



Living with Solar

Class 5 for Solar Team 9

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.

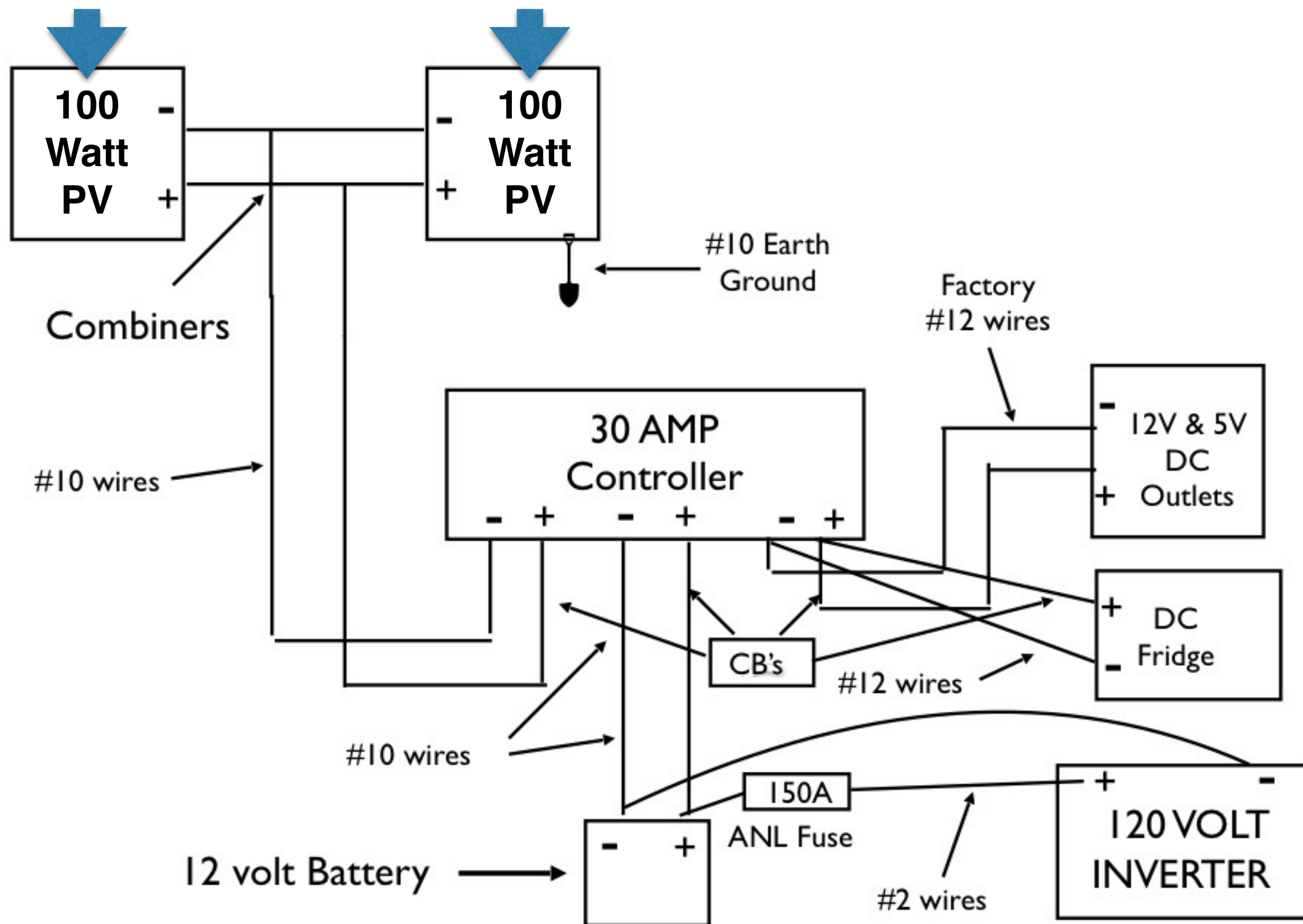
First of all...

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

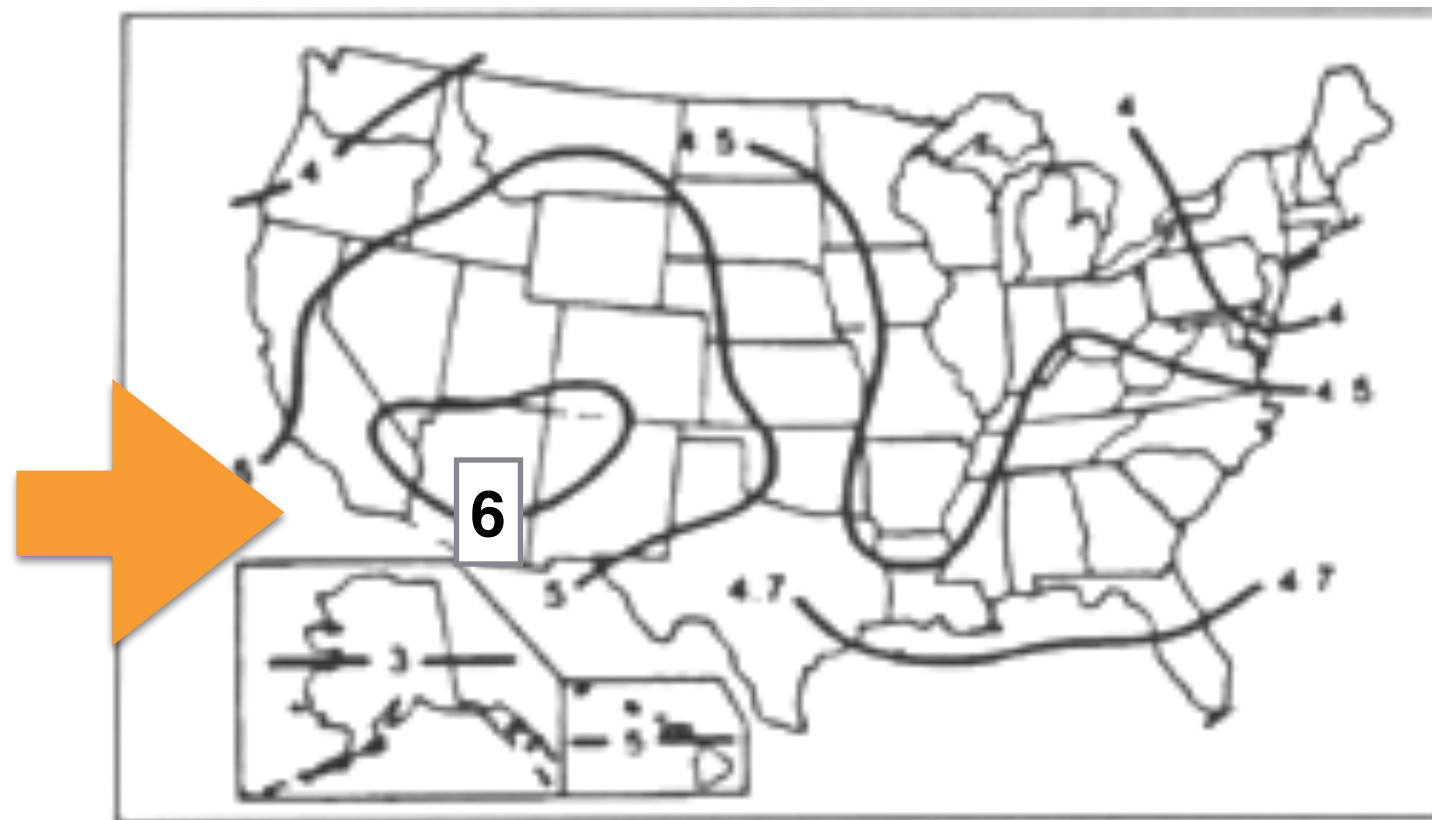
Every electric appliance uses
a rated number of Watts per Hour.

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.

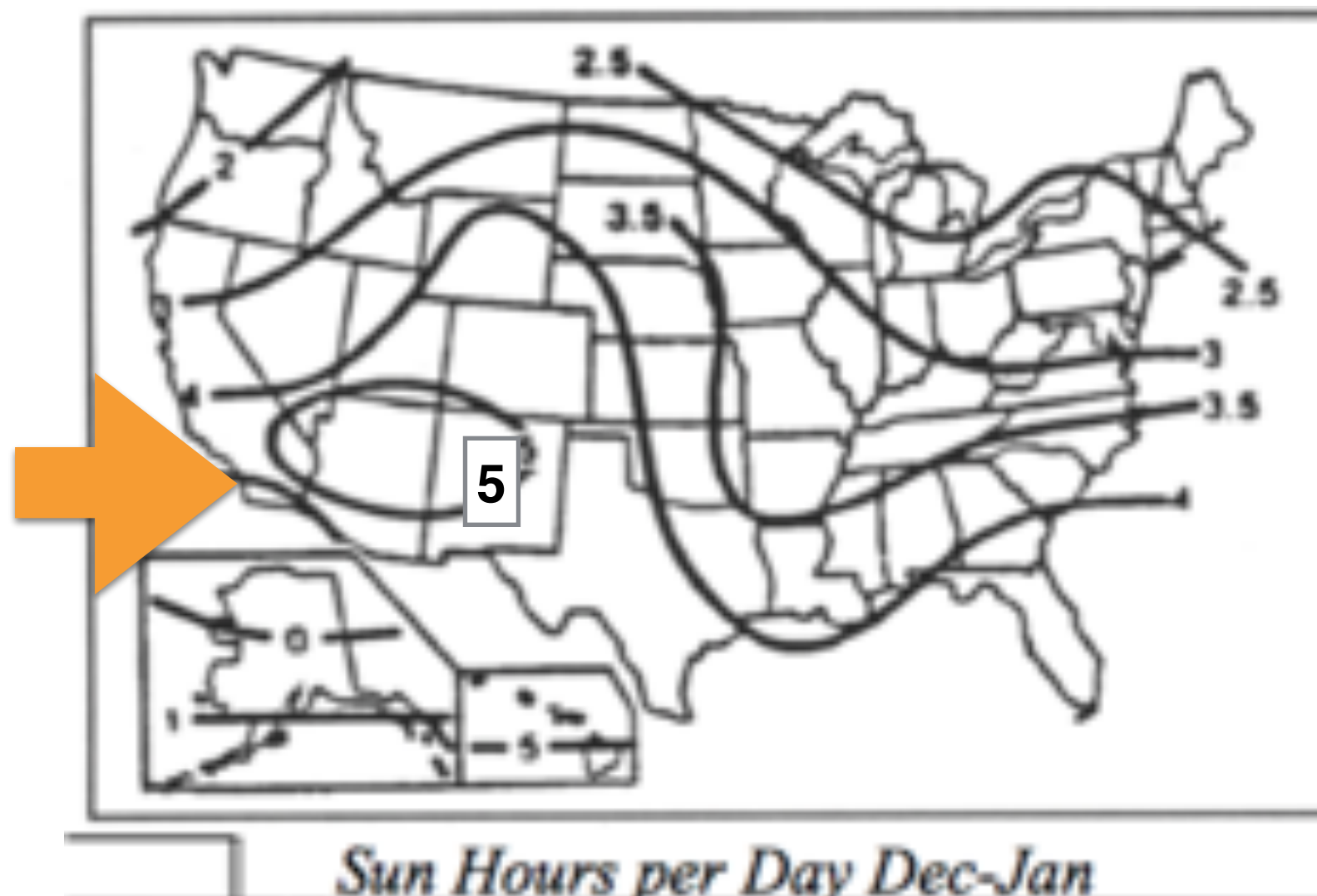


Average Sun Hours Year-Round

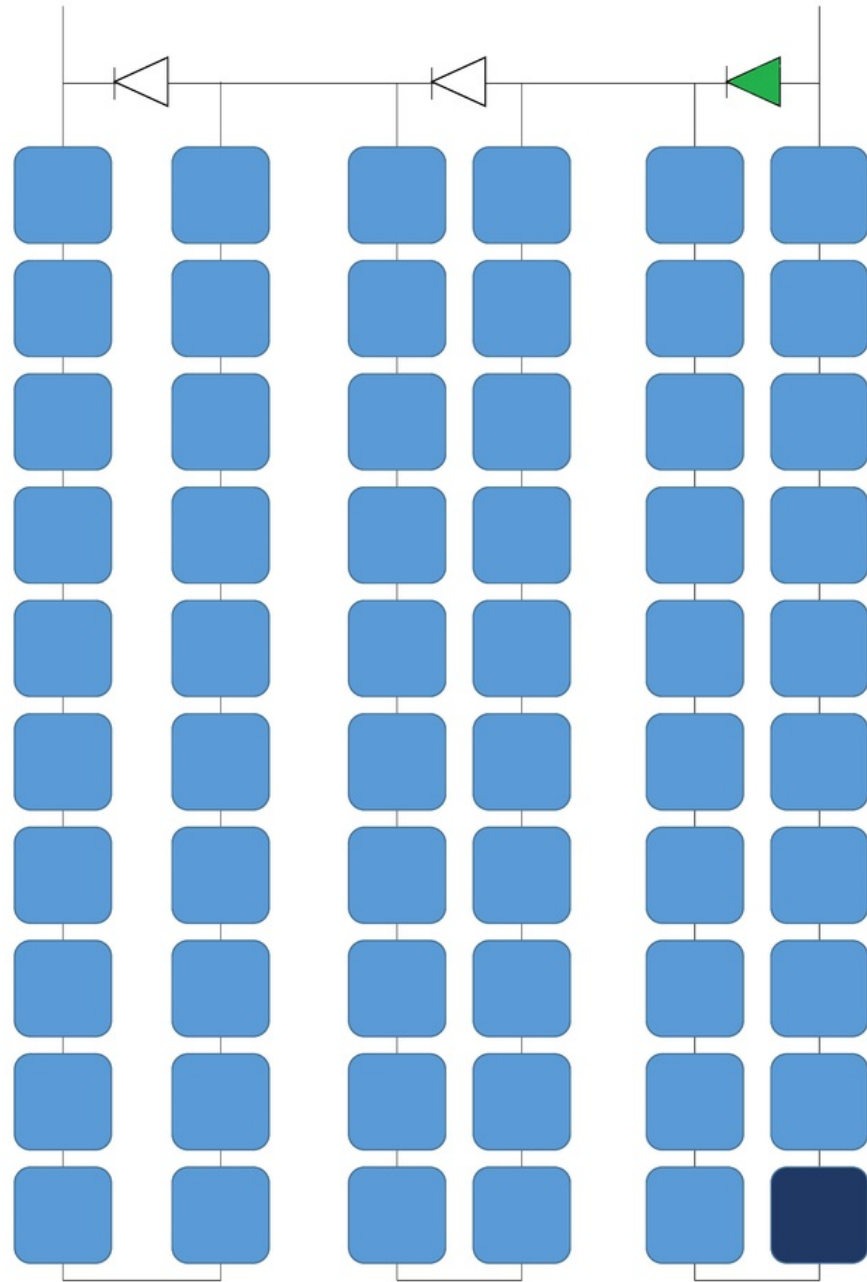
We get six hours of sun.

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

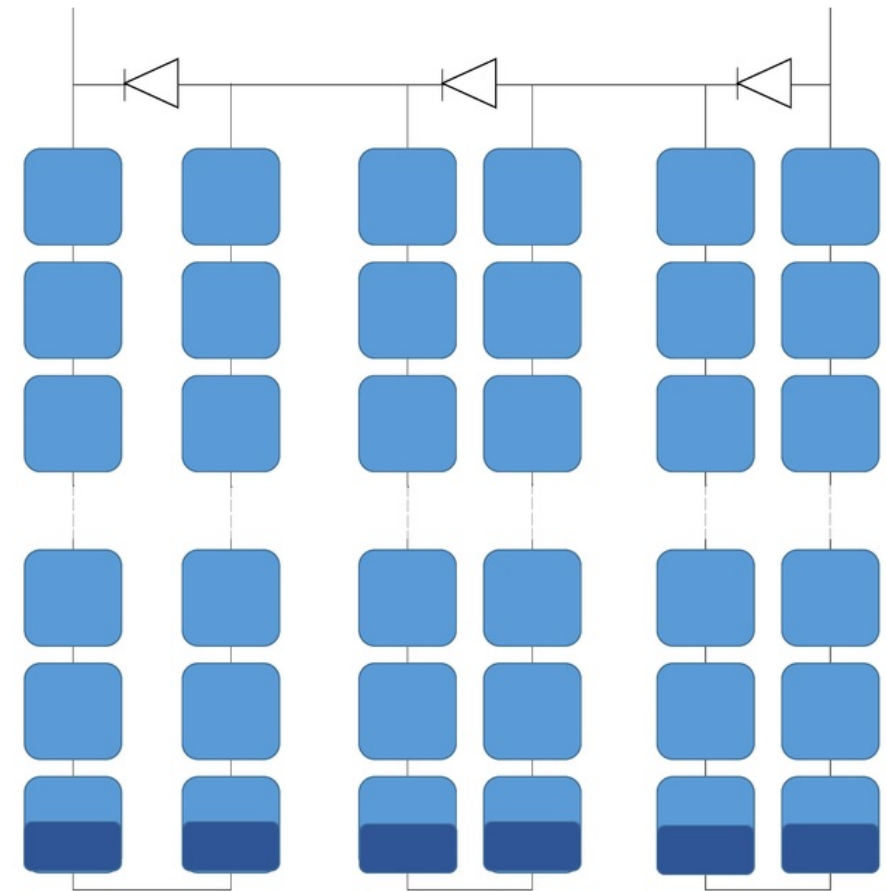
But...sun hours are fewer in winter.
And there are always system losses,
cloudy days and inefficiencies, so to be safe,
reduce 1200WH by 1/3 to **800WH** per day



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



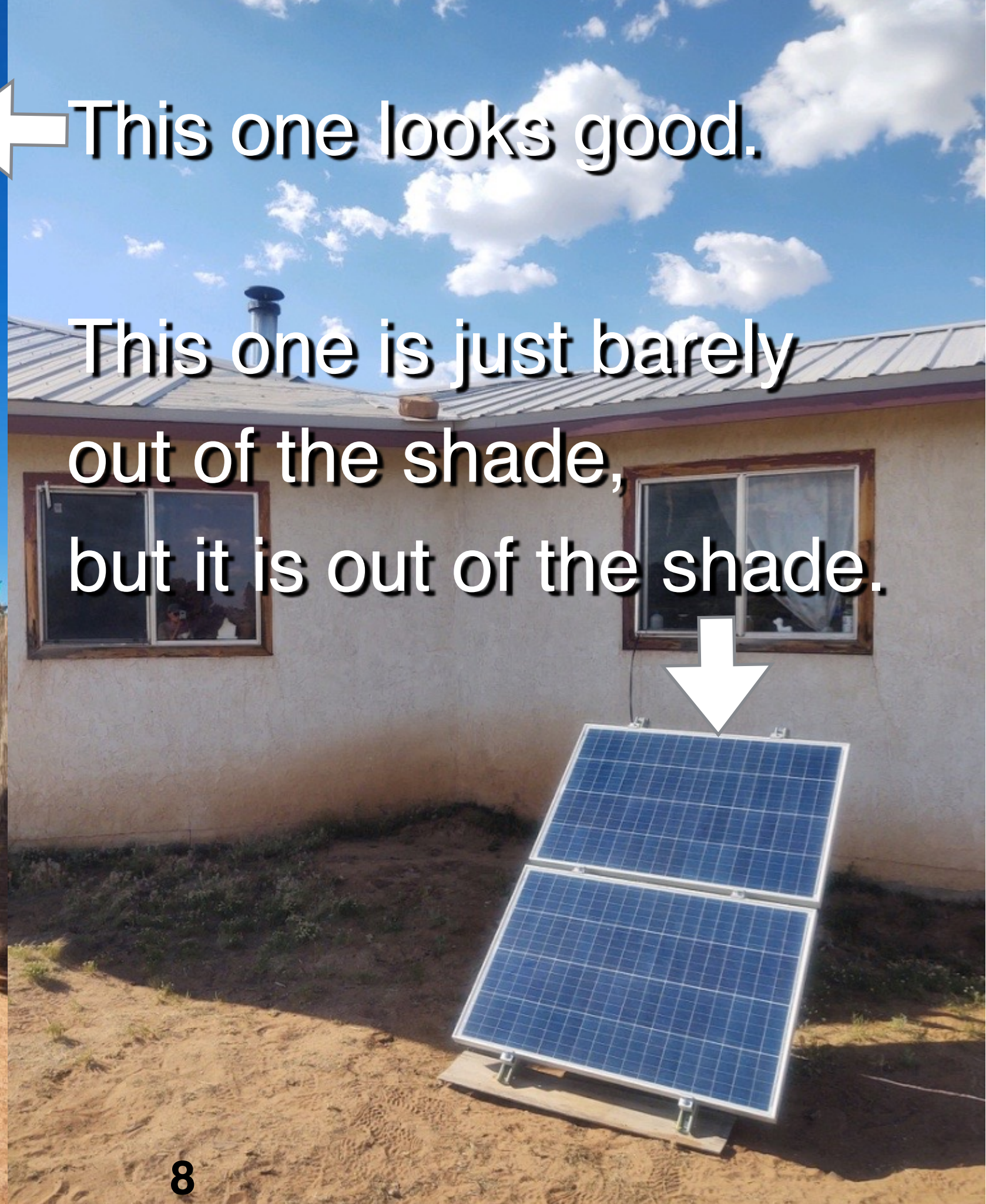
One shaded cell can shut down a string.



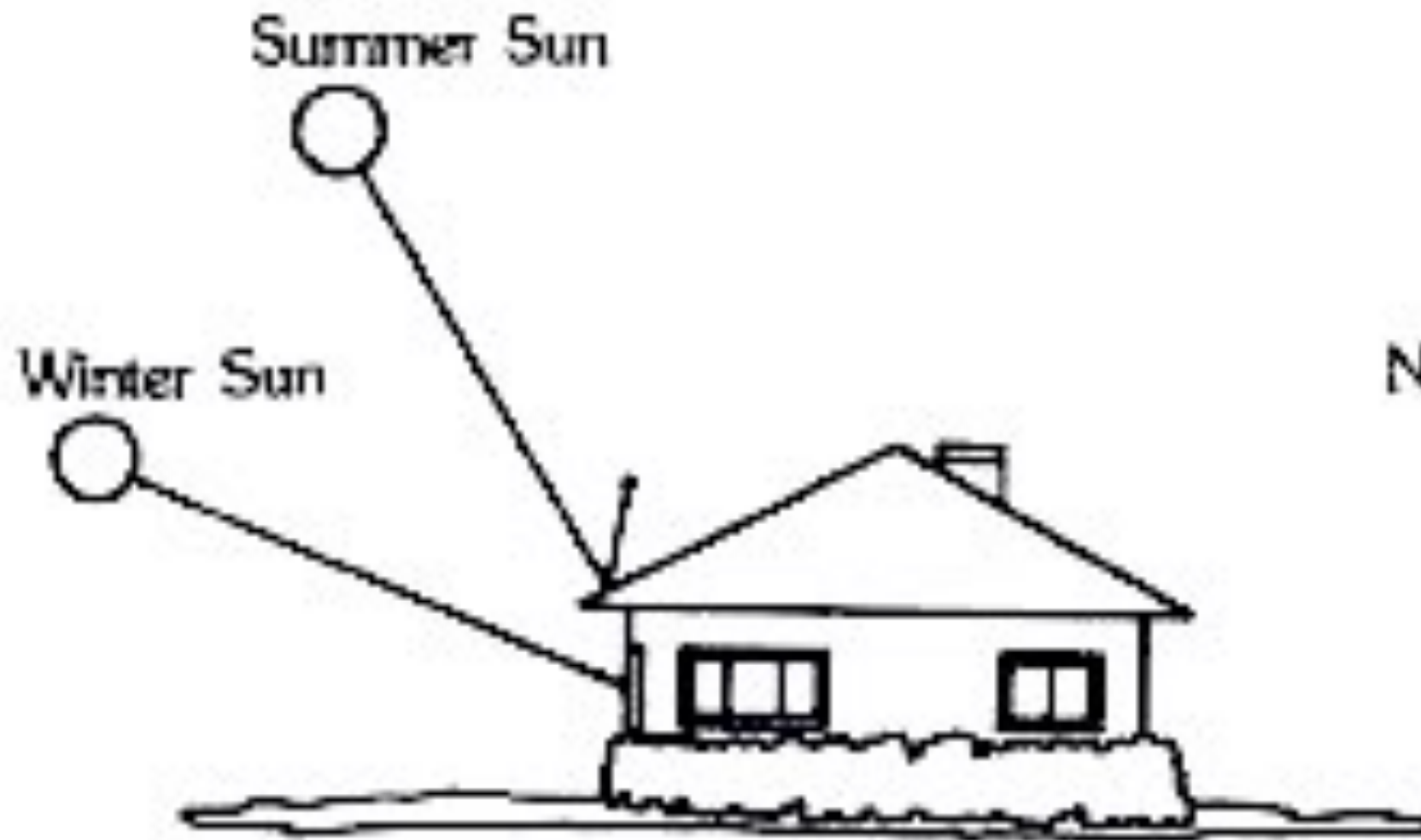
A row of shaded cells can reduce the current of the whole panel.



← This one looks good.



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

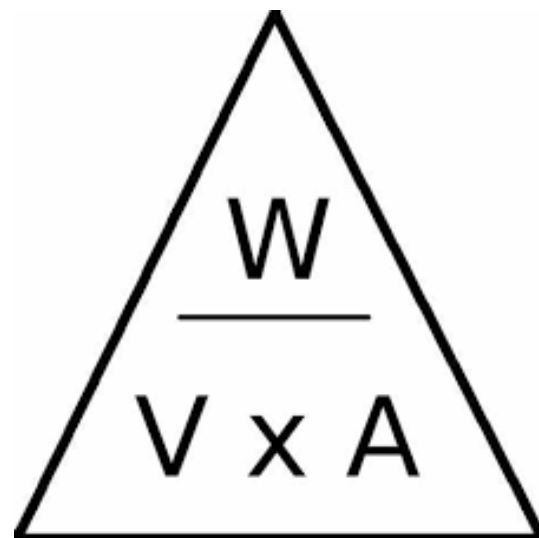


Remember that the sun
is higher in the summer,
lower in the winter.

Next...Watt Hours to Amp Hours

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

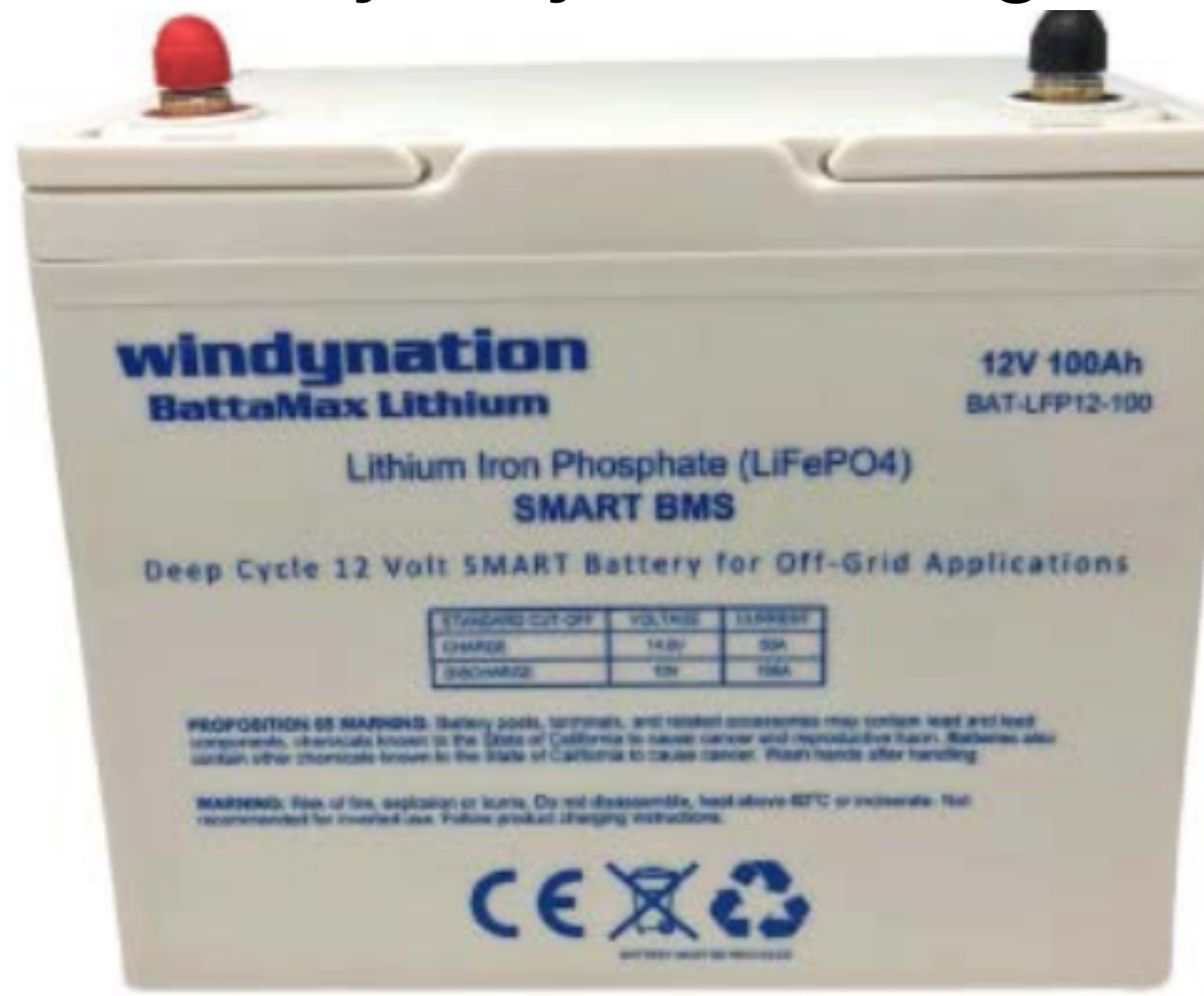
Watt/Hours divided by Voltage equal Amp/Hours.



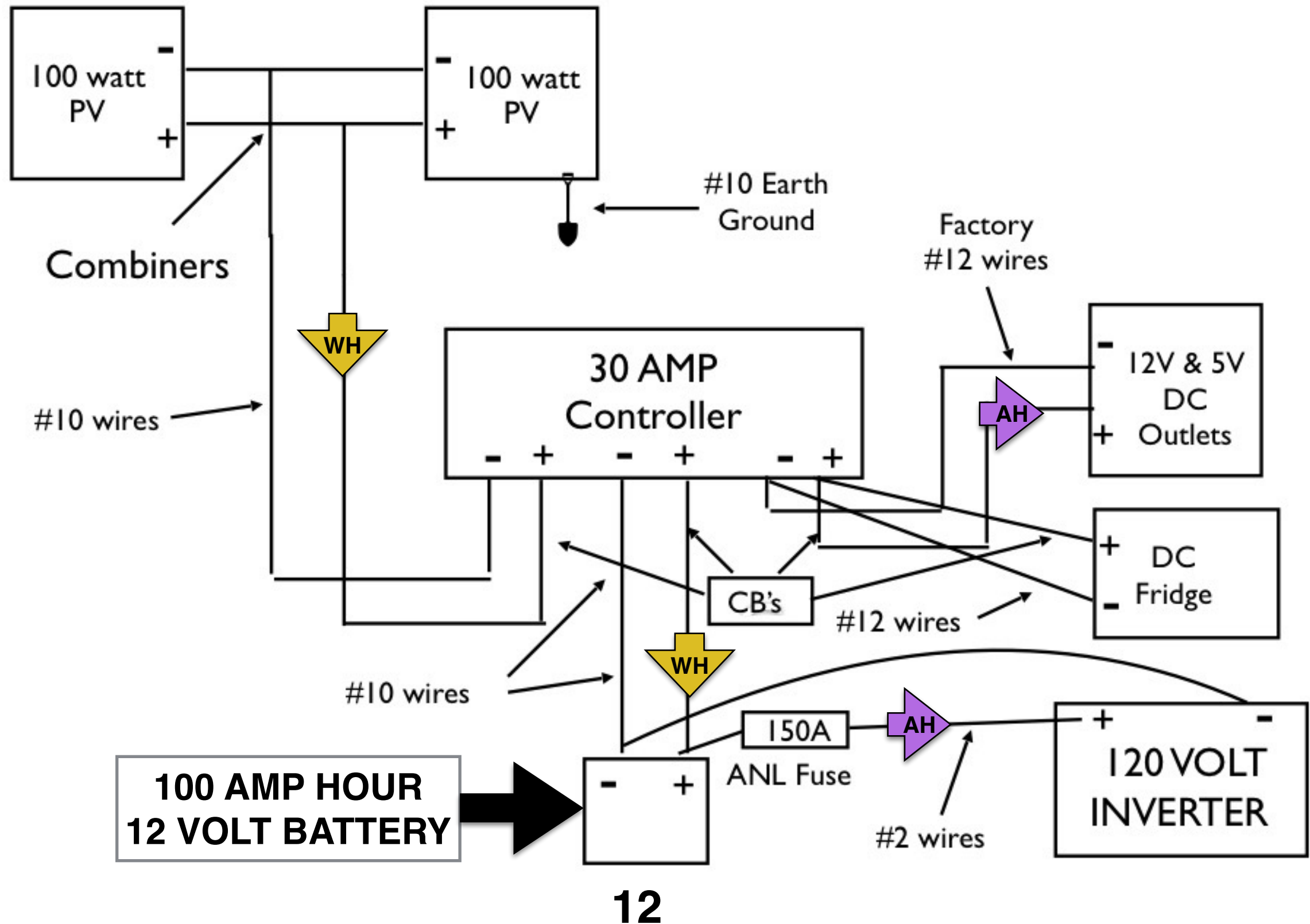
Watts Law

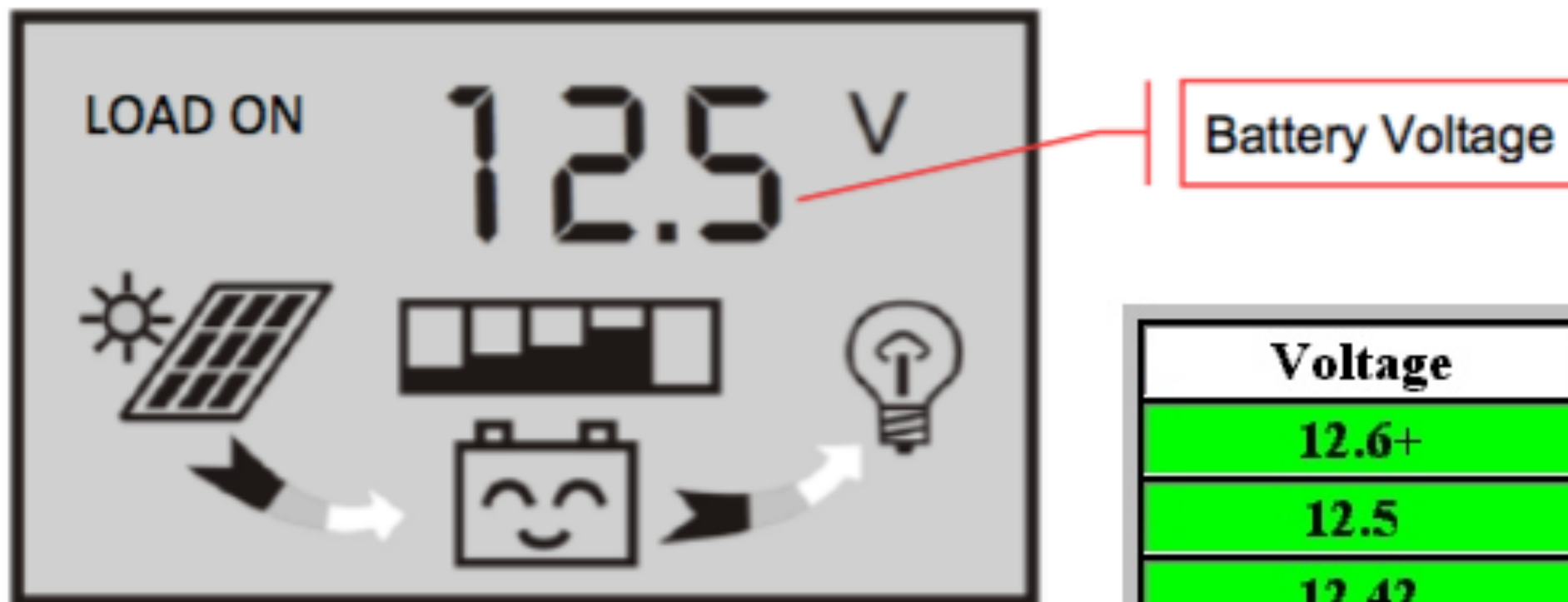
$$800\text{WH} \div 12\text{VBattery} = 66 \text{ Amp/Hours}$$

66 AH is two thirds the total capacity
of your Deep Cycle 12Volt
100 AH lithium battery.
It takes **1 1/2** sunny days to charge it completely.



WH being produced, AH being used





If your controller
shows
12.5 Volts your
battery is 90% full.

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%

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



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

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

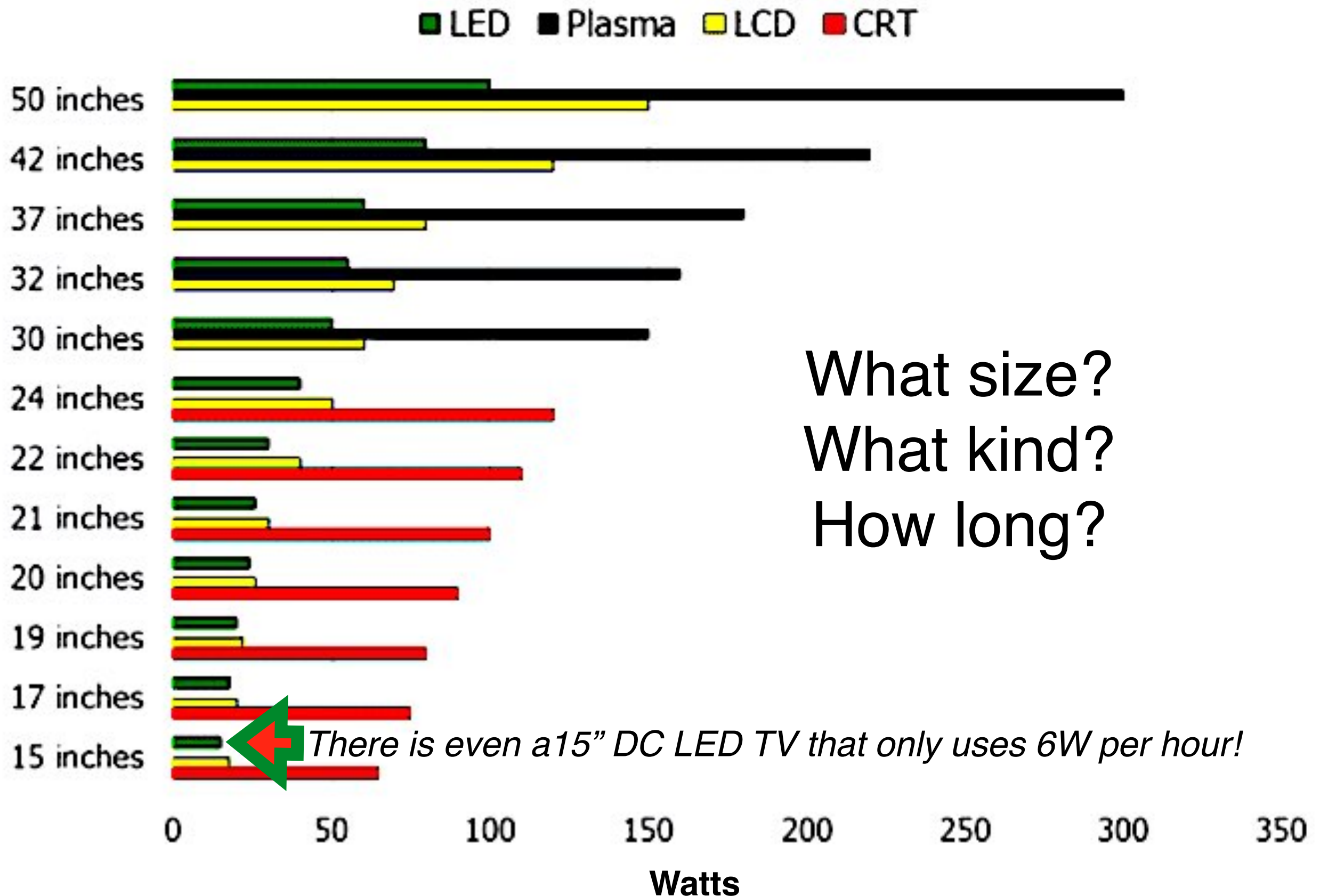
SunDanzer cycles on and off over 24 hours

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



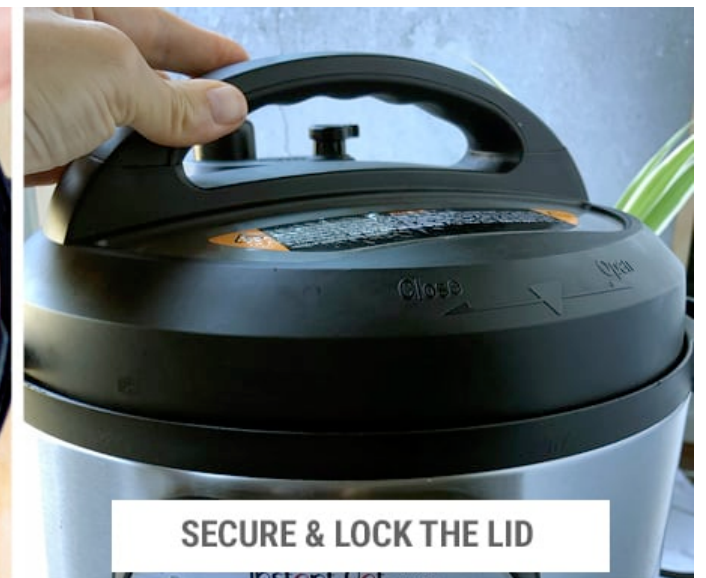
Power Consumption
350W 65W 120W
Watts per Hour



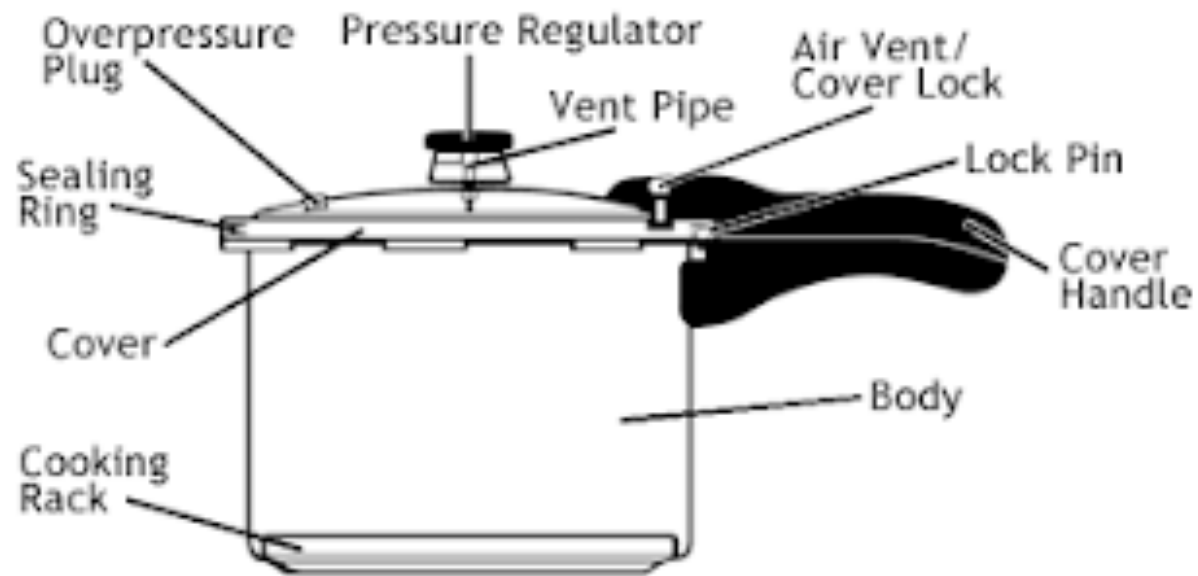
Cooking with a 3 Quart Instant Pot 700W



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



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 cell.



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

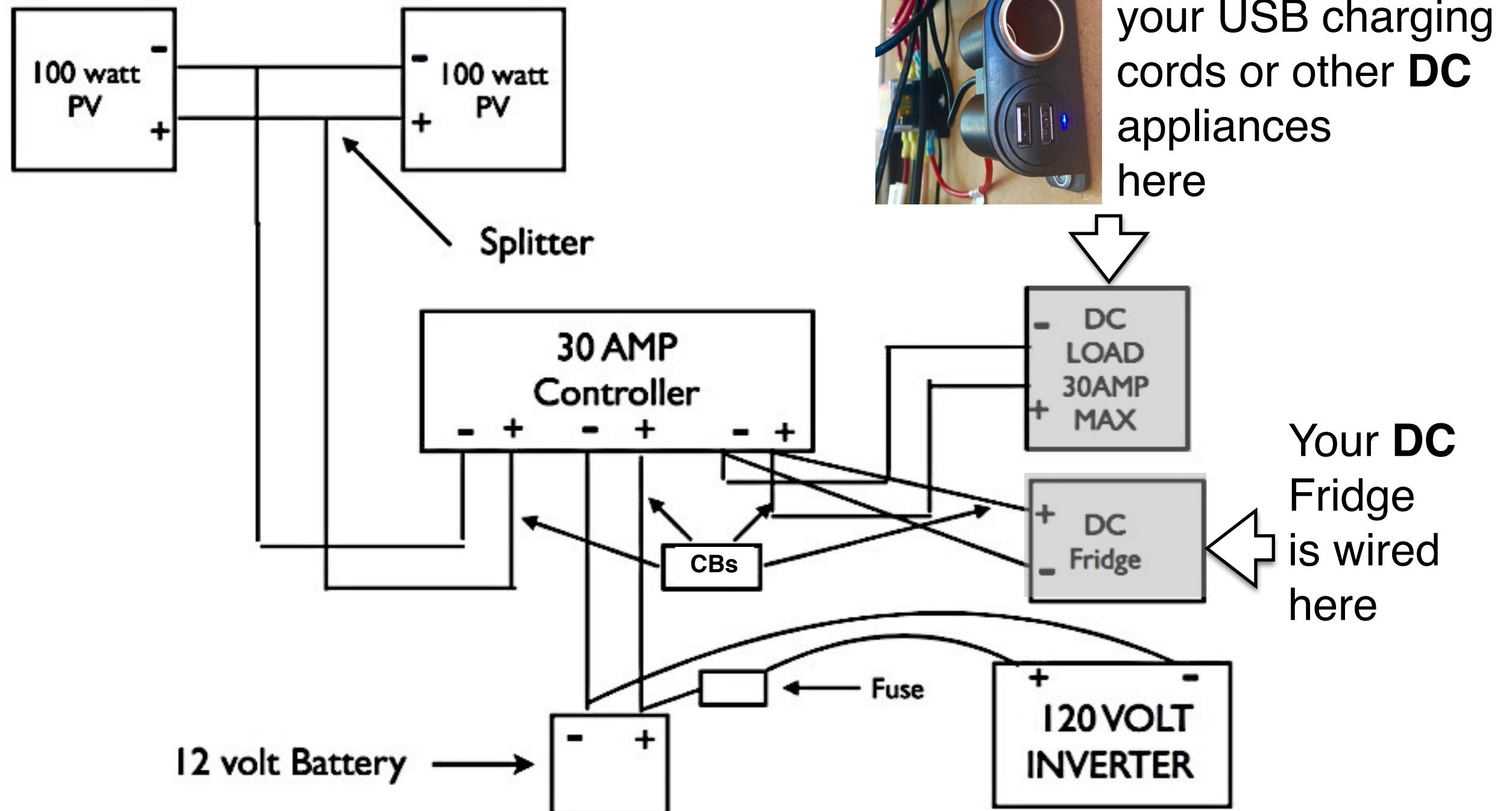
Your panels produce **12VDC**. *Perfect for DC appliances.*



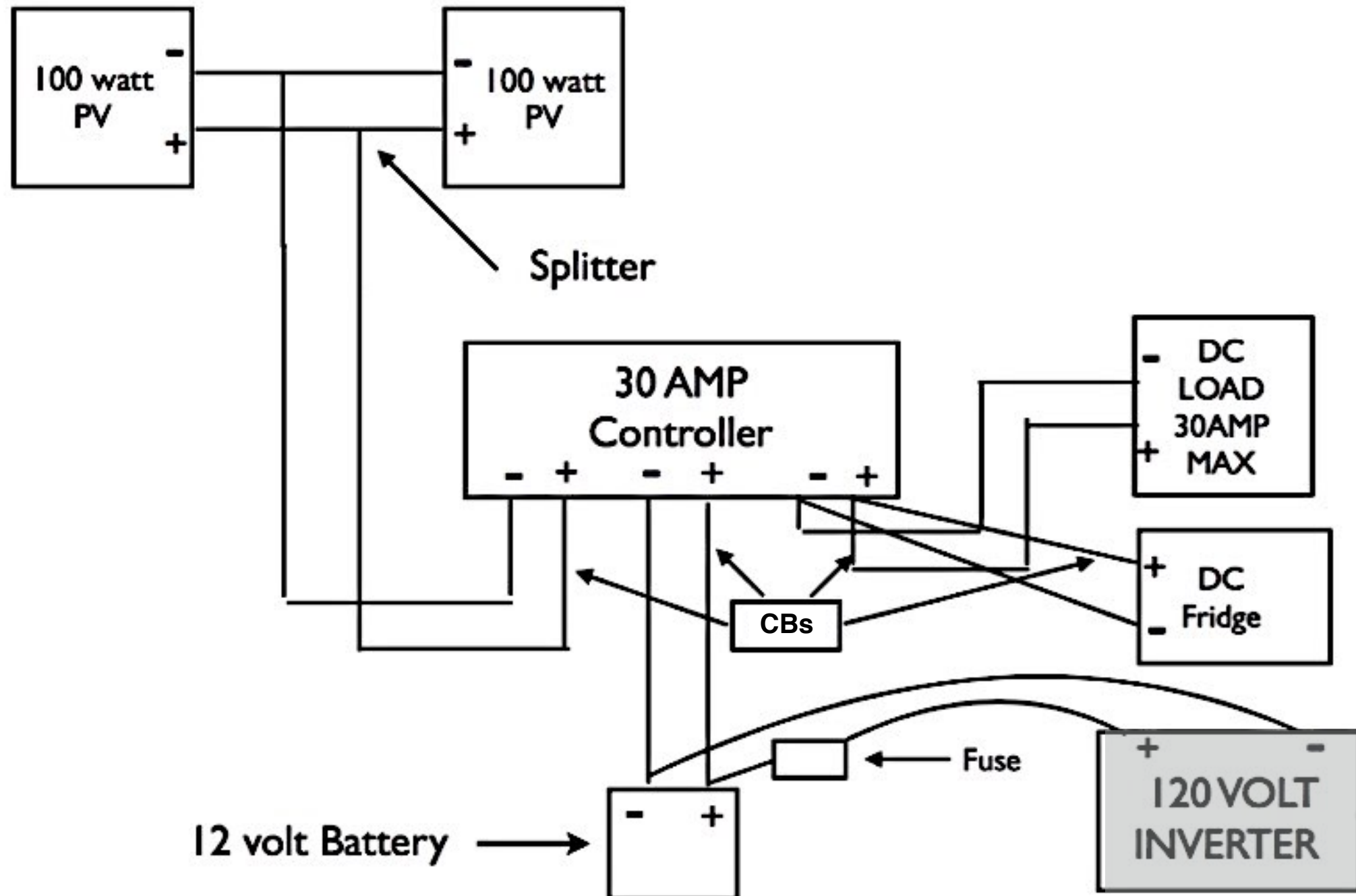
But most appliances need **120VAC**,
Your inverter multiplies the 12VDC from your panels
times 10 to make **120V** and changes **DC** to **AC**.

*DC appliances are more efficient because your inverter
draws some DC electricity to run itself.*

Where is your DC?



Where is your AC?



AC
appliances
plug in here

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

12 VOLT DC APPLIANCES	WATTS power	HOUR time used	WATT HOURS power x time used	AMP HOURS divide WH by 12
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
120 VOLT AC APPLIANCES requires inverter	WATTS power	HOUR time used	WATT HOURS power x time used	AMP HOURS divide WH by 10 for inverter loss
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
TOTAL DC AND AC	WATT HOURS 593 WH		AMP HOURS 55.15AH	

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.

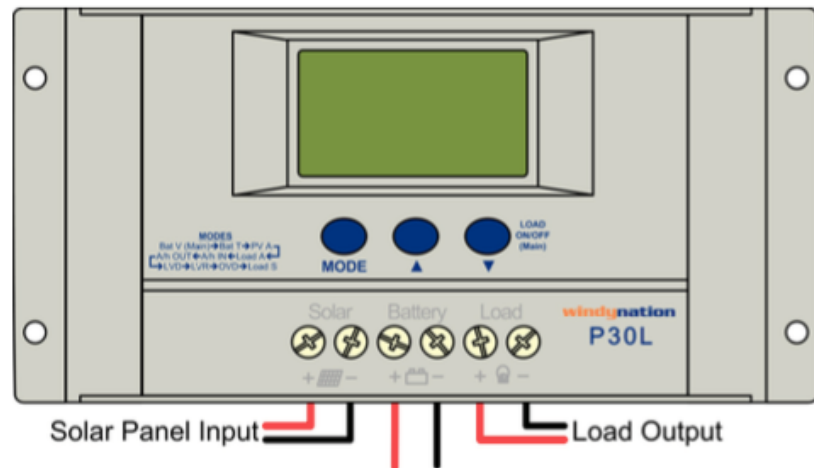
Use that
200 extra watts per hour
of incoming solar power.

Make a big pot
of chili.

A photograph of two men in winter clothing. The man on the left wears a dark blue puffer jacket and a navy blue baseball cap with 'PHOENIX Golf' written on it. He is pointing at a document held by the man on the right. The man on the right wears a green beanie, glasses, and a dark green jacket. He is holding a piece of paper and looking at it. The background is a plain wall with orange and white sections.

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 “chair” away from heat source or shield from heat.

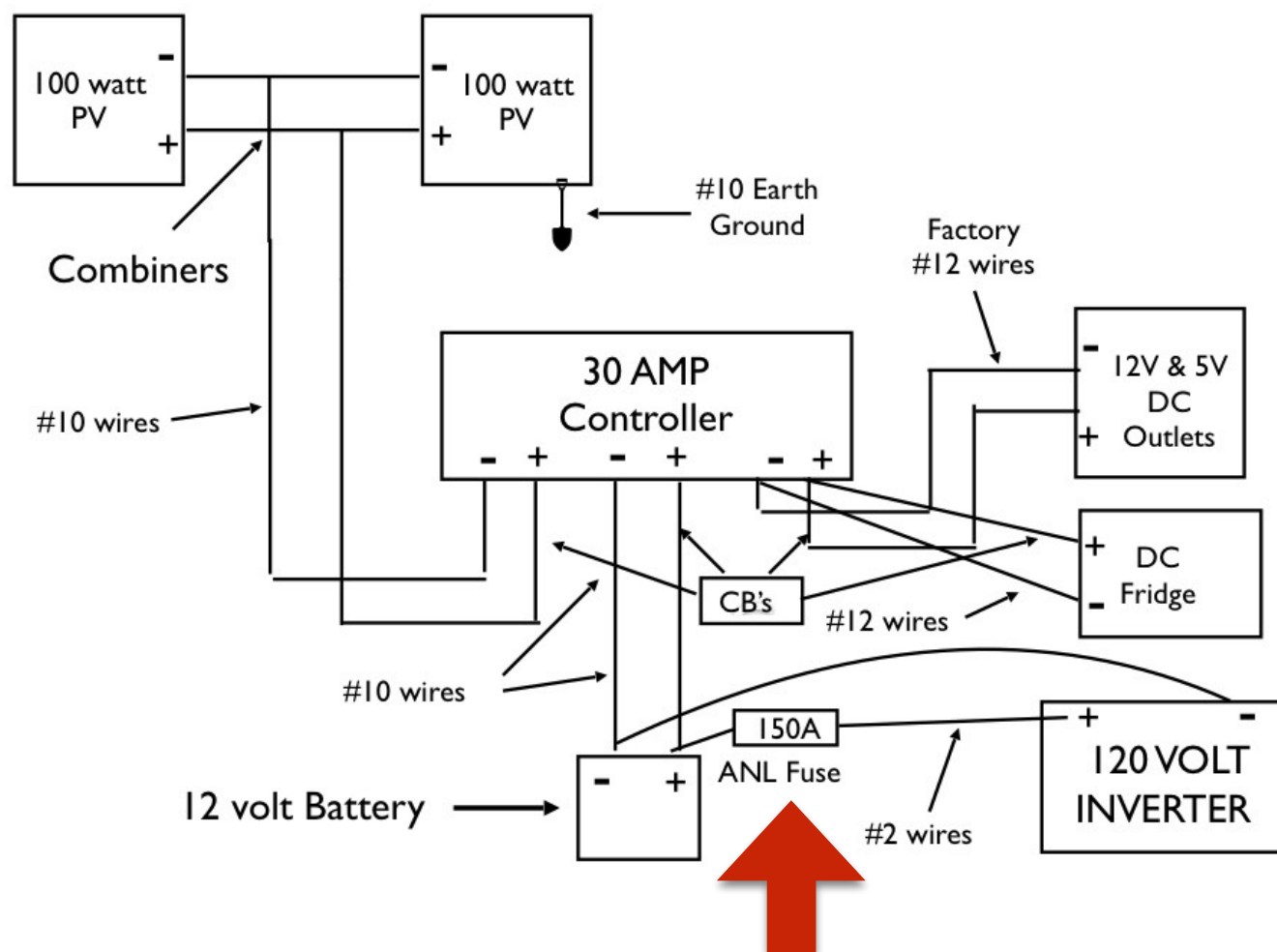
When the temperature drops, the inverter will automatically return to normal operation.

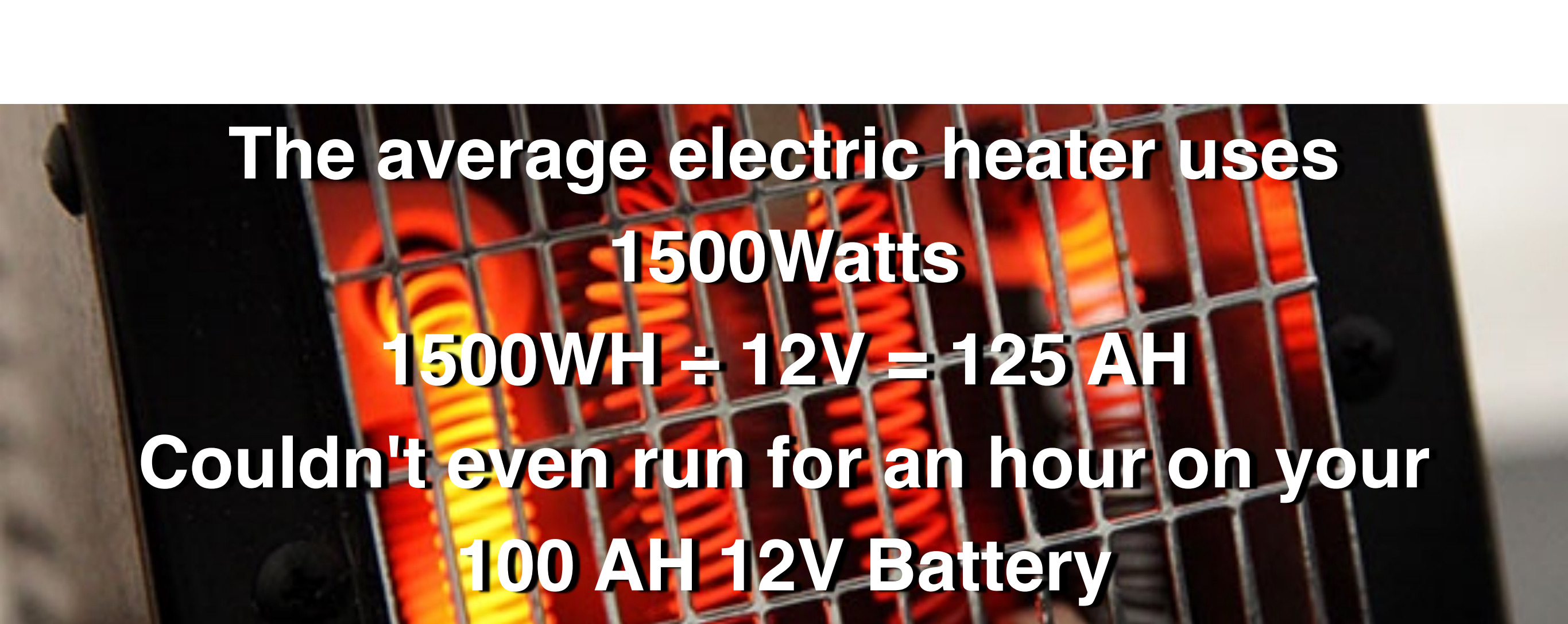
See your manual for more info.

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
100 AH 12V Battery

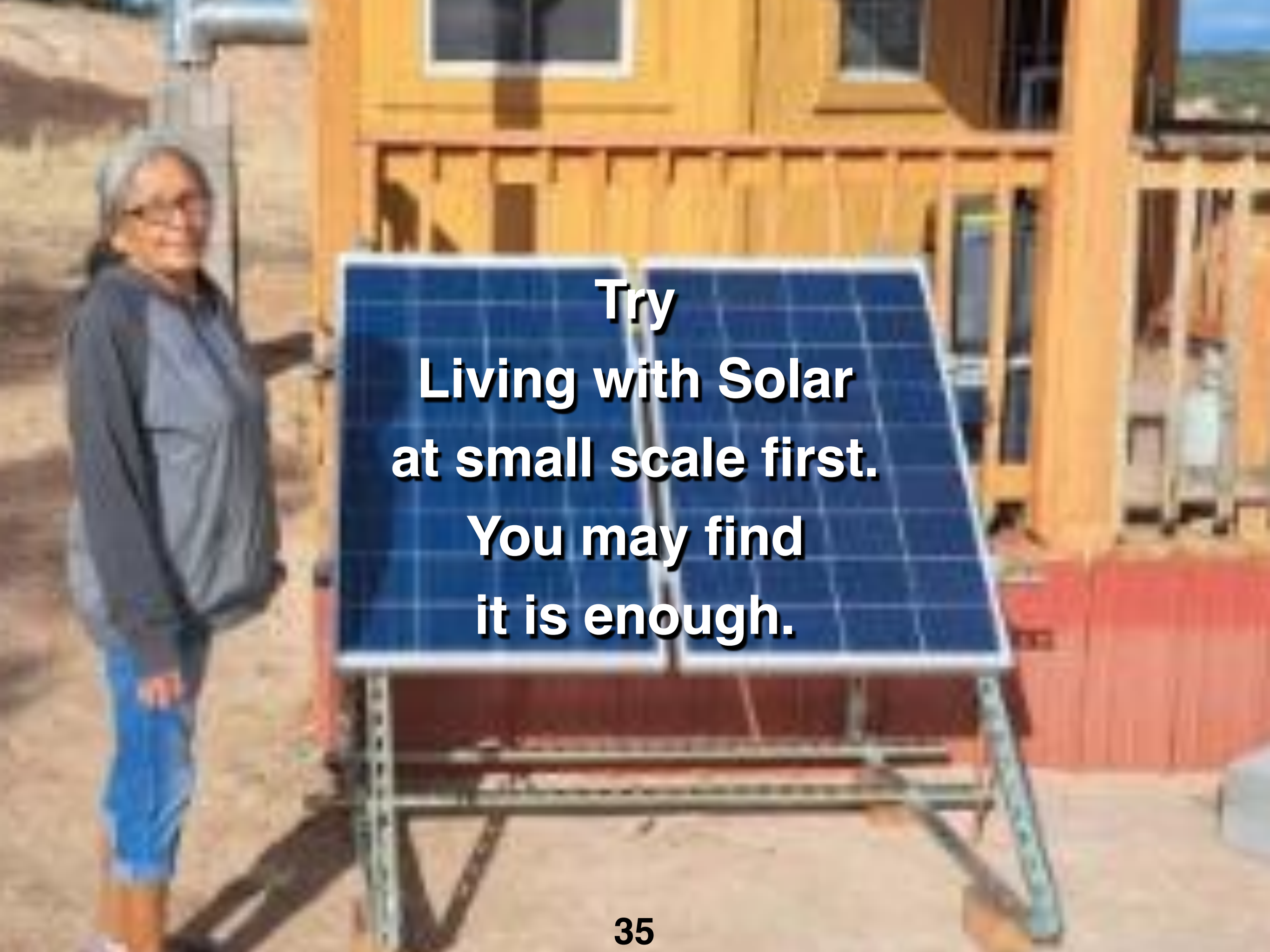
BUT!!!

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 large solar panel array. The array is mounted on a metal frame and is tilted towards the sun. In the background, there is a wooden building with a balcony. The text "Try Living with Solar at small scale first. You may find it is enough." is overlaid on the image in white, bold, sans-serif font.

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