



# Living with Solar

## Class 5 for Solar Team 7





In Class1 **Generating Electricity**  
we looked at the big picture.

In Class 2 **Electricity Basics**  
we saw how electricity works.

In Class 3 **Components**  
we learned about the parts of our system.

In Class 4 **Wiring** we learned how  
our system is put together.

In this Class 5 **Living with Solar**  
we get to decide  
how we will use Solar Power in daily life.

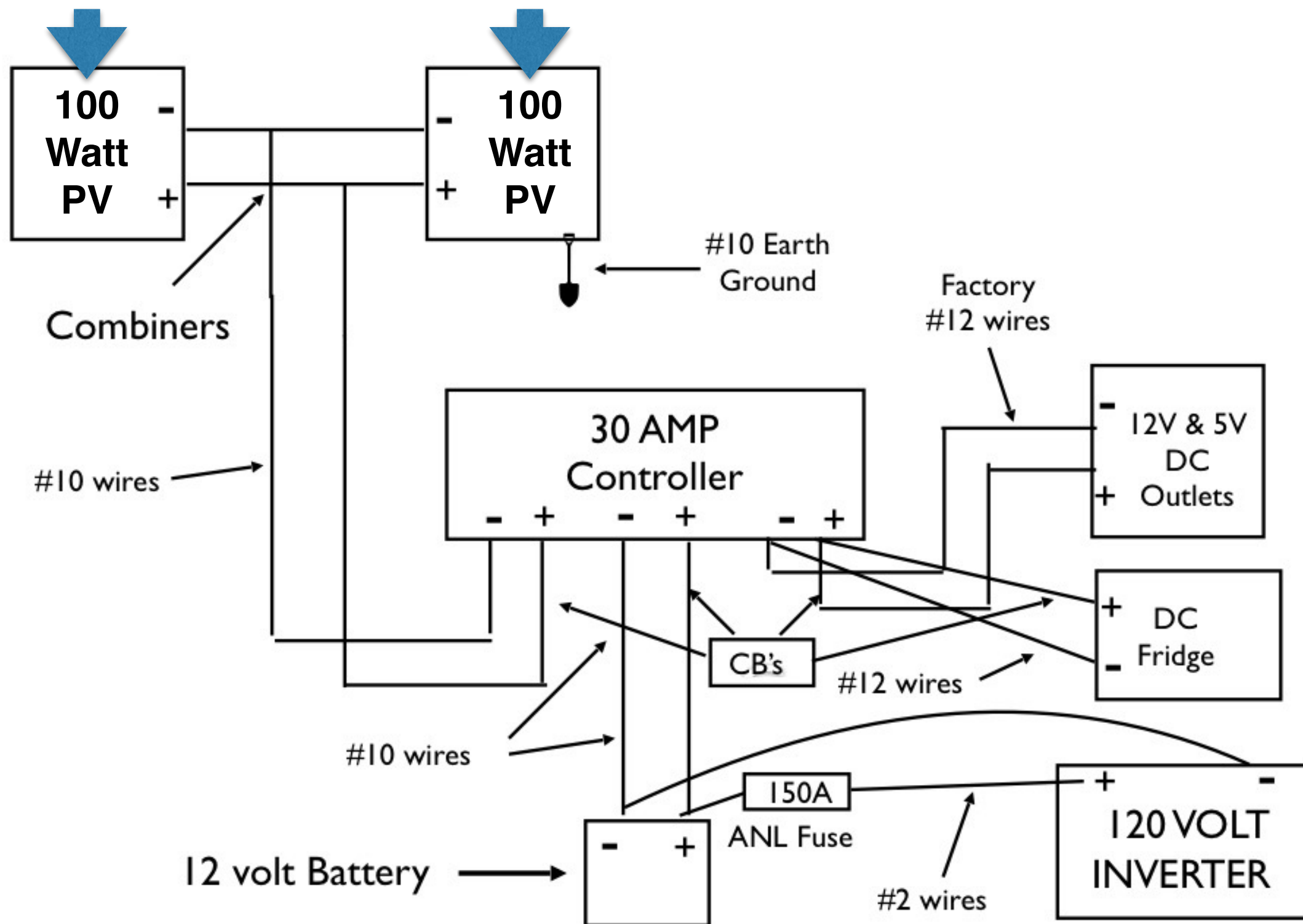
# First of all...

We need to know  
how much electric power it takes  
to run each appliance.

Every electric appliance uses  
a rated number of Watts per Hour.

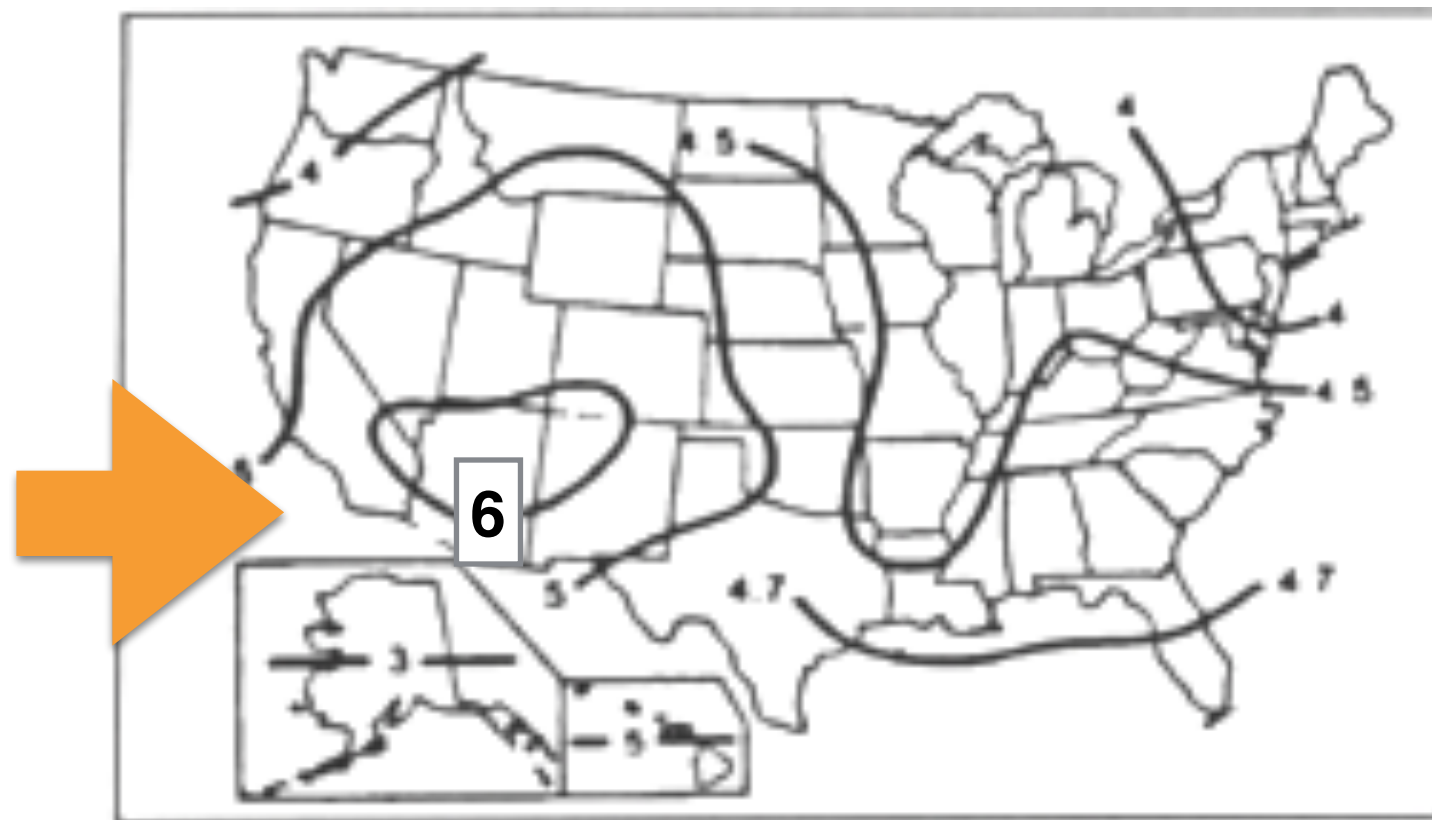
## Watt/Hours WH

How many Watt Hours can be generated by 200 watts of PV (photovoltaic) panels?





It all depends on how many hours of sun you have.

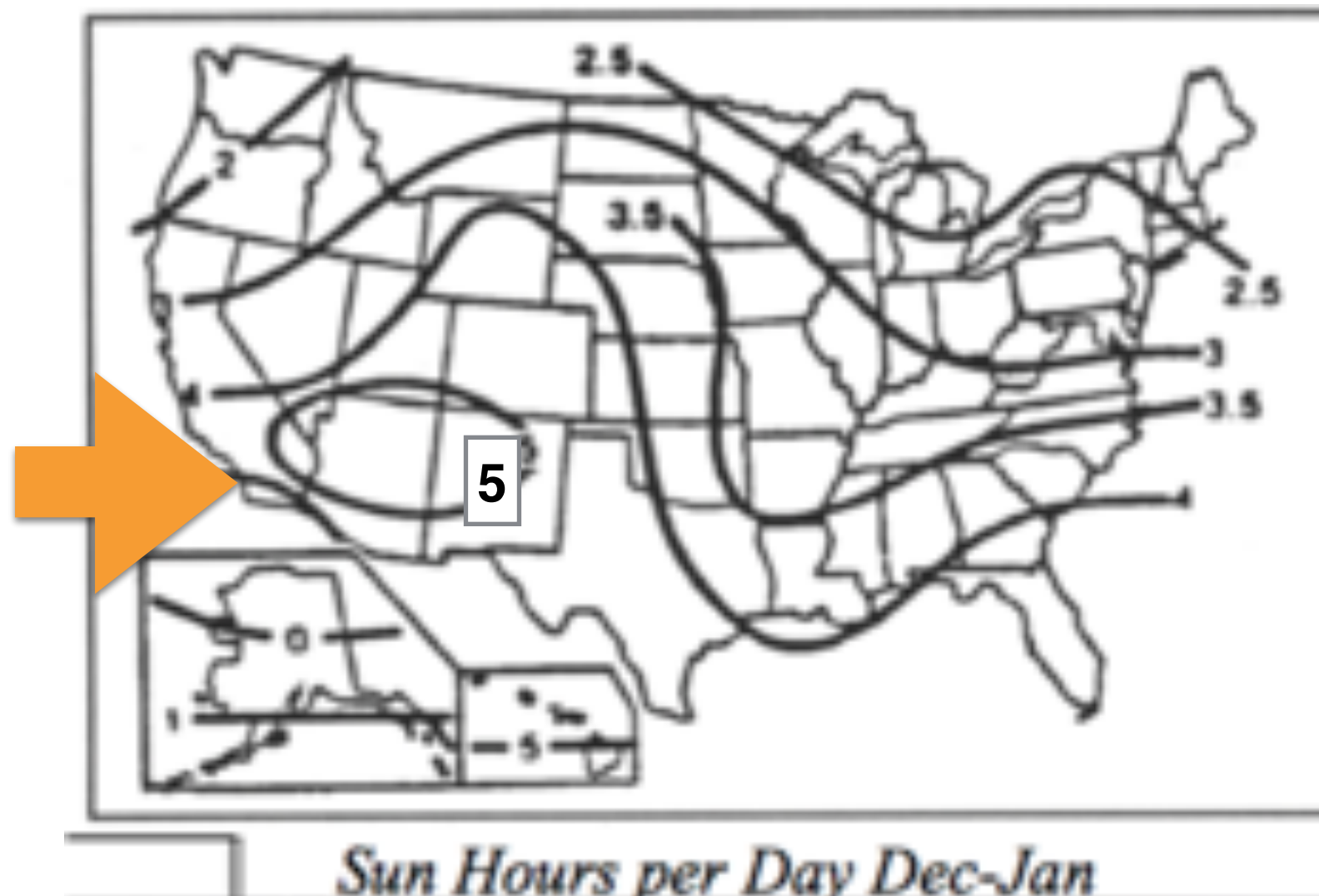


*Average Sun Hours Year-Round*

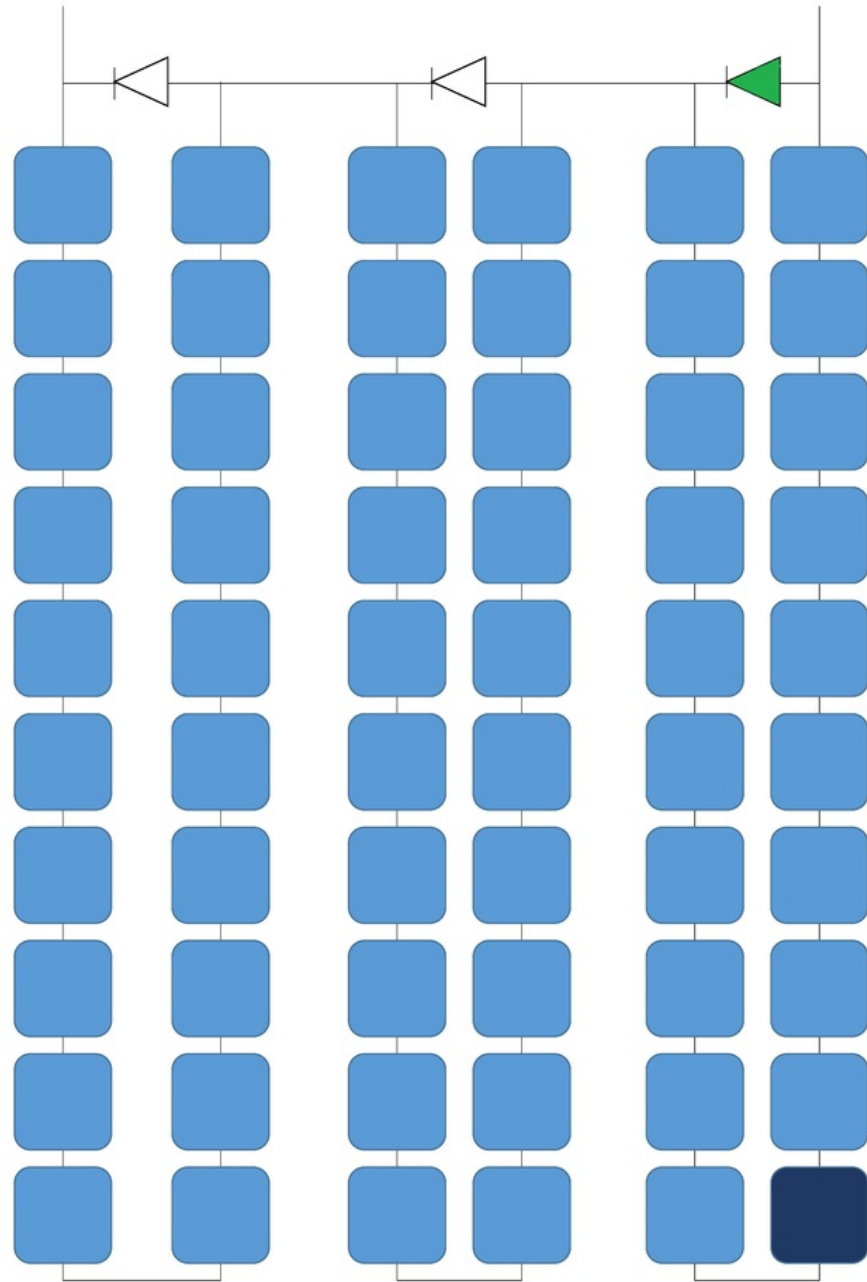
We get six hours of sun.

$$200 \text{ Watts} \times 6 \text{ Hours} = 1200 \text{ WH!}$$

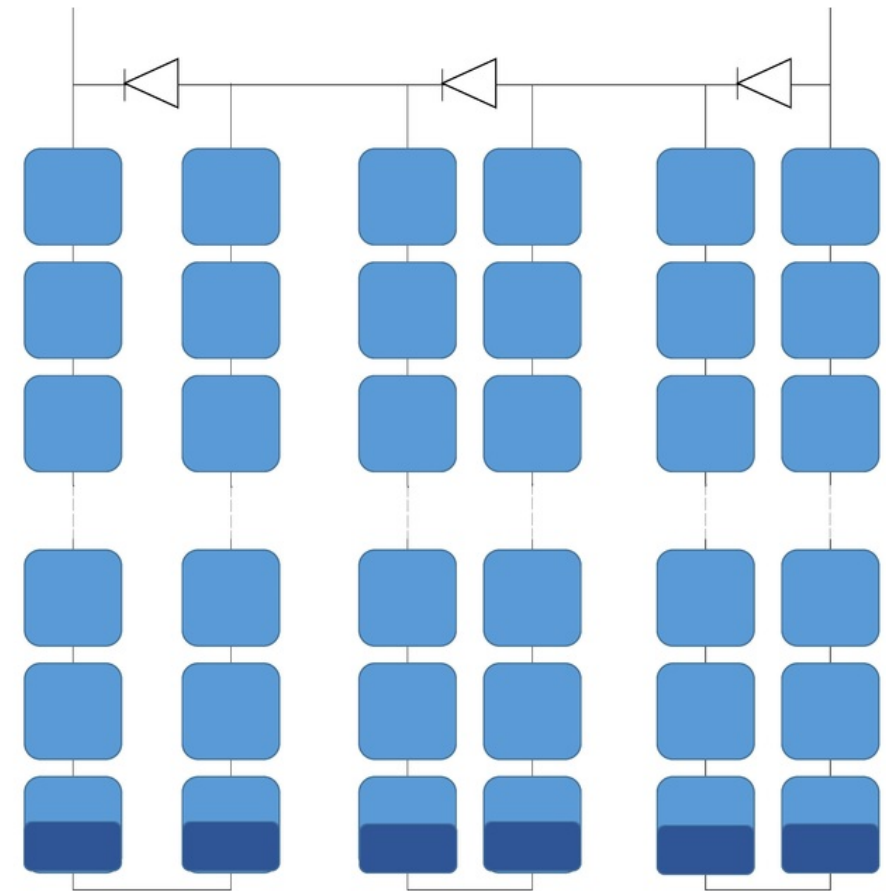
But...sun hours are fewer in winter.  
And there are always system losses,  
cloudy days and inefficiencies, so to be safe,  
reduce 1200WH by 1/3 to **800WH** per day



# Shade affects the WH of solar panels because of their internal wiring.



One shaded cell can shut down a string.

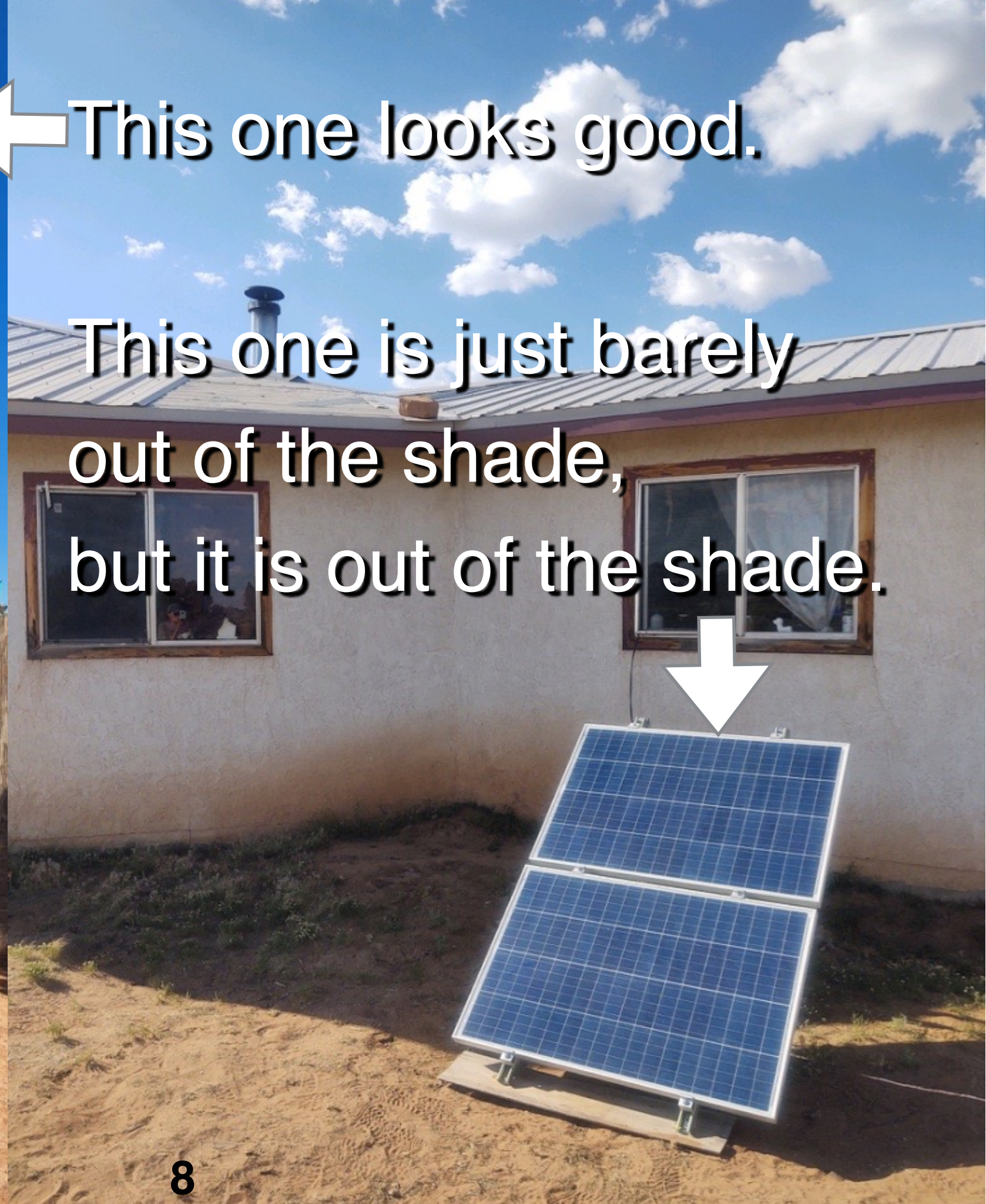


A row of shaded cells can reduce the current of the whole panel.



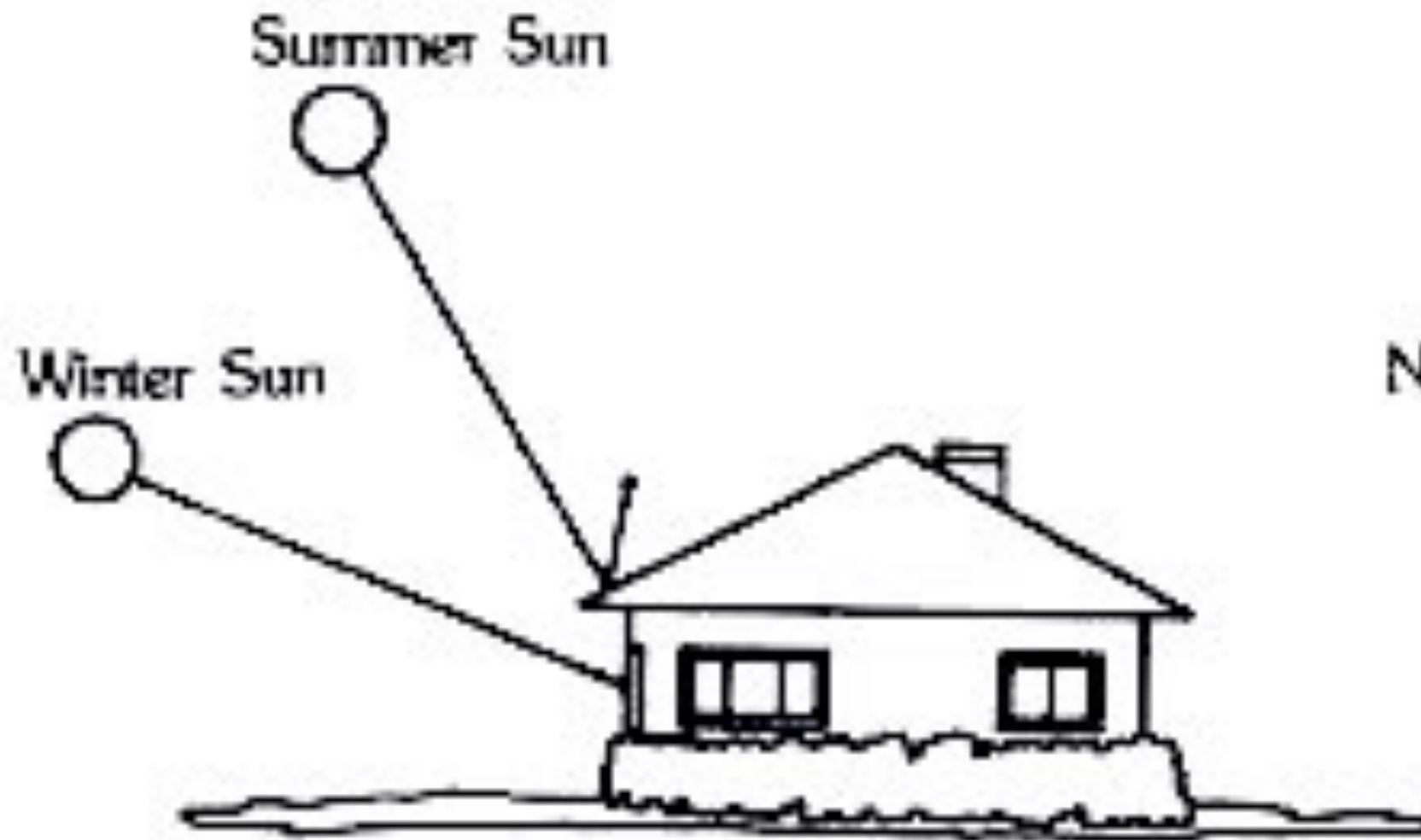


← This one looks good.



This one is just barely  
out of the shade,  
but it is out of the shade.



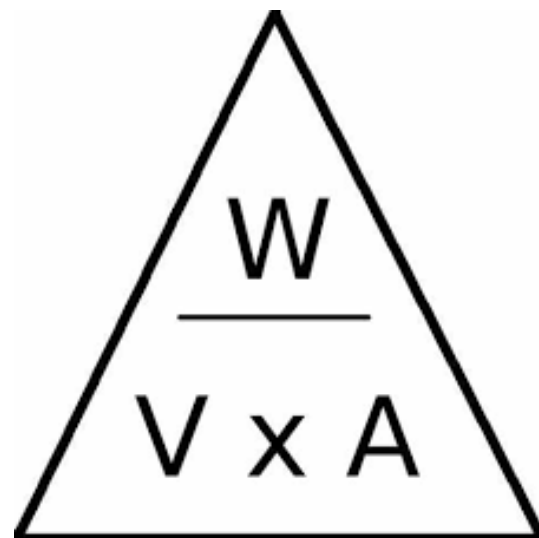


Remember that the sun  
is higher in the summer,  
lower in the winter.

# Next...Watt Hours to Amp Hours

The **800WH** from your solar panels  
are stored as Amp/Hours in your battery.

*Watt/Hours divided by Voltage equal Amp/Hours.*



Watts Law

$$800\text{WH} \div 12\text{VBattery} = 66 \text{ Amp/Hours}$$



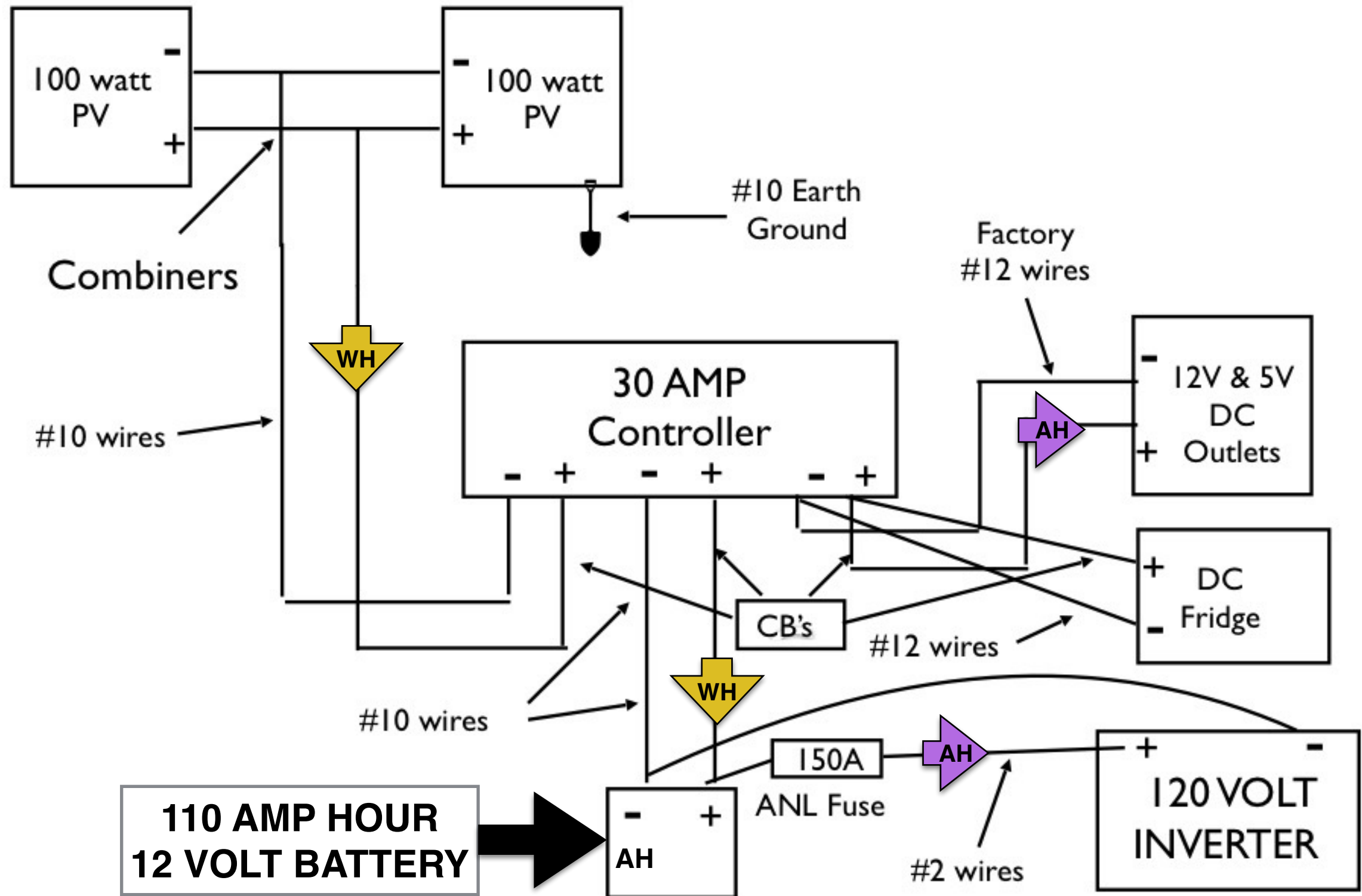
**66 AH** is about half the total capacity  
of your **110 AH** battery.

It takes two sunny days to charge it completely.



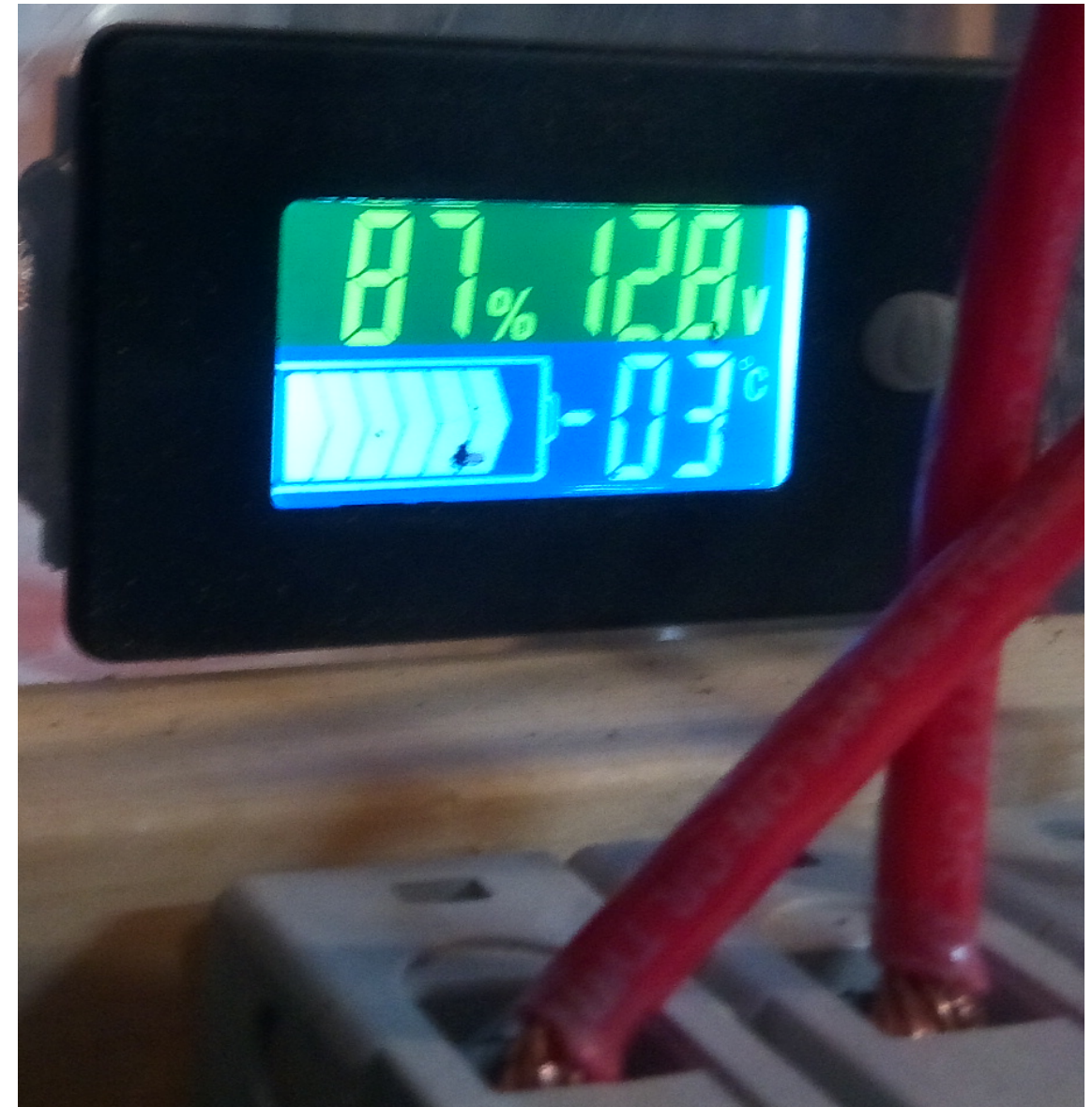
For a longer battery life, try not to  
use more than half your battery capacity,  
**55AH**, half of **110 AH**.

# WH being produced, AH being used



12

Voltage	State of Charge
12.6+	100%
12.5	90%
12.42	80%
12.32	70%
12.20	60%
12.06	50%
11.9	40%
11.75	30%
11.58	20%
11.31	10%
10.5	0%



If your battery meter shows 12.6 Volts or more, your battery is full.



# But...

Reading the battery voltage from any meter:  
on the controller, on the inverter,  
or on a handheld device  
while the sun is shining on the PV's  
will not give you  
the true state of the battery.

The best time to read any of those meters  
is in the morning before the sun  
has energized the PV's.

So how do you begin to live on  
**800WH** per day?





Your fridge uses about 115 WH per day  
As a freezer it uses about 280 WH per day



<b>VOLTAGE</b>	10-31 VDC
<b>AVERAGE ENERGY USE - DCR50 REFRIGERATOR</b>	114 Watt-hrs/day at 32°C 9.6 Amp-hrs/day at 12V, 32°C
<b>AVERAGE ENERGY USE - DCF50 FREEZER</b>	280 Watt-hrs/day at 32°C 24.5 Amp-hrs/day at 12V, 32°C
<b>GROSS CAPACITY</b>	50 L 1.8 ft <sup>3</sup>

<b>PRODUCT DIMENSIONS (WXDXH)</b>	25.75 x 26.75 x 30.5 in 67.3 x 58.4 x 77.5 cm
<b>SHIPPING DIMENSIONS (WXDXH)</b>	27.5 x 24.5 x 36.5 in 69.9 x 62.2 x 92.7 cm
<b>INTERNAL DIMENSIONS (WXDXH)</b>	17.625 x 13 x 12.75 in 44.45 x 33 x 31.75 cm
<b>WEIGHT</b>	75 lbs 34 kg

*SunDanzer* cycles on and off over 24 hours

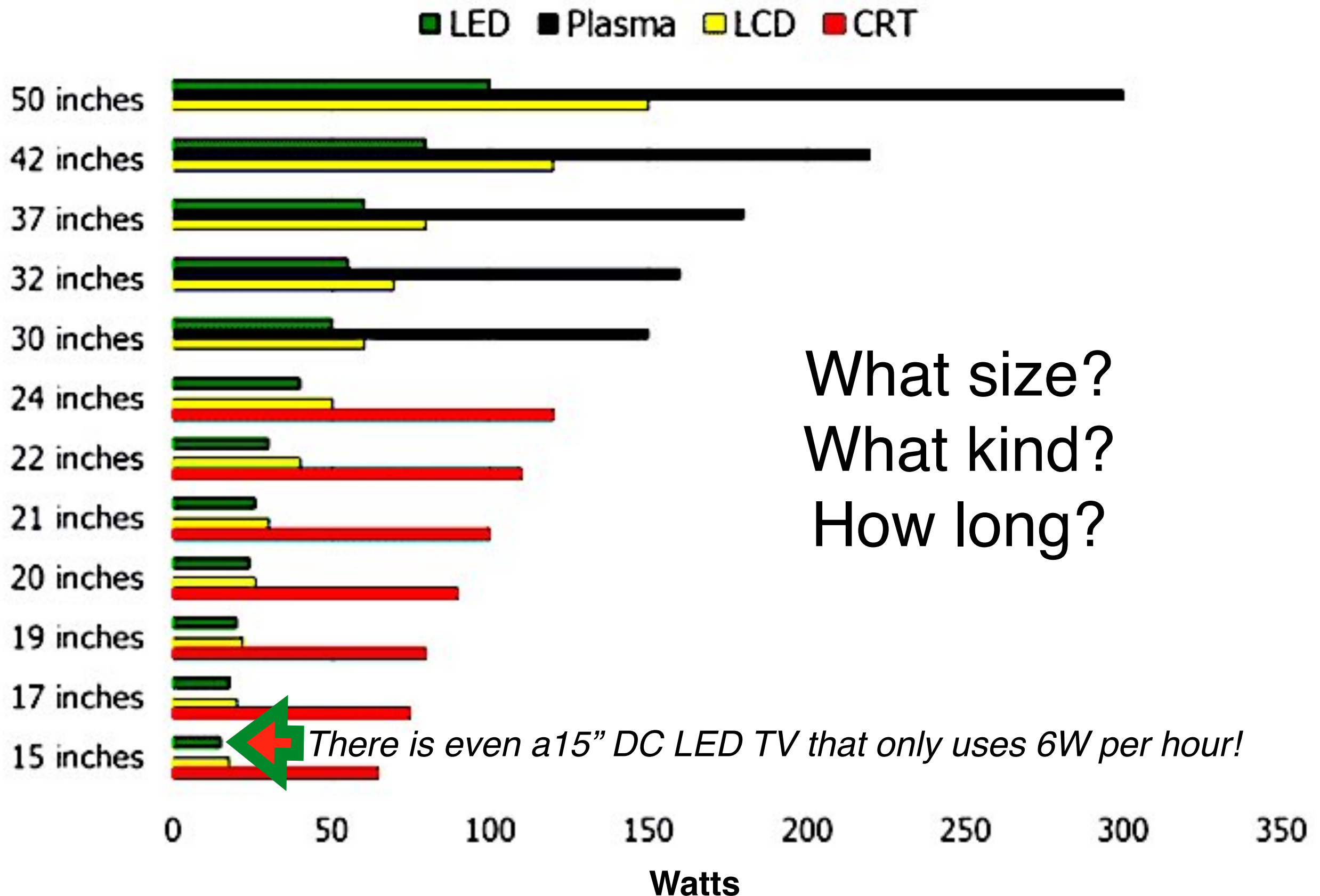


# Your coffee maker uses 600 Watts per Hour



A coffee maker uses about 600WH but you might only have it plugged in for 15 minutes, a quarter hour so you would only use 150WH.

# TV Wattages are all over the place



What size?  
What kind?  
How long?

There is even a 15" DC LED TV that only uses 6W per hour!

# Learn to look at labels.



Power Consumption 65W



Power Consumption  
350W 65W 120W  
Watts per Hour

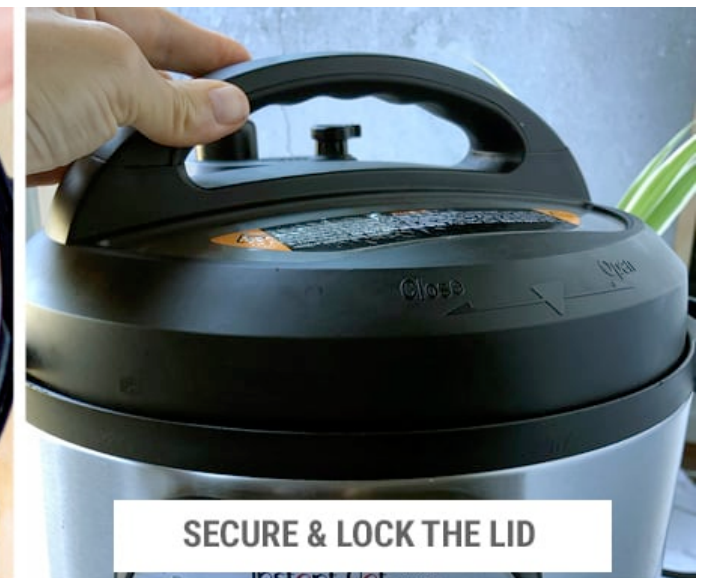




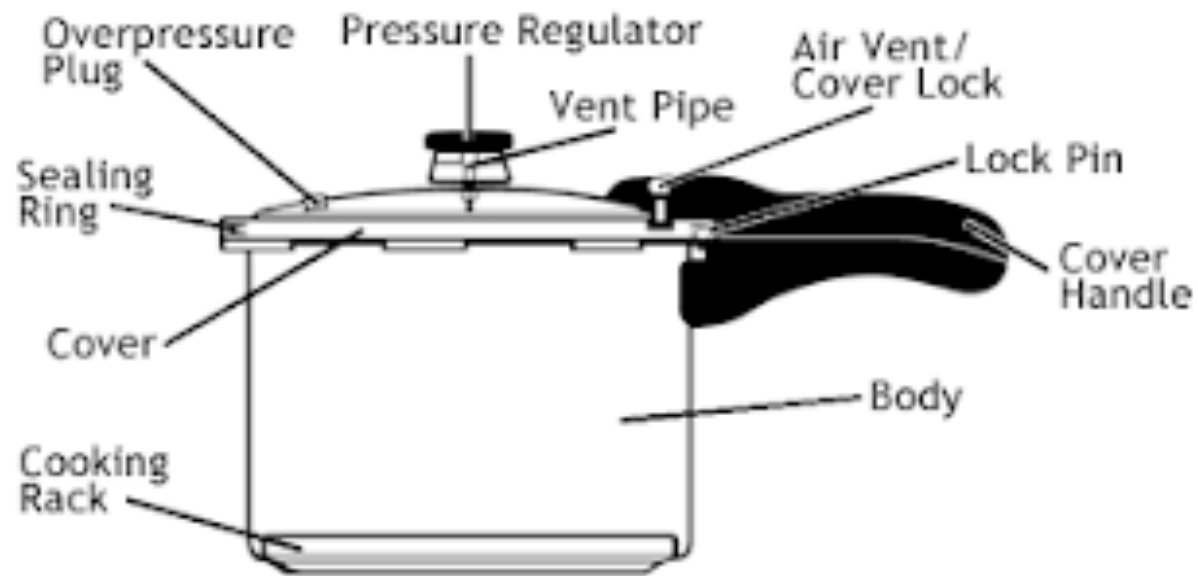
# Cooking with a 3 Quart Instant Pot 700WH



ADD INGREDIENTS & LIQUID



SECURE & LOCK THE LID



SELECT 'PRESSURE COOK'



ADJUST PRESSURE LEVEL IF NEEDED

# Instant Pot

## CONVERTING RECIPES

### FROM SLOW COOKER

Slow Cooker Time	Instant Pot Time
10 hours on low/ 5 hours on high	30 minutes on high pressure
8 hours on low/ 4 hours on high	24 minutes on high pressure
6 hours on low/ 3 hours on high	18 minutes on high pressure
4 hours on low/ 2 hours on high	12 minutes on high pressure

### FROM OVEN/STOVE TOP

Stove/Oven Cook Time	Instant Pot Time
2 hours	40 minutes on high pressure
1 ½ hours	30 minutes on high pressure
1 hour	20 minutes on high pressure
30 minutes	10 minutes on high pressure

### RECIPES WITH PASTA

Lowest Pasta Cook Time	Instant Pot Time
12 minutes	4 minutes on high pressure let NPR for 5 minutes then QR
9 minutes	3 minutes on high pressure let NPR for 4 minutes then QR
6 minutes	2 minutes on high pressure let NPR for 3 minutes then QR
3 minutes	1 minute on high pressure let NPR for 2 minutes then QR

At 700WH every  
15 minutes (1/4 hour)  
of cooking uses  
 $1/4 \text{ of } 700\text{WH} = 175\text{WH}$





# 7Watt LED Lights

5 Hours per day = 35 WH each





# Are your appliances AC or DC?



Some of your appliances run on 12 Volt Direct Current, **12VDC**:  
fridge, lights and charging.



And some use  
120 Volt Alternating  
Current, **120VAC**.  
TV, coffeemaker, instant  
pot, etc.

Your panels produce **12VDC**.

*Perfect for DC appliances.*

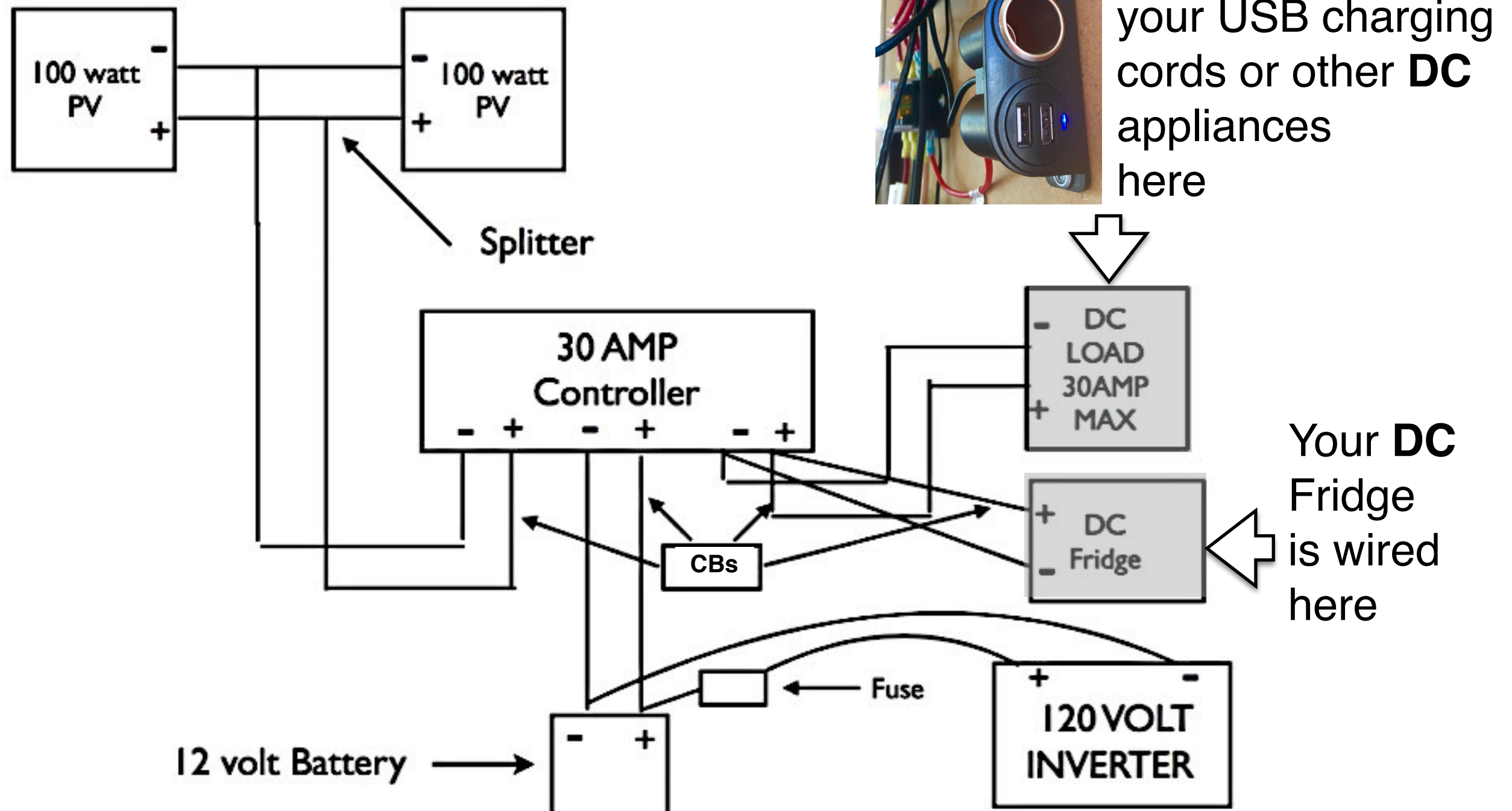


But most appliances need **120VAC**,

Your inverter multiplies the 12VDC from your panels  
times 10 to make **120V** and changes **DC** to **AC**.

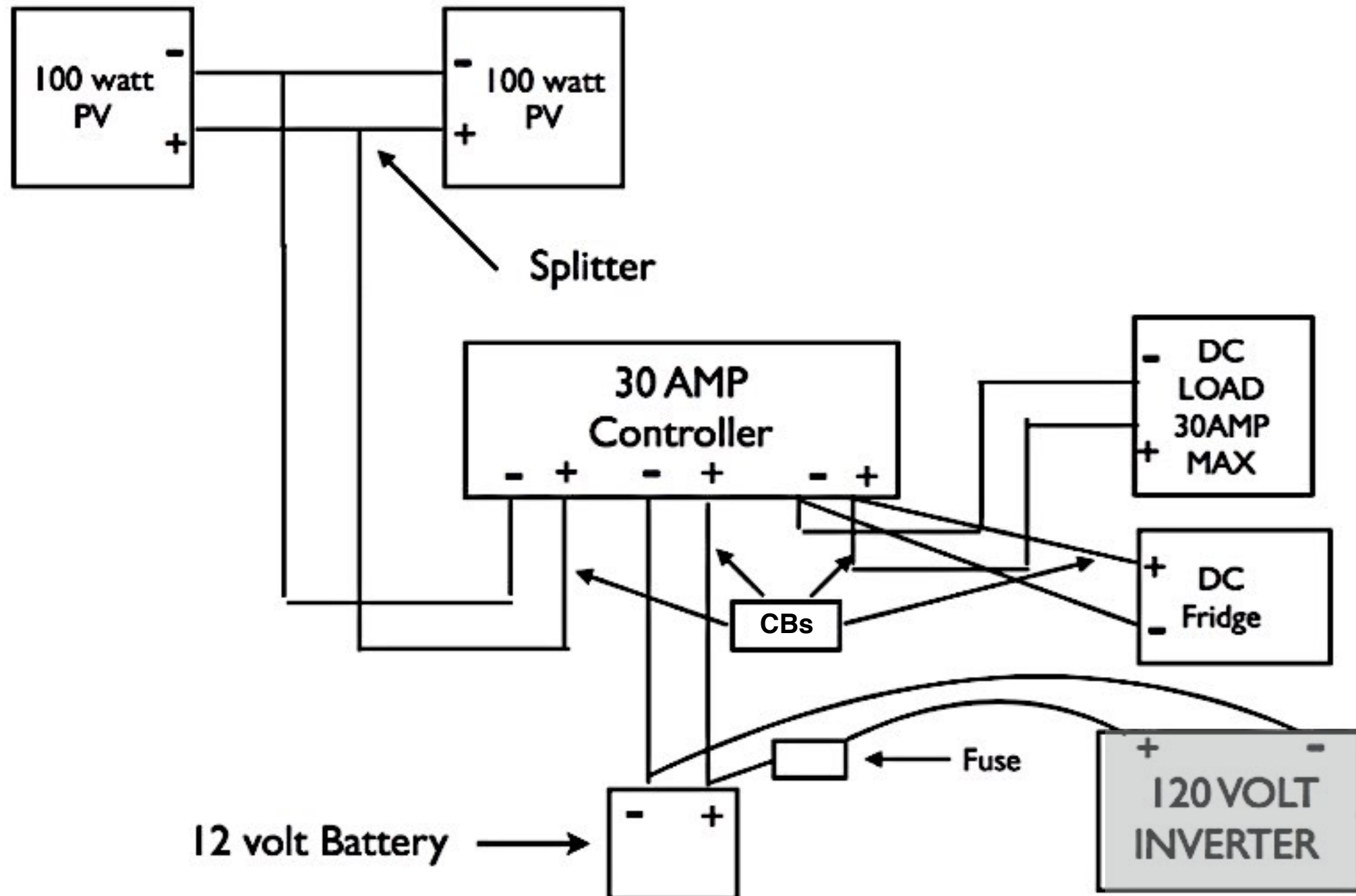
**AC appliances use one tenth the amps per watt  
that DC appliances need to run because  
the voltage is ten times higher.**

# Where is your DC?





# Where is your AC?



**AC**  
appliances  
plug in here

Here is an example of what you can run every day.

<b>12 VOLT DC APPLIANCES</b>	<b>WATTS power</b>	<b>HOUR time used</b>	<b>WATT HOURS power x time used</b>	<b>AMP HOURS divide WH by 12</b>
PHOCOS DC REFRIGERATOR	4.8 W	CYCLES ON AND OFF OVER 24 HRS	115WH	9.6 AH
THREE 7 WATT DC LED LIGHTS	21 W	5 HOURS	105 WH	8.75 AH
CHARGING DEVICES Phone, LED light, etc.	5 W	2 HOURS	10 WH	.8 AH
			230 WH USED	DC LOAD 19.15 AH
<b>120 VOLT AC APPLIANCES requires inverter</b>	<b>WATTS power</b>	<b>HOUR time used</b>	<b>WATT HOURS power x time used</b>	<b>AMP HOURS divide WH by 10 for inverter loss</b>
TV/DVD	90 W	2 HOURS	180WH	18 AH
OR	OR	OR	OR	OR
3 QUART INSTANT POT	700 W	15 MINUTES (1/4 HR) CYCLES ON AND OFF	180WH	18 AH
COFFEE POT	600 W	15 MINUTES (1/4 HR)	150 WH	15 AH
SMALL TOOL	500 W	4 MINUTES (1/15 HR)	33 WH	3AH
			363 WH USED	AC LOAD 36AH
<b>TOTAL DC AND AC</b>	<b>WATT HOURS 593 WH</b>		<b>AMP HOURS 55.15AH</b>	

# Schedule your usage

On sunny afternoons  
when the battery is near 100%  
that's when you should charge  
cell phones, tools, etc.  
or run AC appliances  
from PV power.

Use that  
200 extra watts per hour  
of incoming solar power.

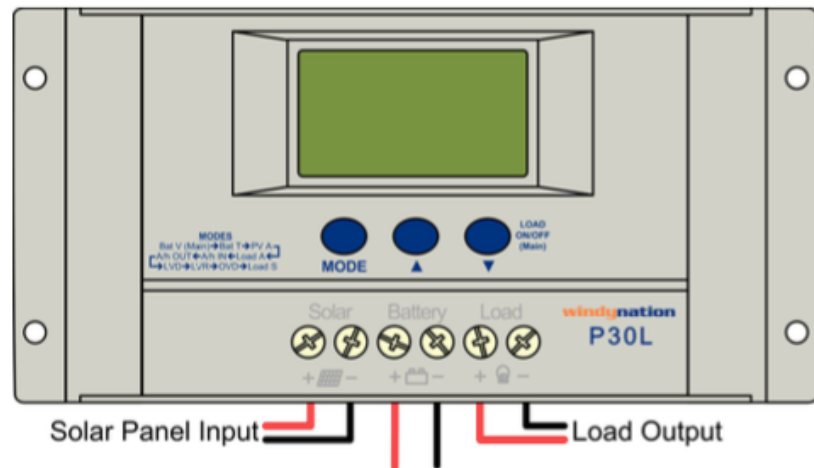
Make a big pot  
of chili.



A photograph of two men in winter attire. The man on the left wears a dark blue puffer jacket and a navy blue baseball cap with 'PHOENIX Golf' in white. He is pointing at a document. The man on the right wears a green beanie, glasses, and a green jacket, holding a document. They are standing in front of an orange wall and a white wall. The word 'Troubleshooting' is overlaid in large white text.

# Troubleshooting

# controller



## Overload Protection

If the Load is drawing a current 1.2 times the rated current, 30 Amps, of the controller for three (3) seconds or more, the controller will enter into an Overload Protection State.

# inverter



## Power Overload

When the starting power exceeds the inverter's power rating, 1500 Watts, the alarm will beep continually and the FAULT LED will blink Red. The inverter will automatically shut down after approx. 20 seconds.

See your manual for more info.



# inverter



## Over Heating

When the inverter exceeds a safe operating temperature, too close to a wood stove or on a very hot day, the alarm will beep two times and the FAULT LED will blink Red.

The inverter will automatically shut down.

Move the inverter to a well ventilated, dry place.

When the temperature drops, the inverter will automatically return to normal operation.

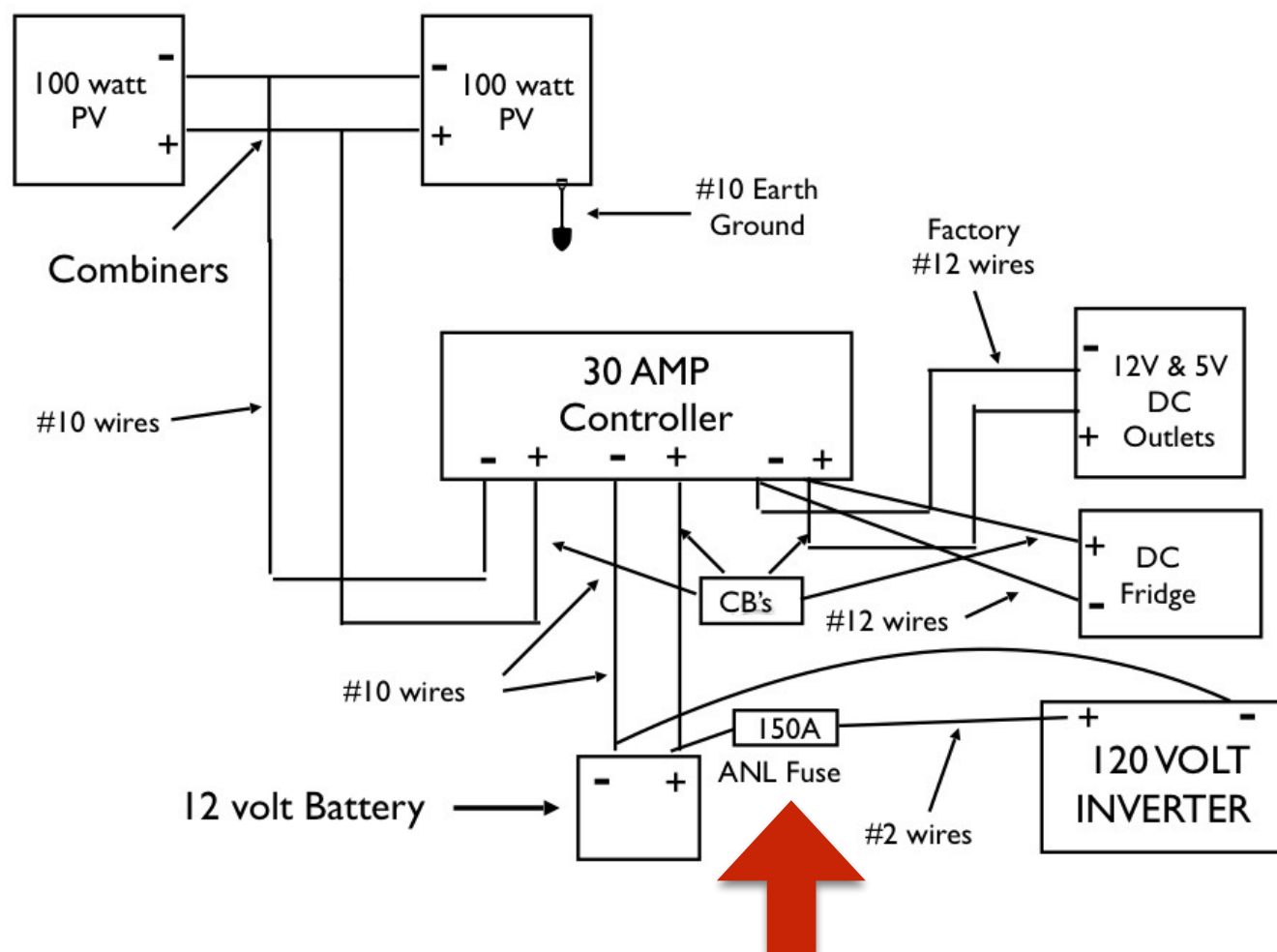
See your manual for more info.

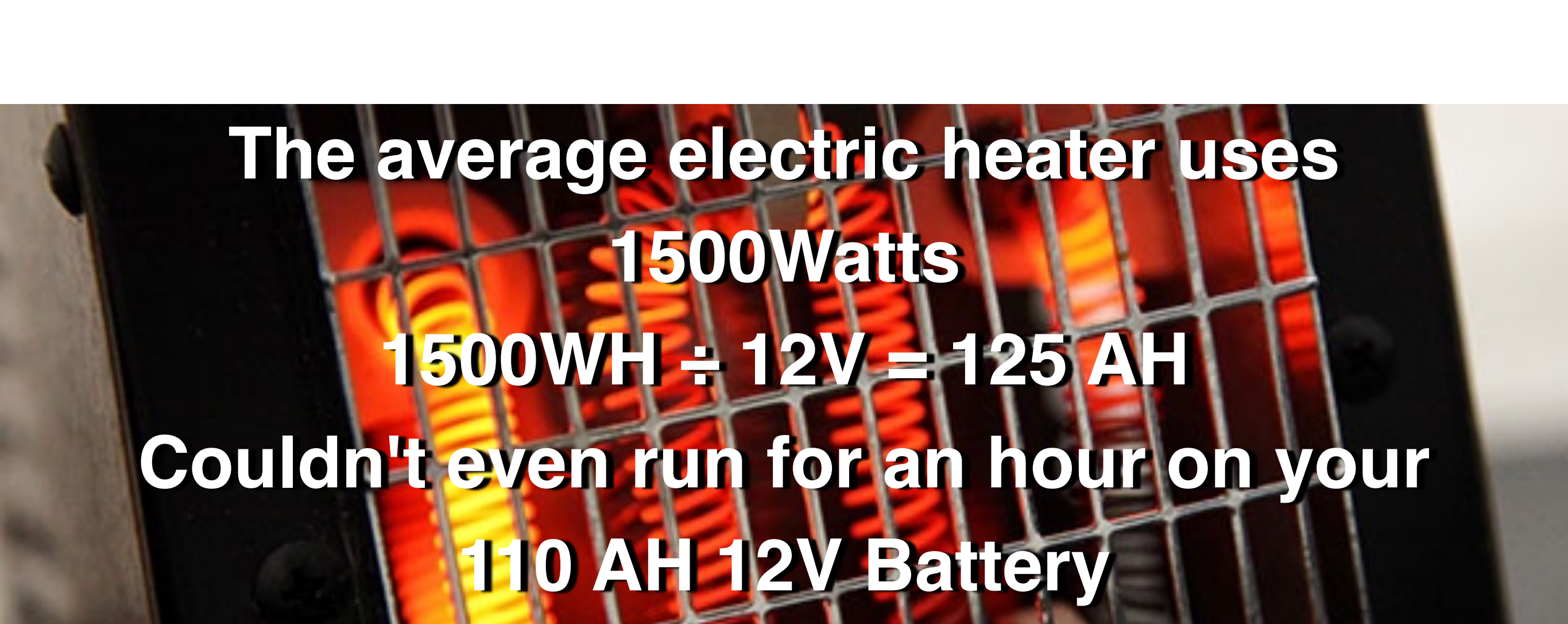


# inverter



During a large wattage AC load your inverter may turn off due to a blown ANL fuse. Your system comes with a replacement fuse.





**The average electric heater uses  
1500Watts  
 $1500\text{WH} \div 12\text{V} = 125\text{ AH}$   
Couldn't even run for an hour on your  
110 AH 12V Battery**

**BUT!!!**

Both controller and inverter will turn off  
AC and DC power if the battery is too low  
and won't come back on until  
the sun has recharged it.

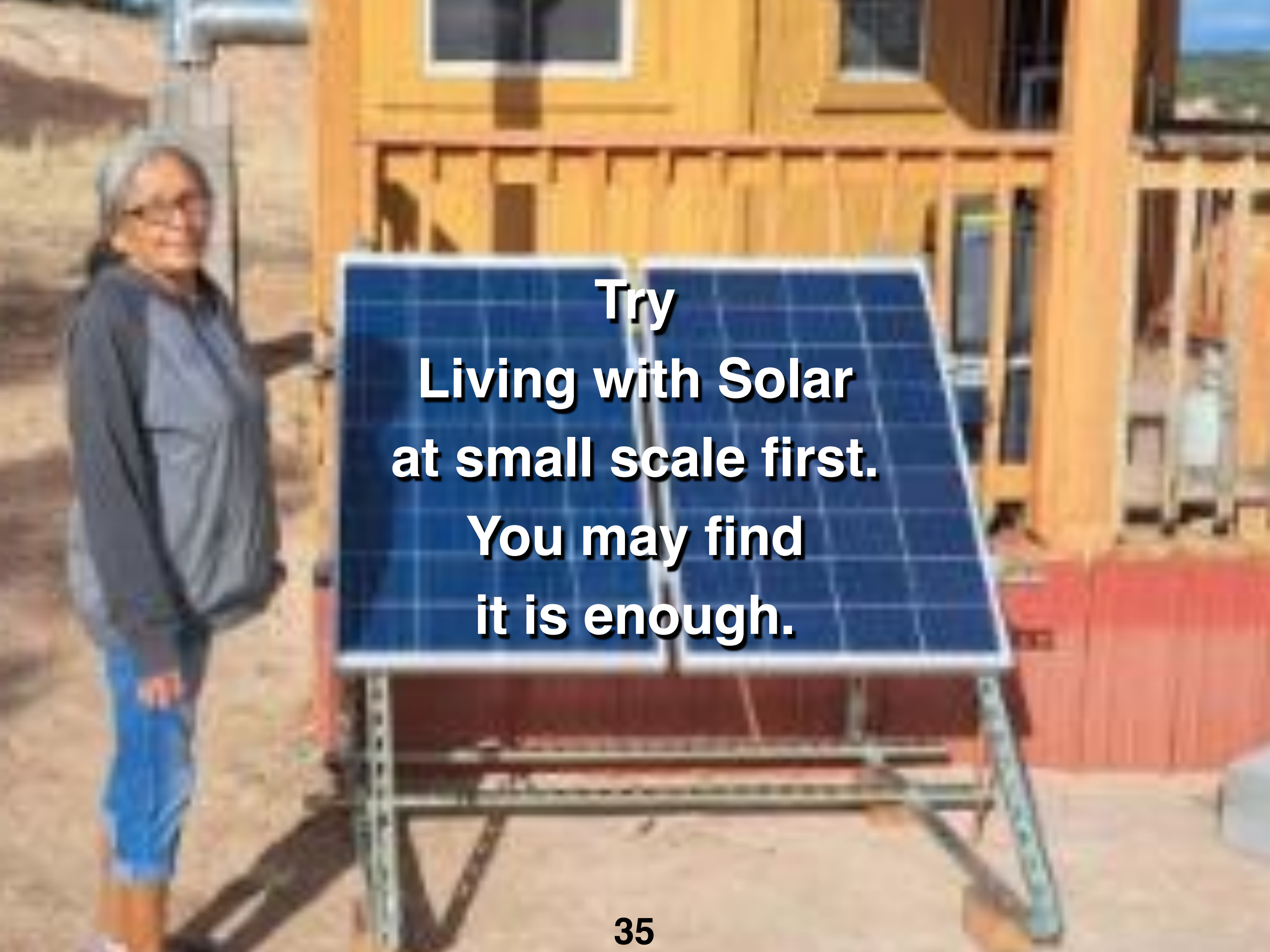


This system was designed by Gallup Solar to power the essentials, a refrigerator, lights, charging some cooking and some entertainment.



If you really need more power  
**our system is expandable.**



A photograph of a woman with short grey hair and glasses, wearing a grey jacket and blue jeans, standing next to a small-scale solar panel array. The array consists of two blue solar panels mounted on a metal frame. The background is a wooden building with a balcony. The text is overlaid on the solar panels.

**Try  
Living with Solar  
at small scale first.  
You may find  
it is enough.**