Wind, Fuel Cell and Solar Power Charging Systems

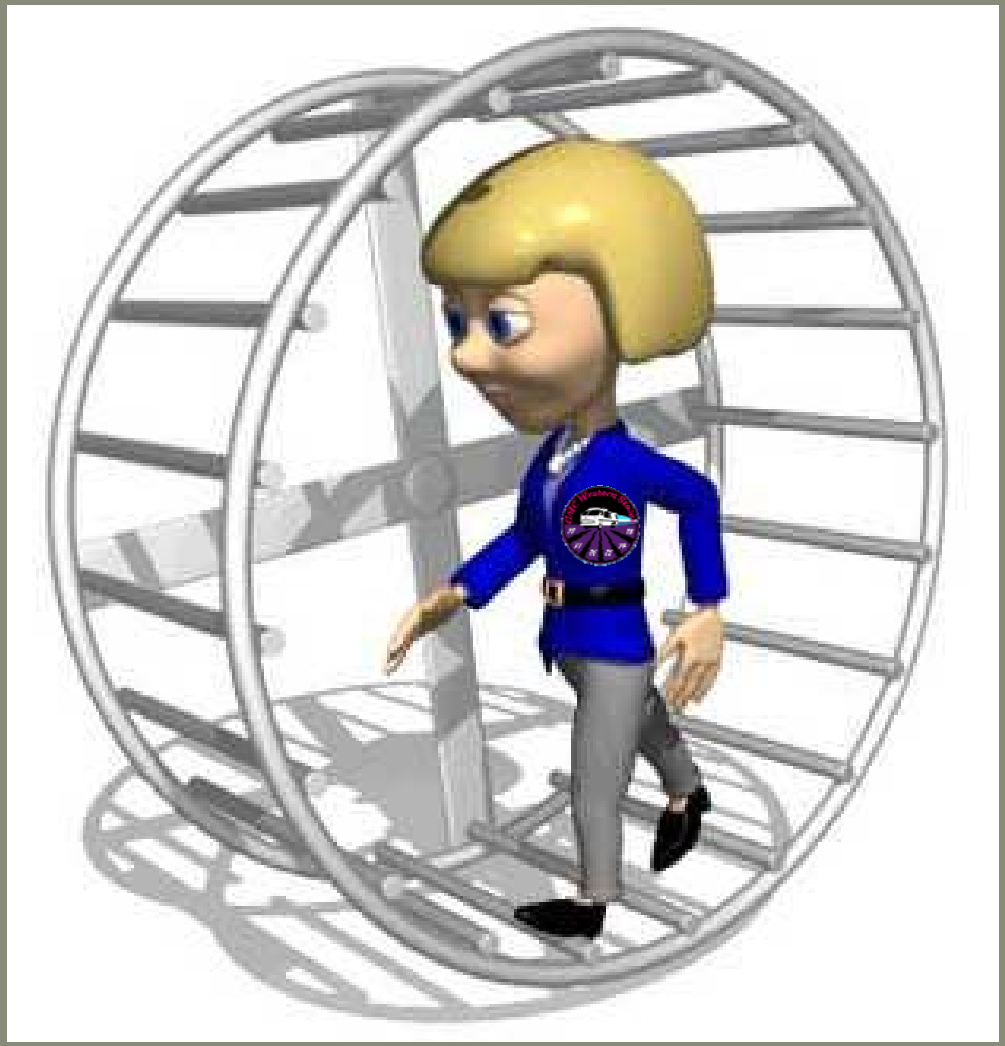
GMC

Cat Power

Hamster Power

Dog Power

Other Methods



What are the Options?

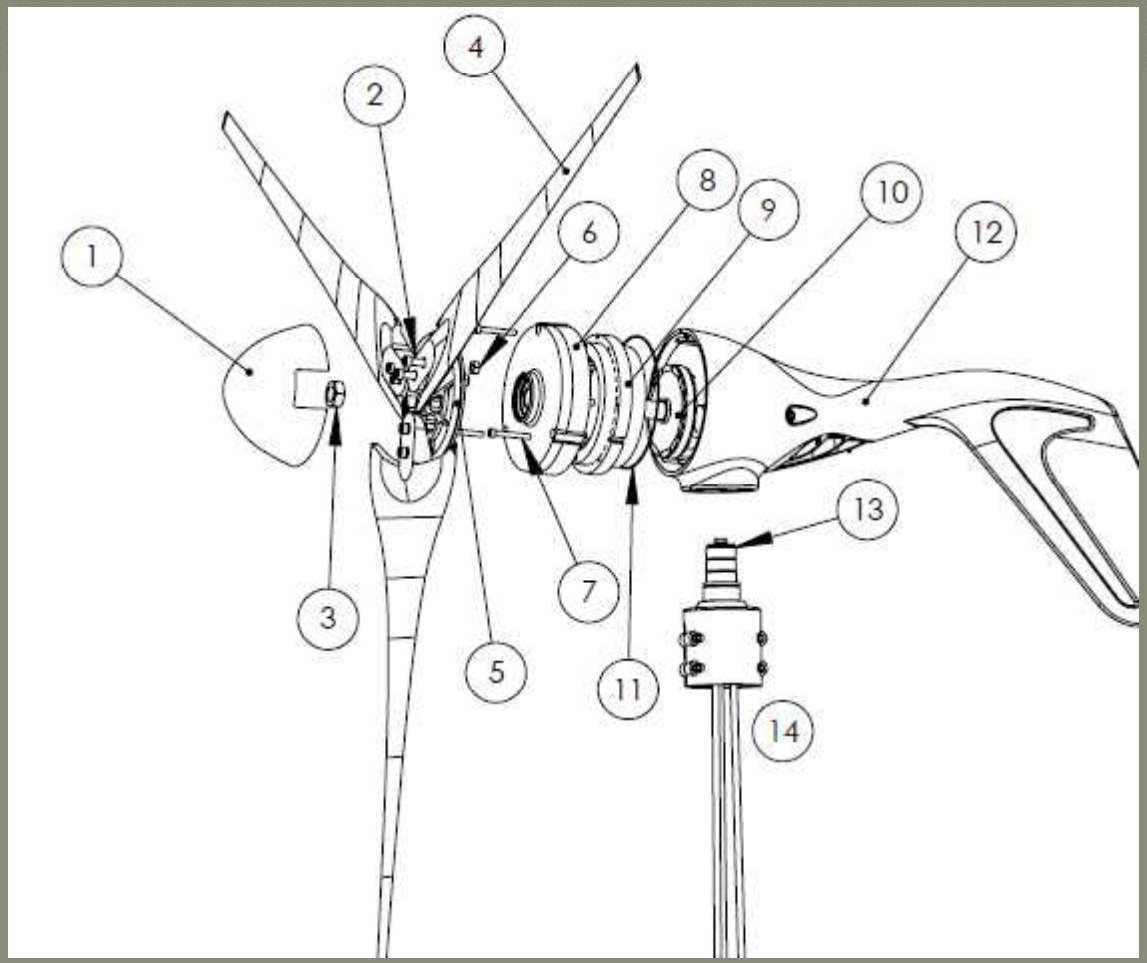
- Wind
- Fuel Cell
  - PEMH (Proton Exchange Membrane Hydrogen)
  - DMFC (Direct Methanol Fuel Cell)
- Solar
  - Passive
  - Passive Single Axis
  - Tracking Multi-Axis

Wind

Wind

- Pro
  - Can provide power day and night
  - Low maintenance
  - Best for long term use
  - Portable for home use.
- Con
  - Noisy
  - Set-Up Time
  - Storage Issues
  - Control Issues

Just like an Alternator



Wind Turbine Availability

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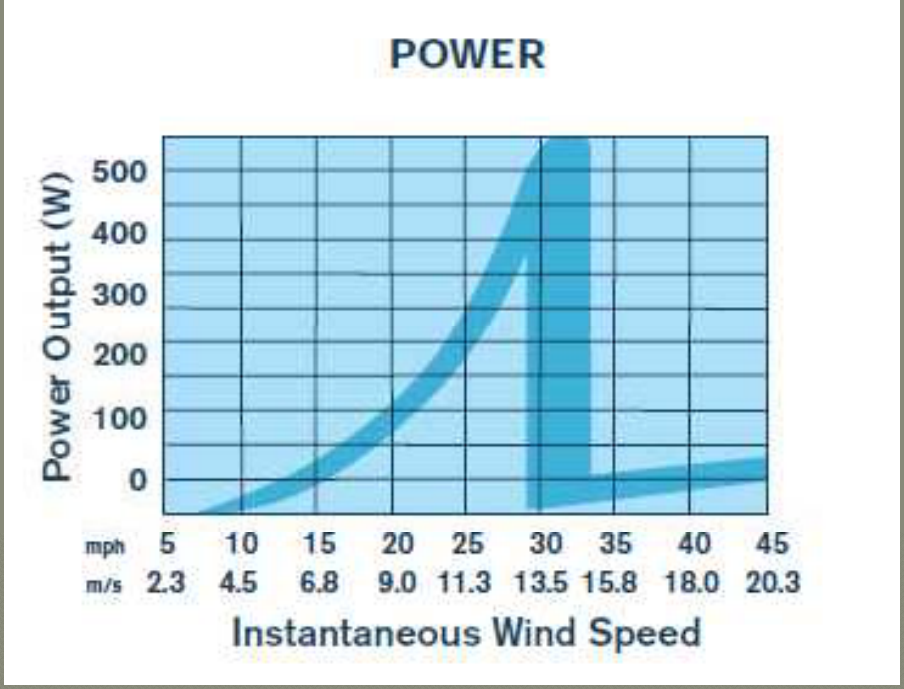


Specs and Cost

- 400 watt x 12 volt turbine = $800.00

- Mounting base = $900.00

- Pole, wire, loom, controller, etc = $300.00

- **Total = $2000.00**

Power Consumption

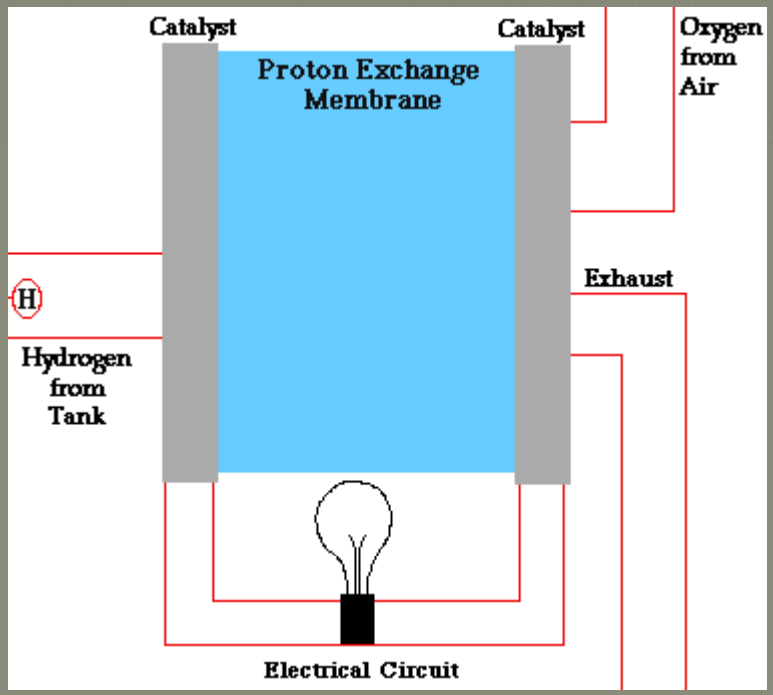
12V Appliances	Amps	x Qty.	x Hrs. Run/day	=Total amps per day
10 watt lights	0.8			
15 watt lights	1			
Water pump	4			
12 volt TV	3			
Automatic Fan	2			
Furnace	8			
12 Volt Stereo	0.8			
Propane Alarm	0.21	1	24	5
*Fan and furnace are not typically run at the same time.				
120 VAC Appliances - Using DC to AC Inverters				
TV	4			
VCR	3			
Satellite	4			
Microwave	100	1	0.1	10
Toaster	65			
Coffee Maker	60			
Blender	12			
Computer	25			
Laptop	5			
Total amp hours per day				
*All amperage ratings are based on a 12 volt system.				

Fuel Cells

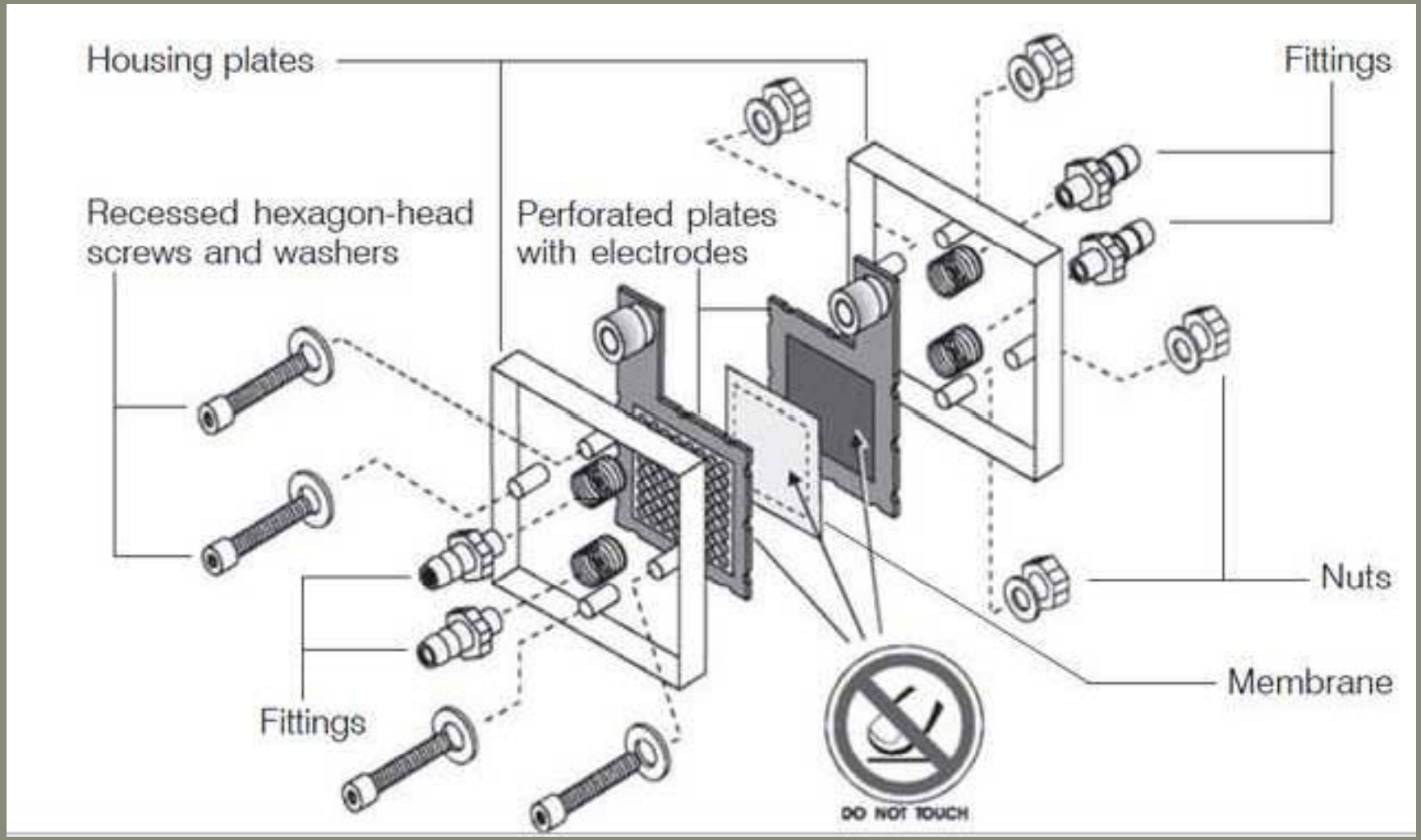
- Two basic types
  - PEM
    - (proton exchange membrane)
  - DMFC
    - (direct methanol fuel cell)

PEM Fuel Cell Power Cycle

PEM Fuel Cell Operation



PEM Hydrogen fuel cell



PEM pros and cons

- Pros
  - Silent
  - Only by-product is water
  - No moving parts
  - High power density
  - Low weight
  - Fast start up time
- Cons
  - Hydrogen is tough to store
  - Expense (platinum electrodes)
  - Very sensitive to CO poisoning
  - Temperature sensitive

JADOO

- Regulated 12VDC and 110VAC continuous output 100 watts
- External automotive-type output; convenient for directly powering 12VDC applications
- Weight: 50 lbs (23kg) — half the weight of batteries providing the same energy
- Operates indoors or out
- Zero GHG emissions
- 180 amp hours of runtime and offers twice the energy density of deep cycle marine batteries.

XRT weighs only 50 pounds, but provides the energy of four 45 Amp-hour batteries that weigh over 100 pounds.

Direct Methanol Fuel Cell (DFMC Methanol)

- Pros
  - Fuel easy to store as a liquid
  - Much better energy density than hydrogen
  - Wider operating temperature range
- Cons
  - Not totally silent
  - Has CO2 as a by product
  - Methanol hazardous to health

DMFC Operation

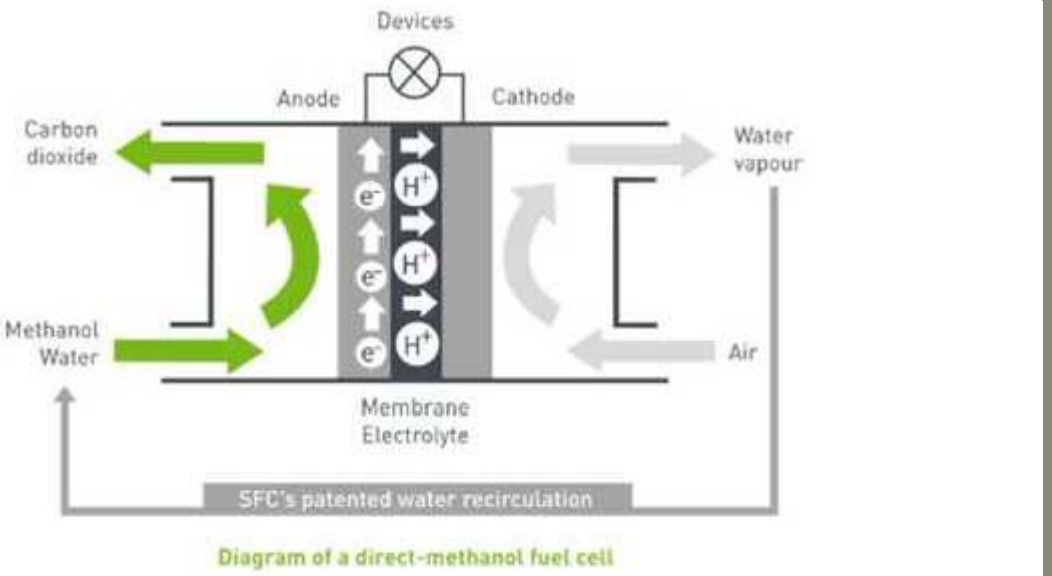


Diagram of a direct-methanol fuel cell

Methanol + Oxygen → Carbon dioxide + Water vapor

$2\ CH_3OH + 3\ O_2 \rightarrow 2\ CO_2 + 4\ H_2O$

EFOY (Methanol)

- Optional on Westphalia Coaches
- JAYCO in 2012

- The EFOY is connected directly to the battery and activates when battery voltage falls below a set value and deactivates to a standby mode when batter is fully charged.

EFOY Specs

- An EFOY Pro 2200 using a 28-litre methanol cartridge can power a 100W device for 13 days
- Ideally a fuel cell would be used in conjunction with solar

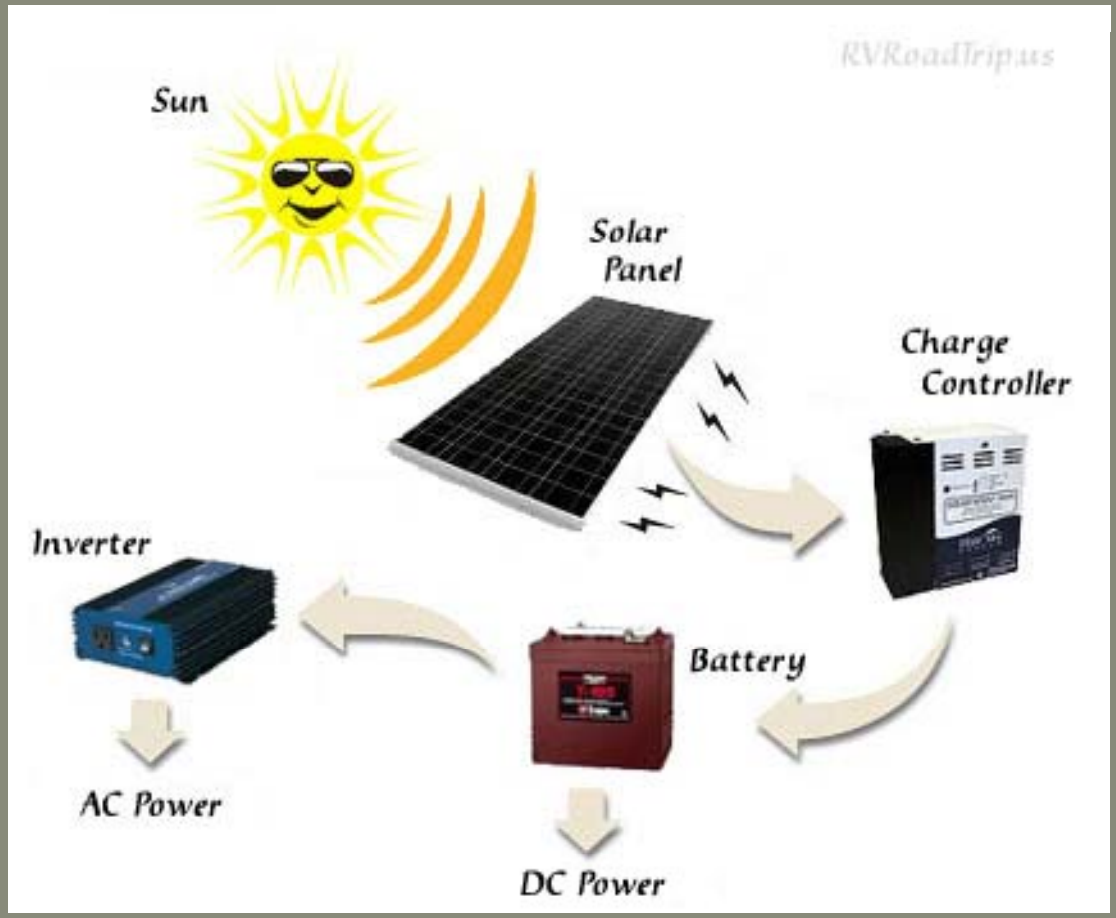
2160 Wh / day
90 W
12 V / 24 V
7.5 A 3.75 A
8.95 kg (19.7 lbs)
-20 to +45 °C (-4 °F to +113 °F)
0.9 l / kWh
433 x 188 x 278 mm (17 x 8 x 11 in)

Fuel Cell Costs

- EFOY 2200 (smaller units available)
  - $6500.00 unit
  - $57.00 for 10 liters of methanol
- JADOO XRT 1600
  - $8000.00 unit
  - $100.00 hydrogen cannister
  - Can be refilled using regular welding supply hydrogen

Solar

Basic Solar for a GMC

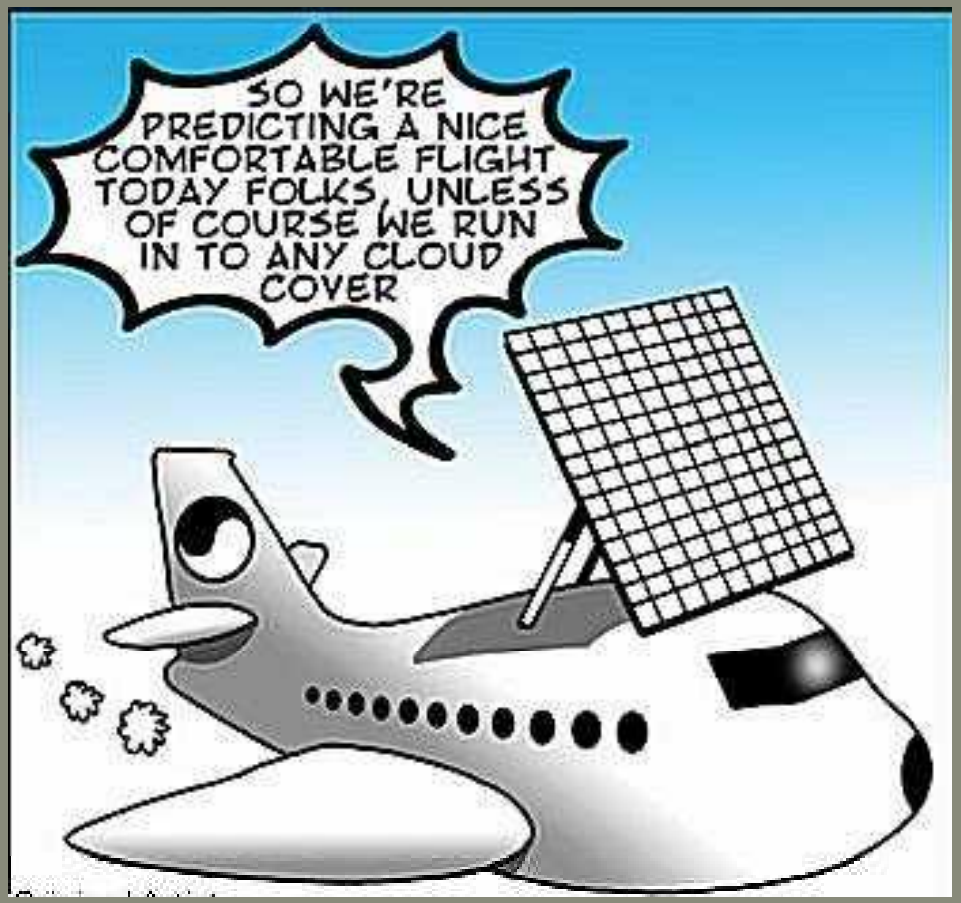


130 watts per square foot

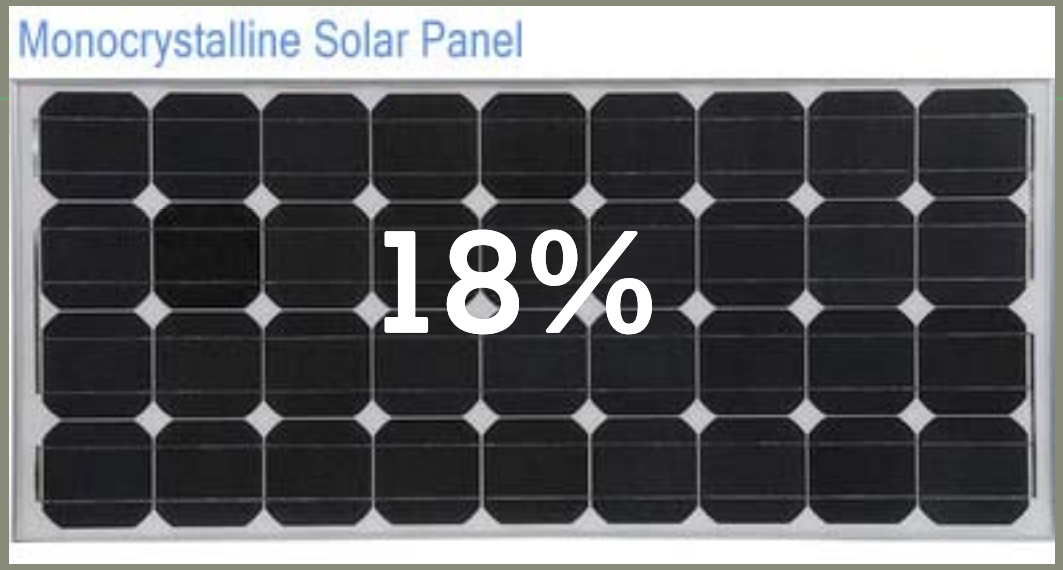
- If we could capture the sun's energy output completely we could generate 130 watts per square foot.
- 10 square feet of panel 1300 watts.

HOWEVER

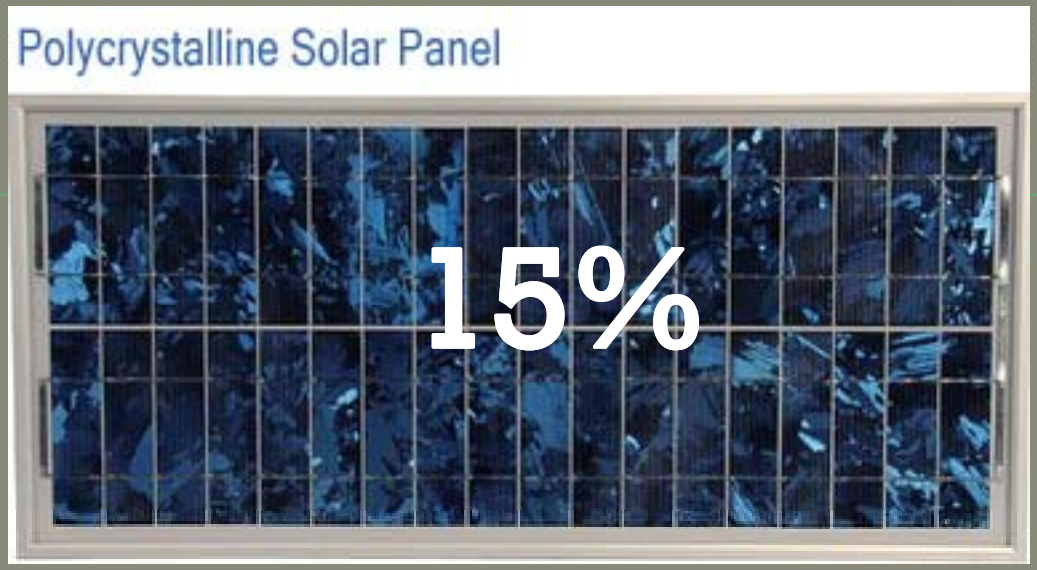
Today's solar panels are horribly inefficient



Types of Panels



- Monocrystalline solar panels are made from a large crystal of silicon.
- These type of solar panels are the most efficient as in absorbing sunlight and converting it into electricity, however they are the most expensive.
- They do somewhat better in lower light conditions then the other types of solar panels.



- Polycrystalline Solar Panels are the most common type of solar panels on the market today.
- They look a lot like shattered glass.
- They are slightly less efficient then the monocrystalline solar panels and less expensive to produce.
- Instead of one large crystal, this type of solar panel consists of multiple amounts of smaller silicon crystals.

•Amorphous solar panels consist of a thin-like film made from molten silicon that is spread directly across large plates of stainless steel or similar material.
•These types of solar panels have lower efficiency then the other two types of solar panels, and the cheapest to produce.
•One advantage of amorphous solar panels over the other two is that they are shadow protected. That means that the solar panel continues to charge while part of the solar panel cells are in a shadow.
•These work great on boats and other types of transportation.

Charge Controllers

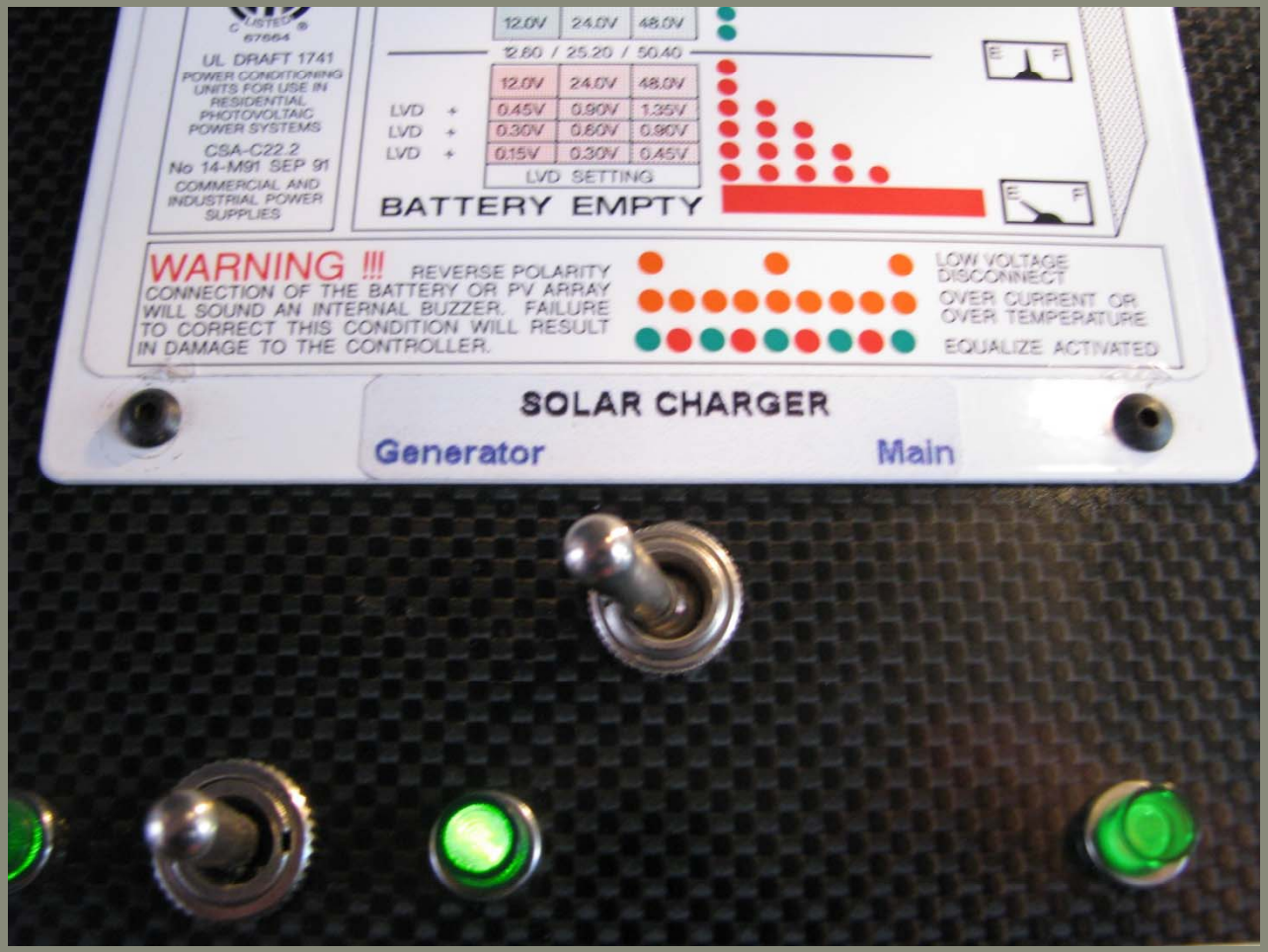
- A charge controller, or charge regulator is similar to the voltage regulator in your car.
- It regulates the voltage and current coming from the solar panels going to the battery.
- Most "12 volt" panels put out about 16 to 20 volts, so if there is no regulation the batteries will be damaged from overcharging.
- Most batteries need around 14 to 14.5 volts to get fully charged.

Charge Controllers

- Wide variety from $20.00 to $180.00
- Basic differences
  - Fixed voltage
  - Adjustable voltage
  - Adjustable for battery types

Trace C40 Panel

Main/Generator Switch



Batteries (All AGM)

3 banks

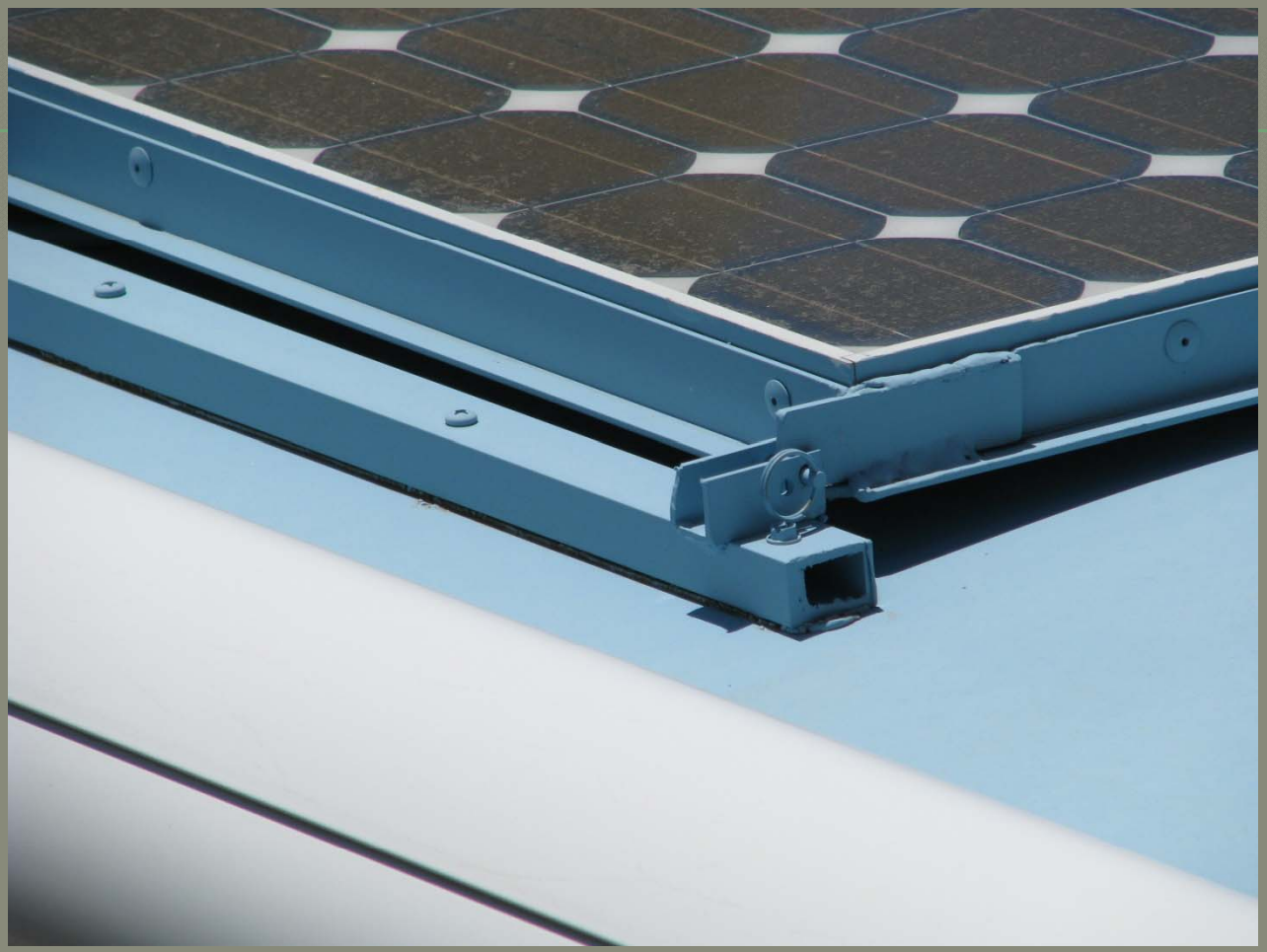
- ✓ House 2 x 125A
- ✓Start 2 x 125A

Start and House on combiner when running

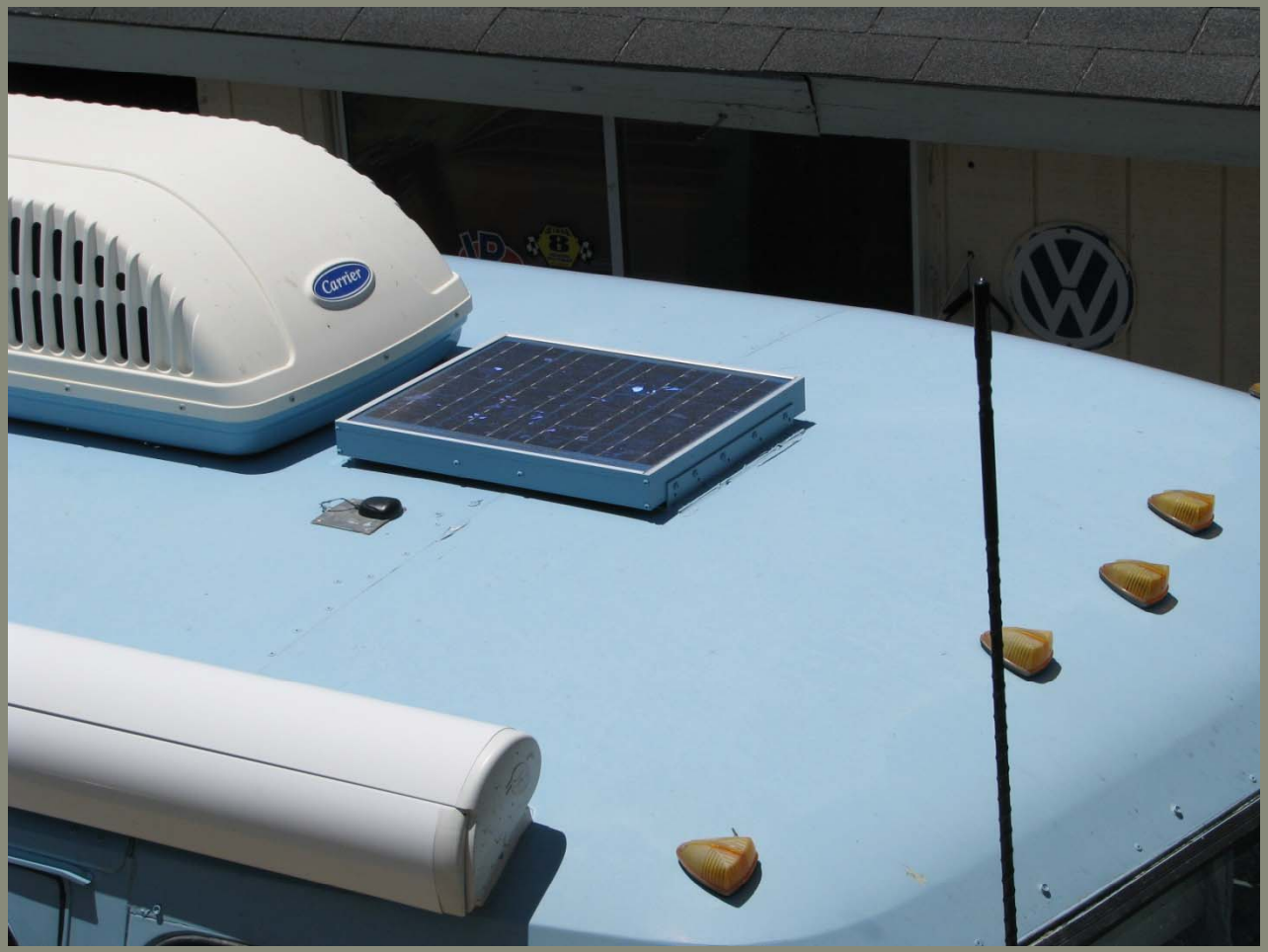
- ✓Generac 1 x 75A

Mounting Solar Panels on your GMC

House Battery Panels
2 x 75 watts @ 12v



Starting Battery Panel
20 watts @ 12v



Tilt Racks

Fixed on GMC

Another GMC

Another GMC

About 35 amps on this GMC

Solar Cost

2 x 75 watt panels	$700.00
Charge Controller	$100.00
Wiring	$40.00
Mounts	$70.00
TOTAL	$910.00

For those of you who really want to blow some cash!!

Next Gen Solar Panels