - ◆ Many variables
  - ◆ What are you using?
  - ◆ Where are you using it?
  - ◆ Are you living there full time?
  
- ◆ Stress on your system
  - ◆ Loads
  - ◆ Idle time / not in use
  - ◆ Heat / Cold
  - ◆ Critters / theft





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## Tiny House Specific

- ◆ Sizing?
  - ◆ Loads to carry
  - ◆ Don't buy the cheapest system if you really need something bigger
  - ◆ Grid tied?
  - ◆ Generator supplement?
  - ◆ Budget
  
- ◆ Safety
  - ◆ The electrical code is our friend and ally
  - ◆ Marine / RV code can be particular useful for Tiny Homes





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## Tiny House Specific

- ◆ Where?
  - ◆ Panel placement  
Roof top; portable;  
ground mount?
  - ◆ Component storage  
Under the home; in a box;  
in a closet
  - ◆ Venting/temperature  
control
  - ◆ Climate?





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## Tiny House Specific

- ◆ Panel placement
  - ◆ Avoiding shadows
  - ◆ Flexible placement?
  - ◆ No real maintenance, so ...
  - ◆ Removal?
  
- ◆ Safety
  - ◆ Wind resistance
  - ◆ Theft
  - ◆ Critters





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## Tiny House Specific

- ◆ Battery placement
  - ◆ Access for monitoring
  - ◆ Temperature control
  - ◆ Lead specific
    - \* Watering
    - \* Venting
    - \* Weight
  - ◆ Distance from solar controller and inverter
  
- ◆ Safety
  - ◆ Off gassing
  - ◆ Theft
  - ◆ Critters
  - ◆ Heat and Cold





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## Tiny House Specific

- ◆ Component placement
  - ◆ Access for monitoring and control (ie. Turn off / on)
  - ◆ Moisture / Dust
  - ◆ Distance from solar panels
  - ◆ Distance to battery





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## Tiny House Specific

- ◆ Integration with electrical system
  - ◆ 12v ?
  - ◆ DC/DC conversion?
  - ◆ Wiring into the panel
  - ◆ Transfer switches







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## Questions?

- ◆ Queries? Quibbles?



- ◆ The time is now!

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And safe reliable solar power