

Energy Usage



- The energy you don't need is the most cost effective energy you can produce

Energy Usage

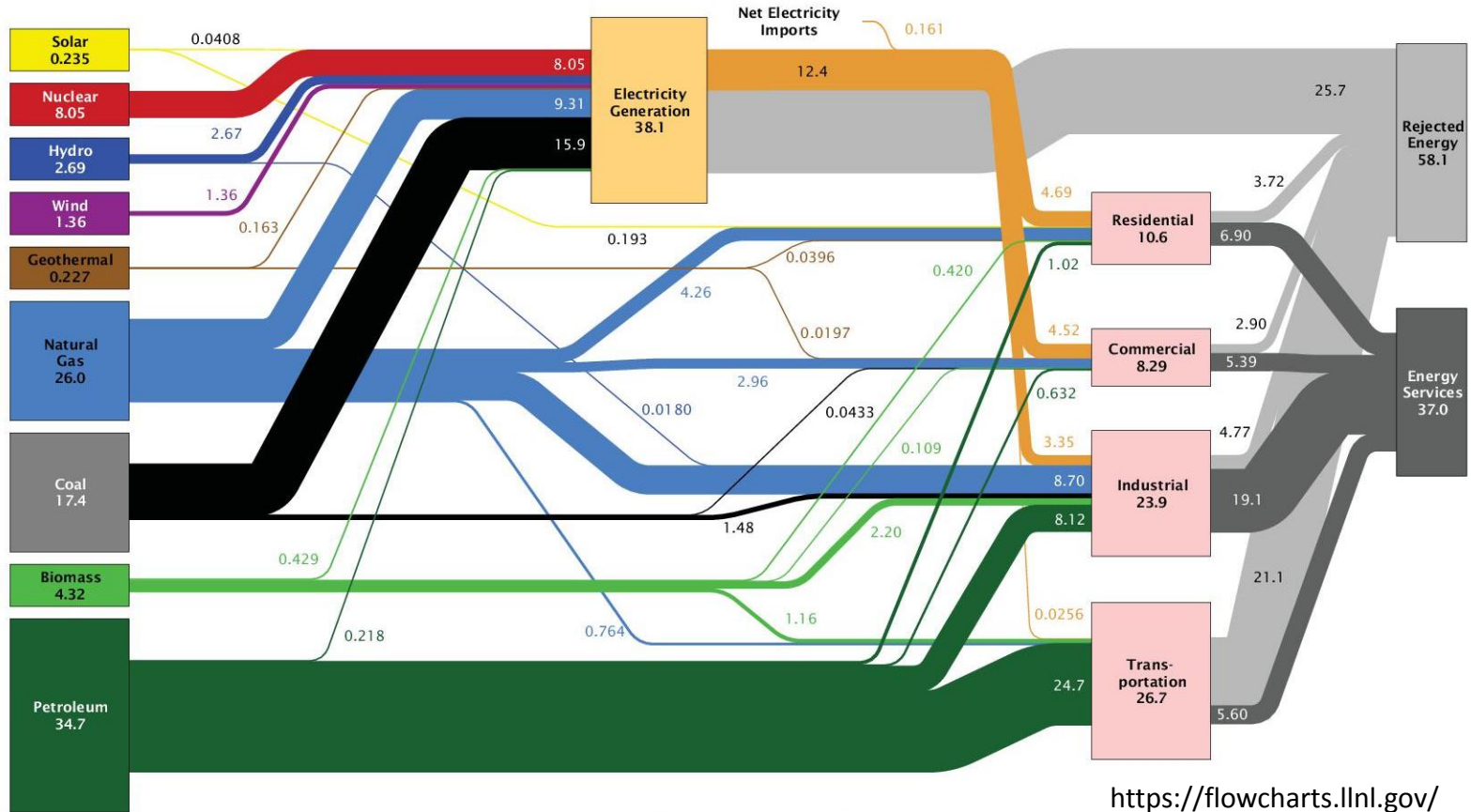


 **Most Efficient**
2013
ENERGY STAR www.energystar.gov

Where Does Our Energy Come From



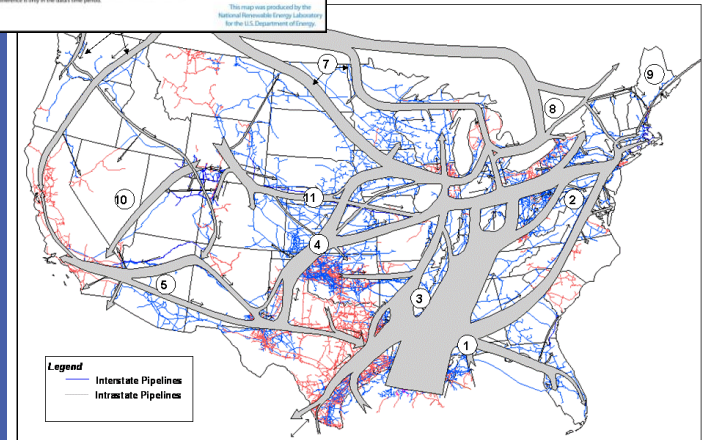
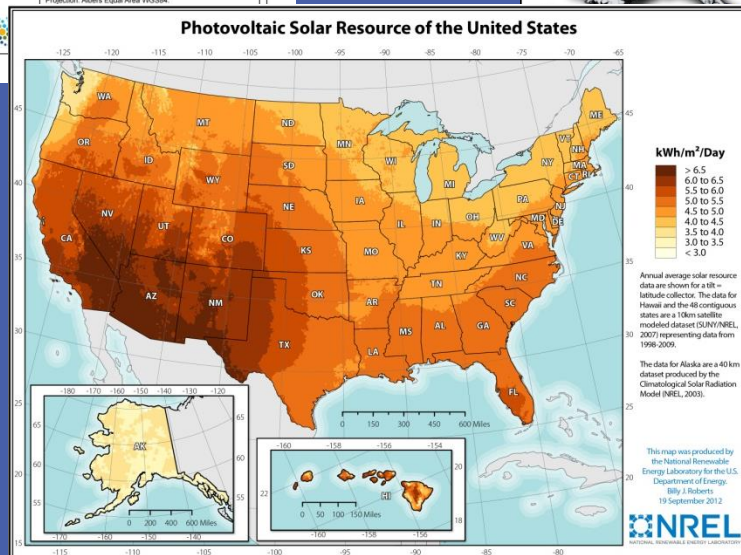
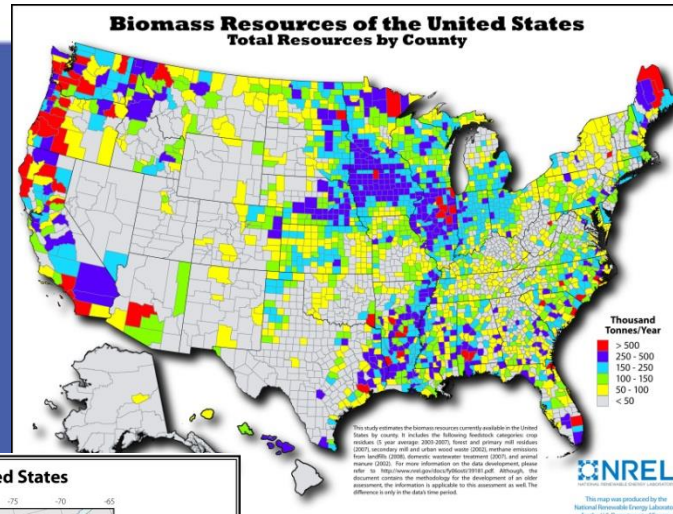
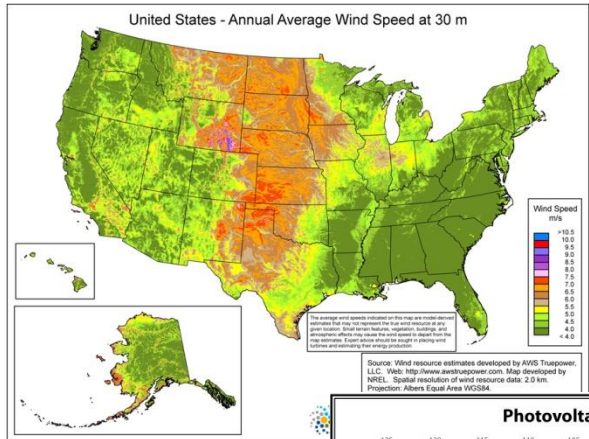
Estimated U.S. Energy Use in 2012: ~95.1 Quads



<https://flowcharts.llnl.gov/>

Source: LLNL 2013. Data is based on DOE/EIA-0035(2013-05), May, 2013. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant "heat rate." The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 65% for the residential and commercial sectors 80% for the industrial sector, and 21% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527

Where Does Our Energy Come From

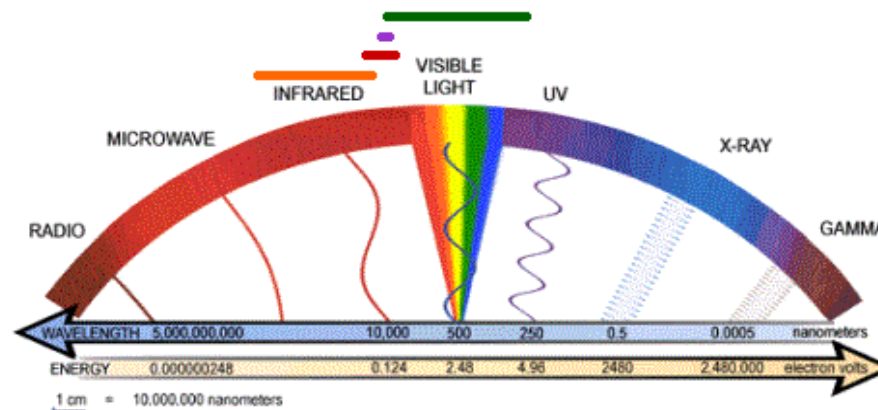


Source: Energy Information Administration, Office of Oil and Gas, Natural Gas Division, Gas/Tran Gas Transportation Information System.

The EIA has determined that the informational map displays here do not raise security concerns, based on the application of the Federal Geographic Data Committee's Guidelines for Providing Appropriate Access to Geospatial Data in Response to Security Concerns.

Two Types of Solar Energy

Thermal – which captures heat energy into storage directly from the sun
Photovoltaic's – which converts the rays of light from the sun into an electrical current

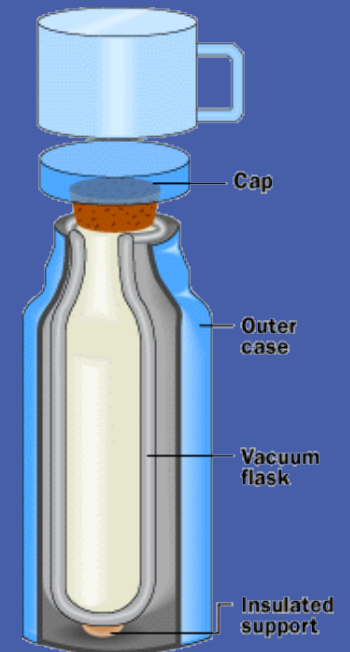


Approximate Wavelengths Covered by TMT's Science Instruments

- Approx. 0.8-2.5 microns: IRIS, IRMOS, PFI, WIRC
- 5-28 microns: MIRES
- 1-5 microns: NIRES
- Approx. 0.31-1.8 microns: HROS, WFOS

Thermal Technology

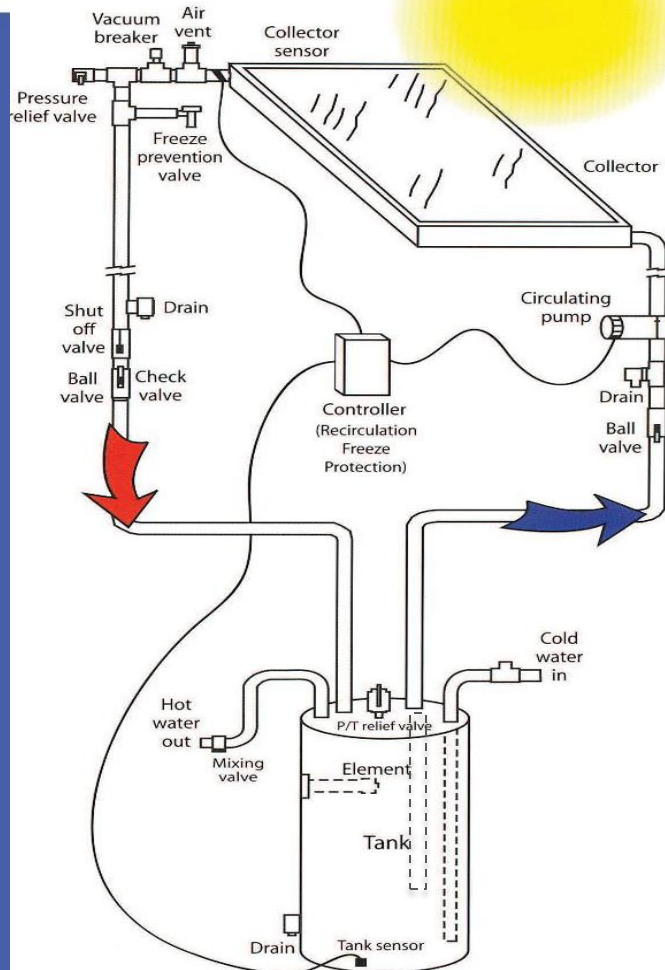
What happens when you turn on the water from a hose that has been sitting in the sun for an hour or so



©2009 New Stuff Works

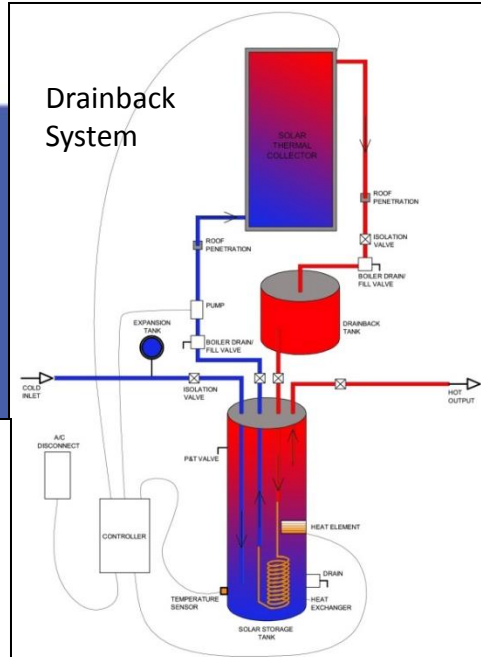
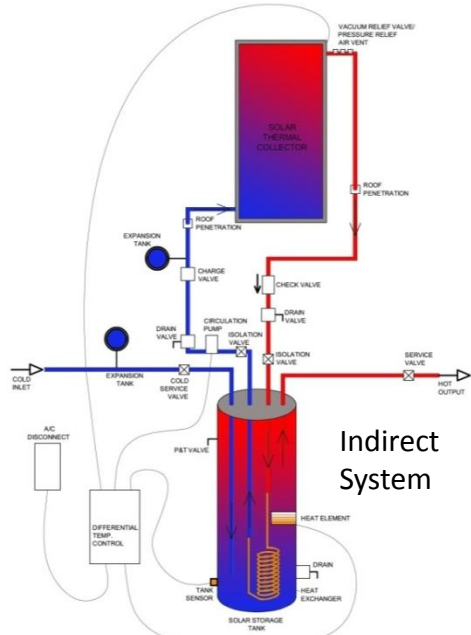
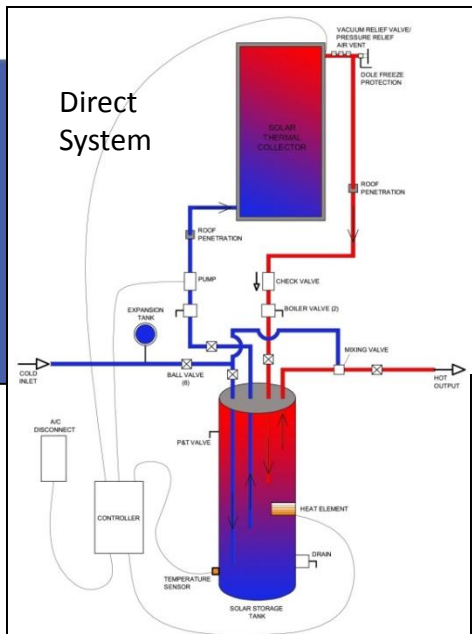
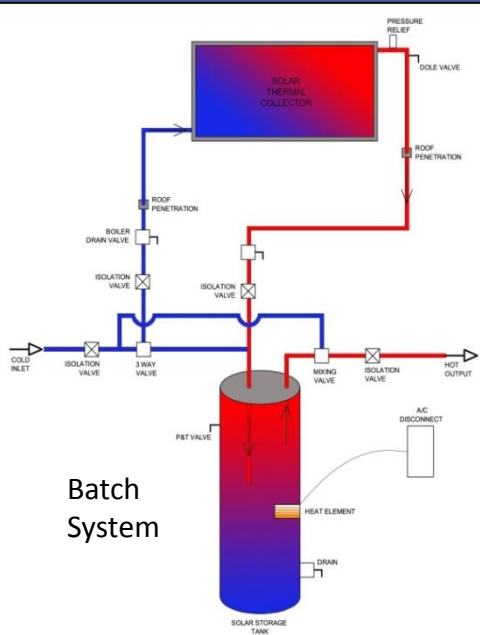
This is thermal technology at its simplest form

Typical Domestic Thermal System



Cold water is circulated through a solar collector on the roof of a house and stored in a collection tank to be used for domestic hot water usage.

4 Thermal Systems



Types of Thermal Collectors

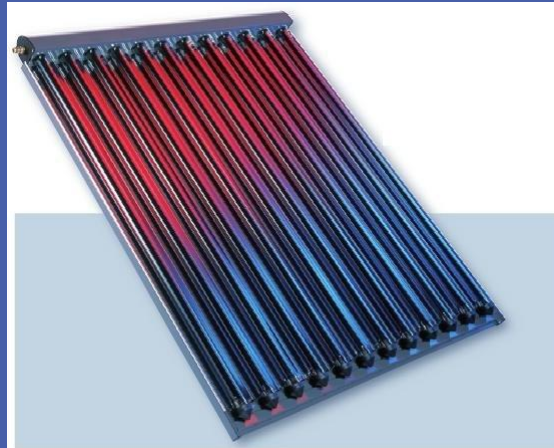
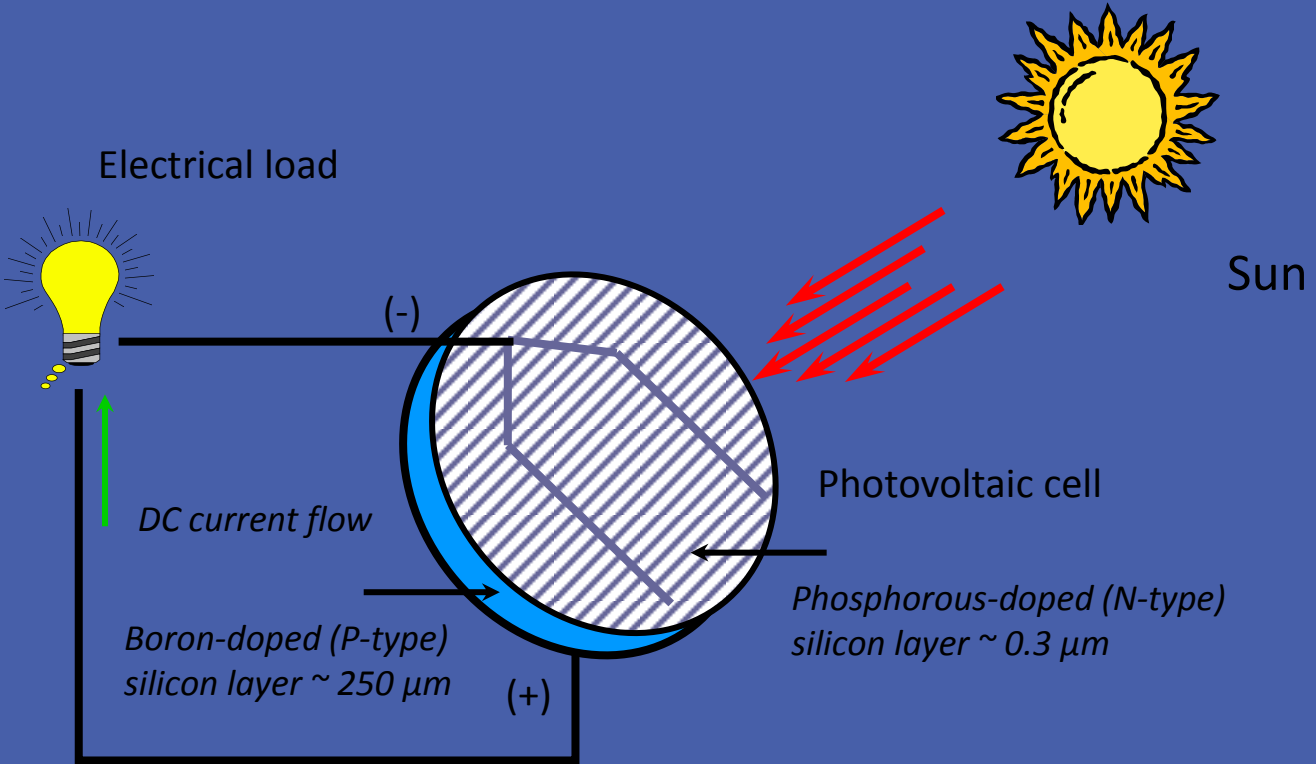


Photo Electric or Photovoltaic

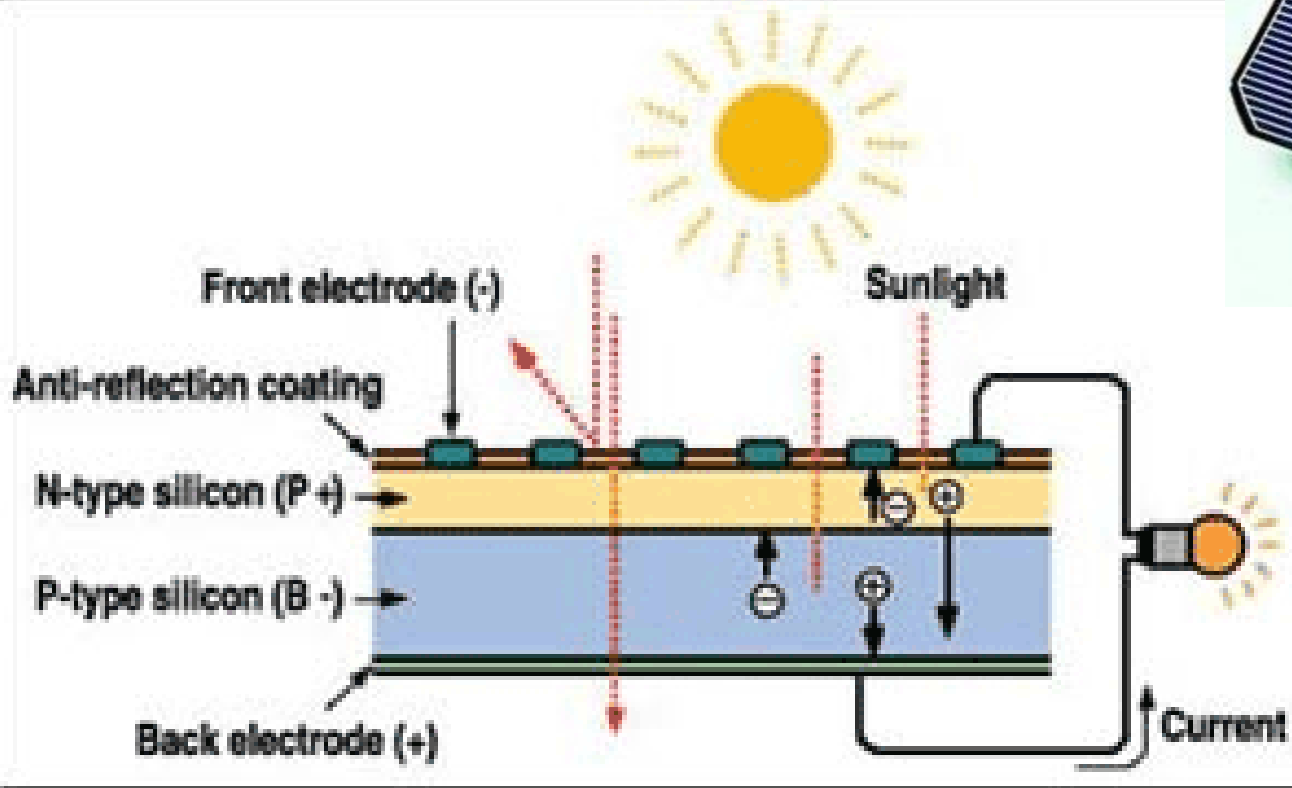


The PV Magic



The Solar PV Solution

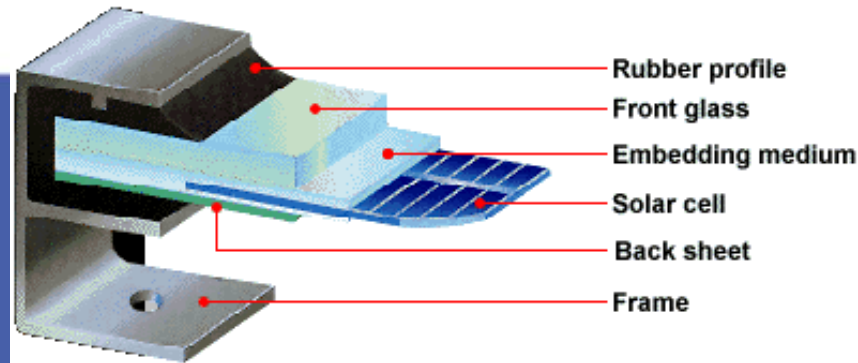
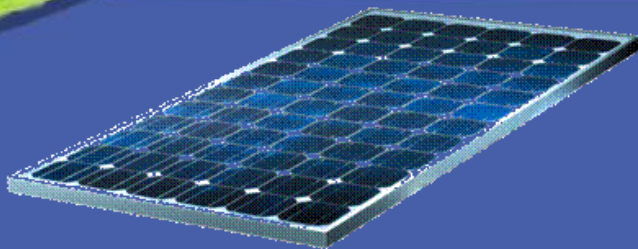
How it Works



The average cell produces ~1 – 4 watts of power per cell depending on quality

The Solar PV Solution

How it's made



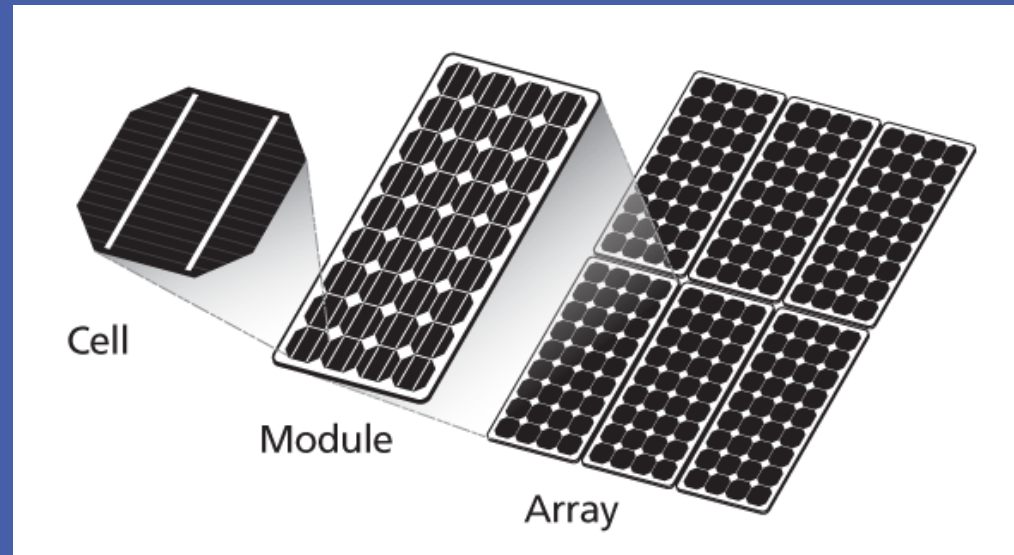
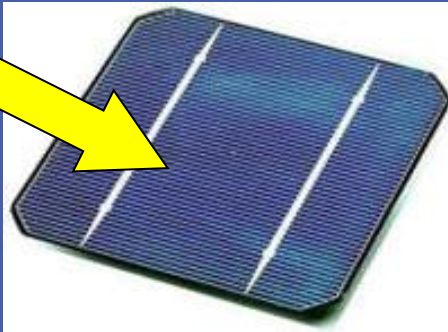
- Low iron, water tight tempered glass front
- EVA encapsulated layer
- Solar cell circuit
- Vinyl encapsulated layer
- Tedlar back sheet
- Power Tolerance +/- 3%
- Anodized aluminum frame
- Cable Connectors
- 25 Year Manufacturer's Warranty
- Wind Load Designs available up to 180 mph
- UL, CEC, IEC, FSEC certified

Solar Modules



Sun Light

PV Solar Cell



- A single Photoelectric cell is made of a special silicon.
- As light hits the cell an electrical current is created.
- A group of cells are combined to create a solar module

PV Cell Ratings

PV Panels create Direct Current (DC) Electricity

PV Panels are rated by Wattage
150W, 200W, 240W, 260W

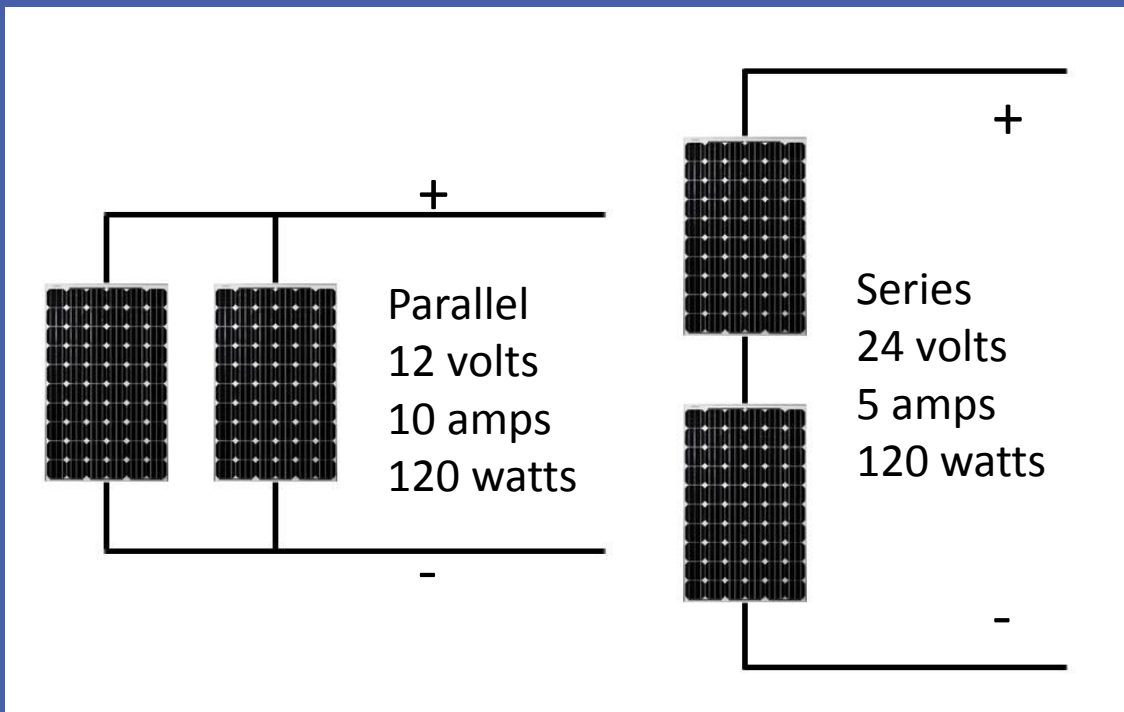
Wattage is a function of
Amperage X Voltage = Wattage ($E=IR$)

5 amps x 12 volts = 60 Watts



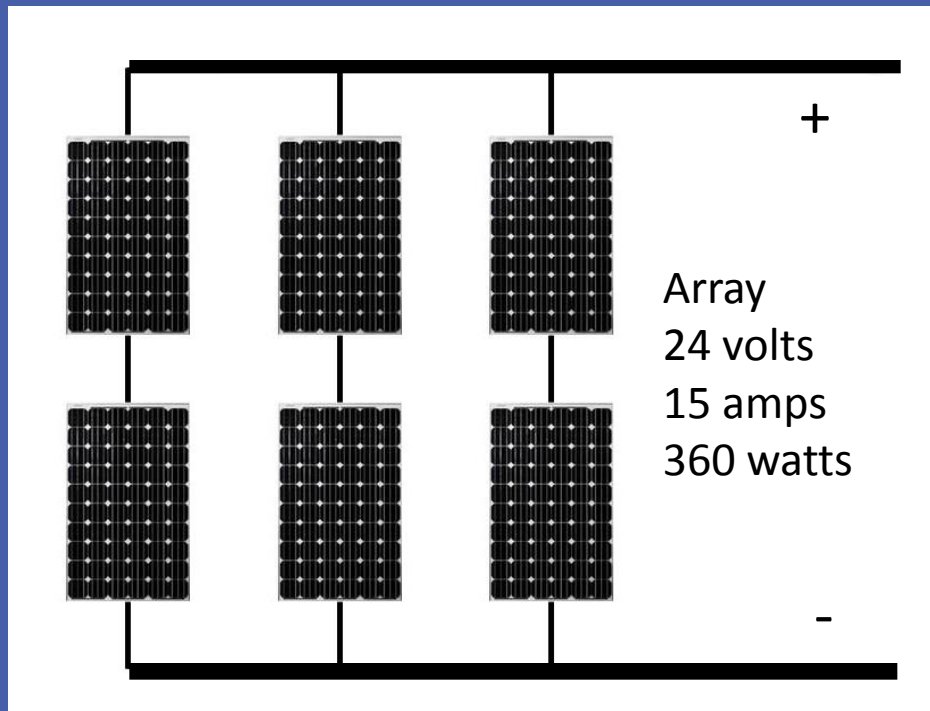
PV Cell Ratings

When you string panels in Parallel you increase Amperage
When you string panels in Series you increase Voltage



PV Cell Ratings

When you Series and Parallel panels
you can increase Wattage



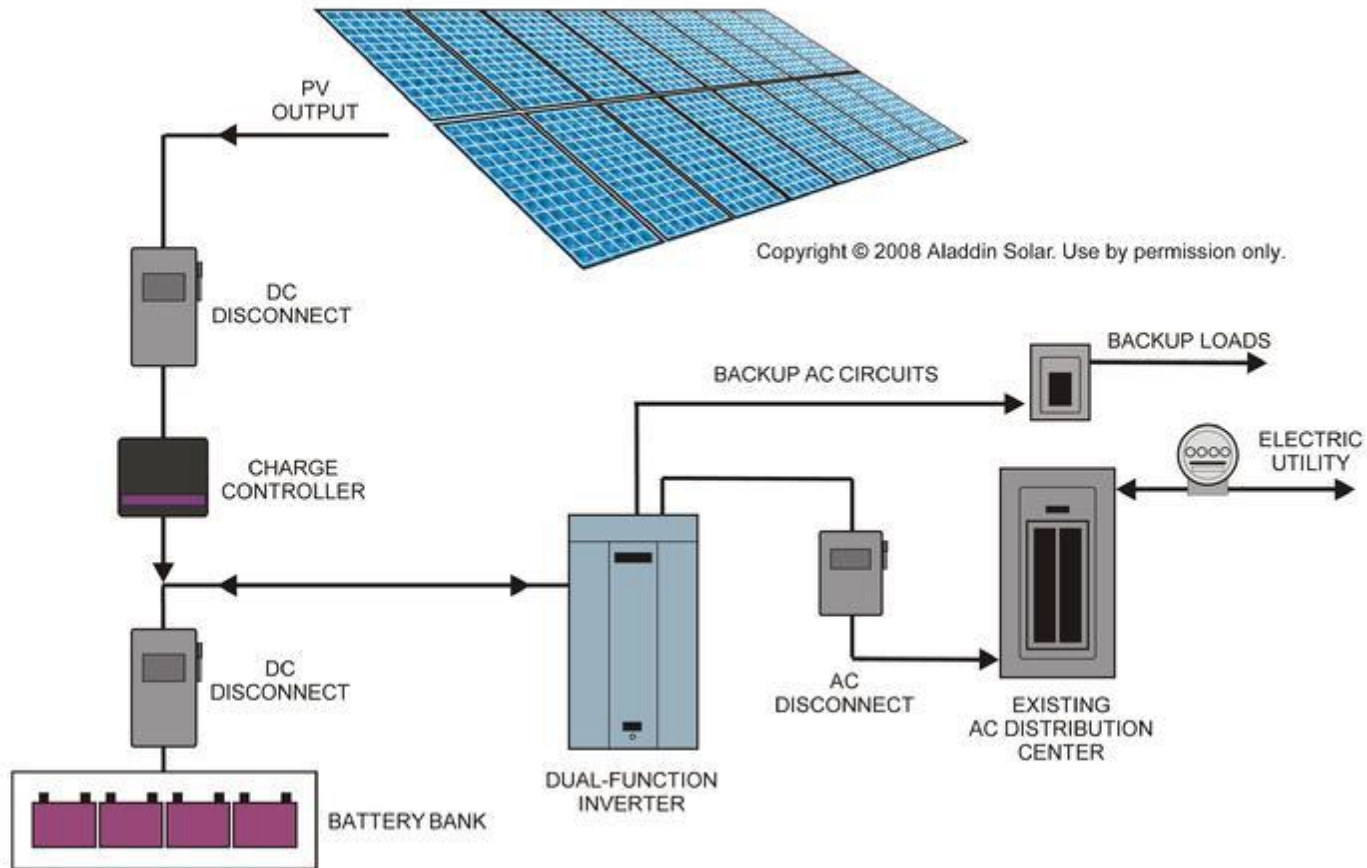


PV Cell Ratings



Typical Solar PV Solution

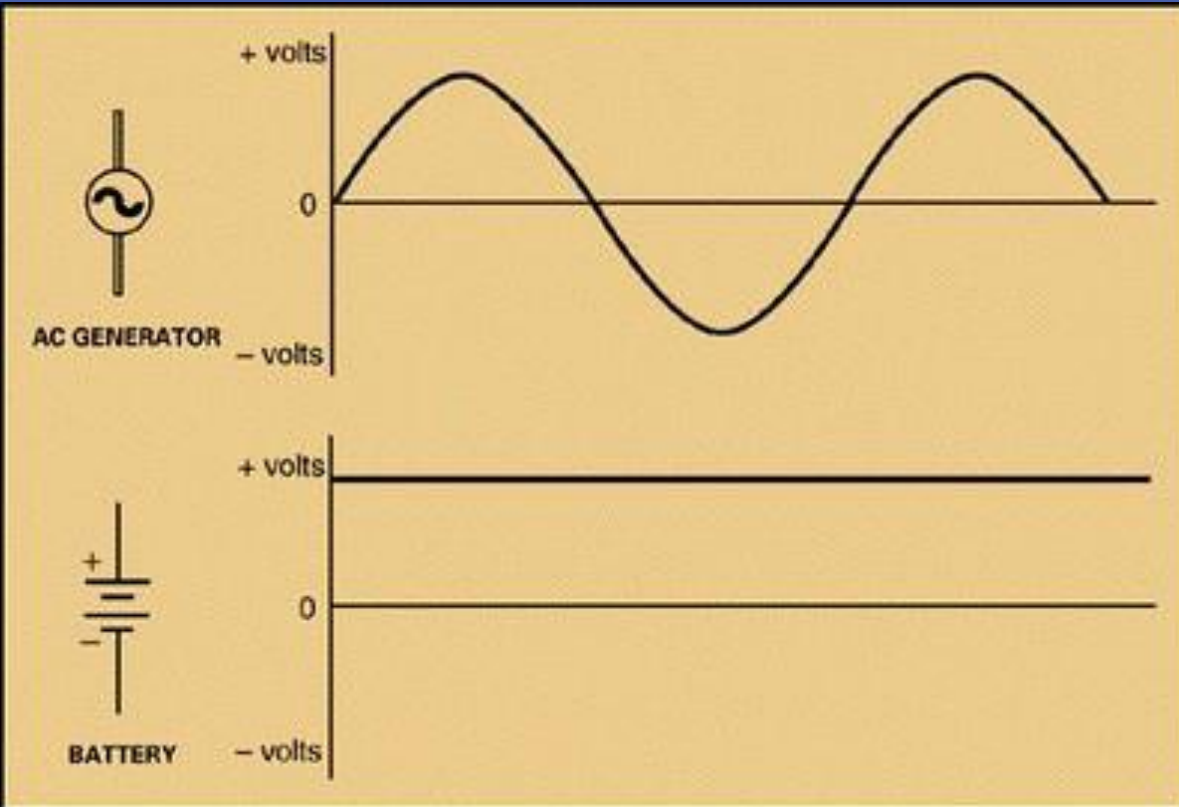
TYPICAL PV GRID-TIE SYSTEM WITH BATTERY BACKUP





TOURNAMENT of GENIUS

(2) Thomas Edison vs **(7) Nikola Tesla**

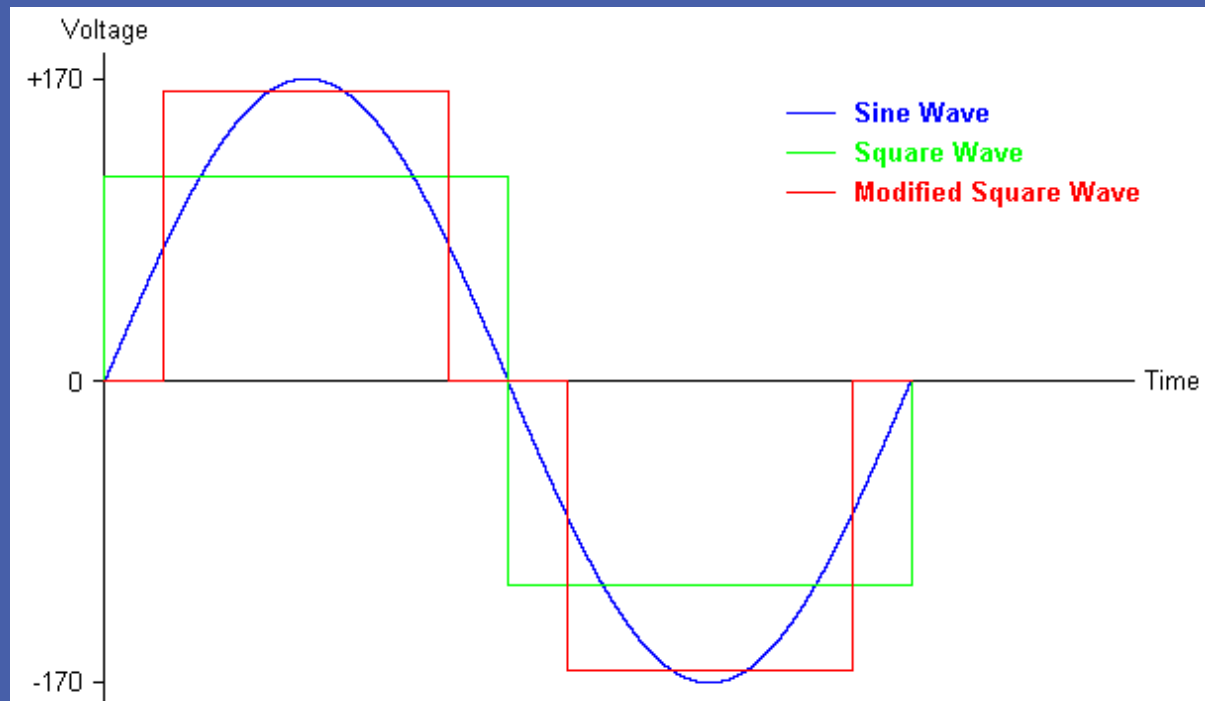


Alternate Current

Direct Current

Inverters

- True sine wave output
- Ability to match frequency
- Clean consistent power



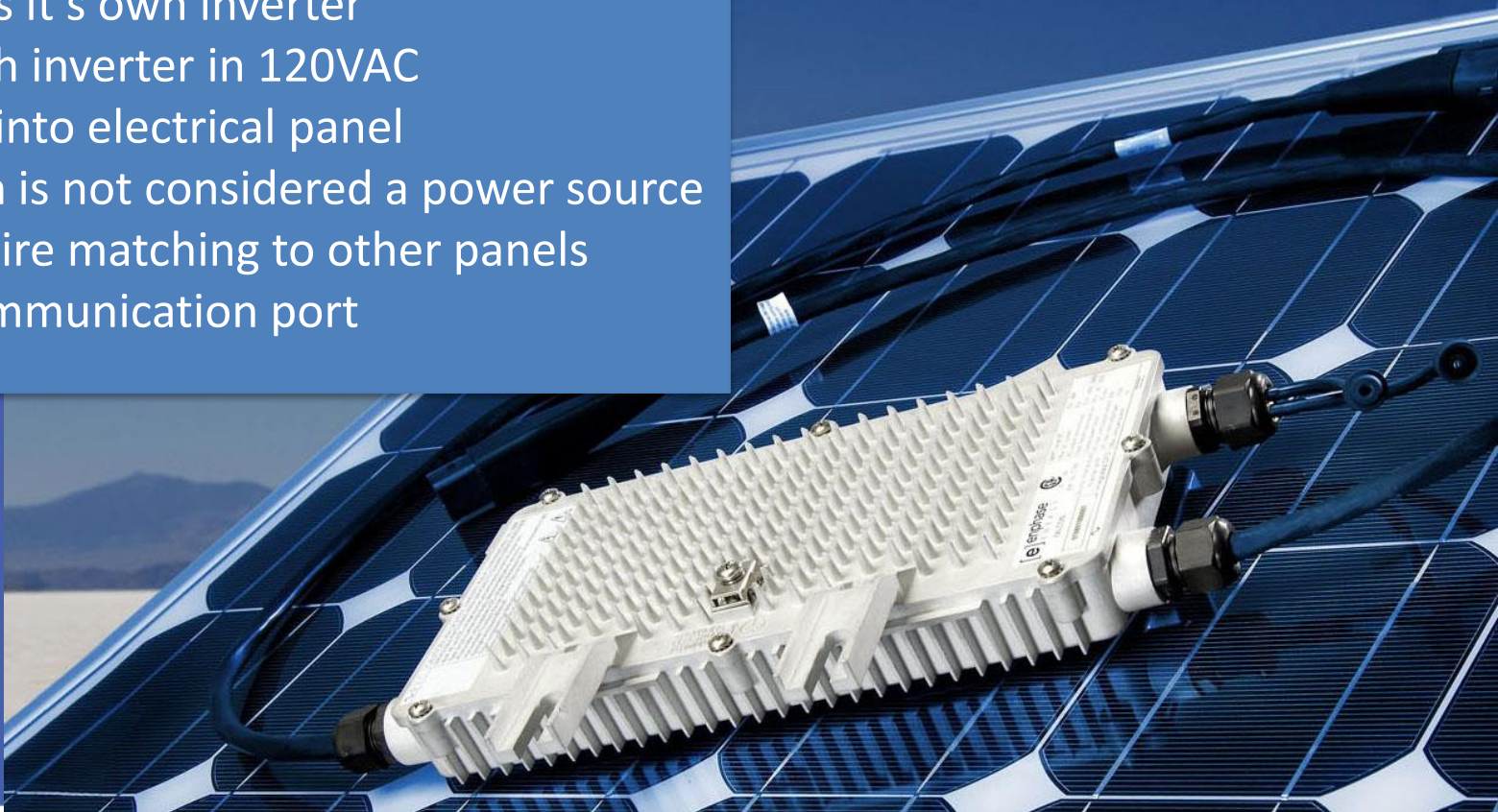


Inverters are sized to the power source



Micro-Inverters

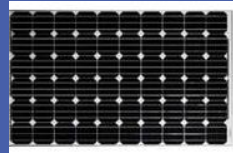
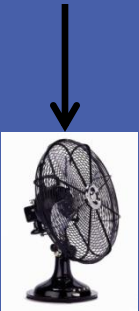
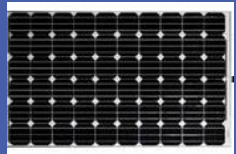
- Each panel has its own inverter
- Output of each inverter is 120VAC
- Hook directly into electrical panel
- AC connection is not considered a power source
- Does not require matching to other panels
- Contains a communication port



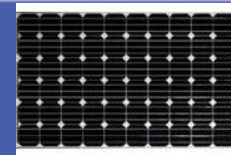
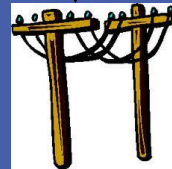
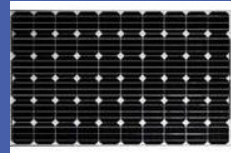
Types of Distributive Systems

Stand-Alone Systems

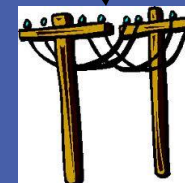
PV-Direct



Battery-less Grid-Tied Systems

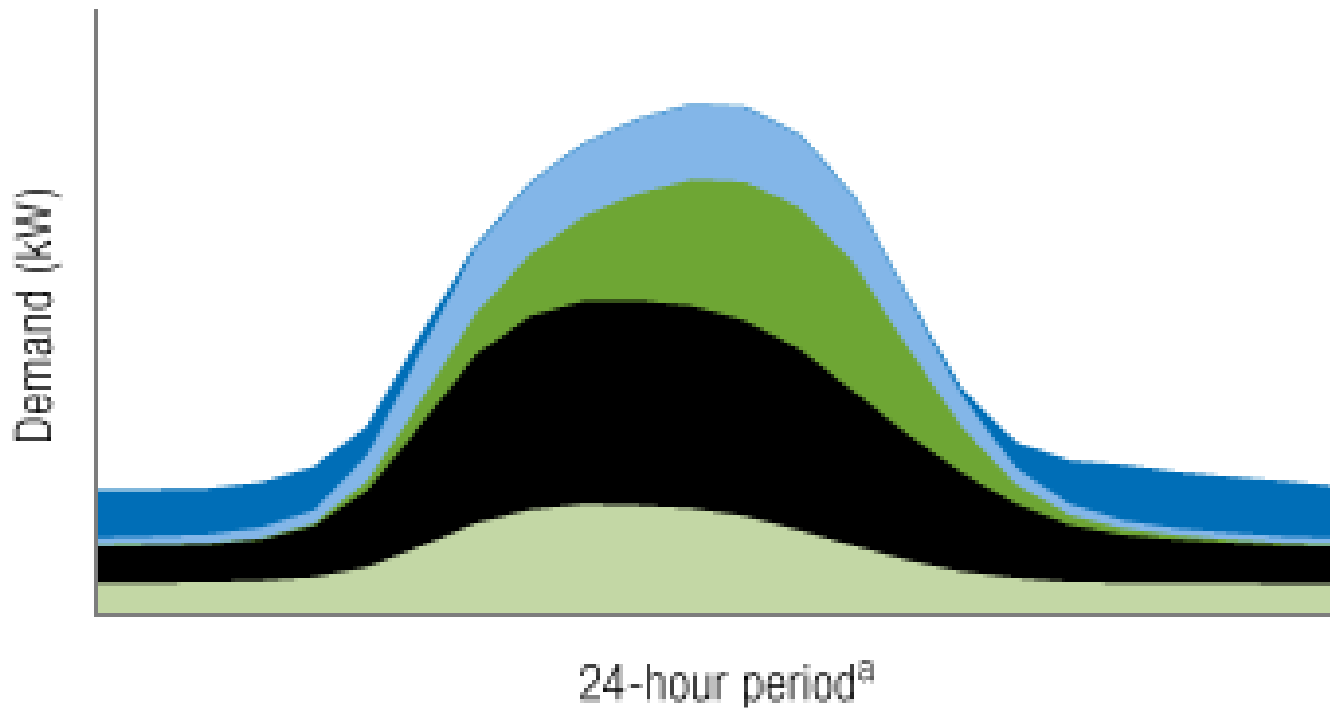


Battery Based Grid-Tied Systems



Electrical Storage

- Exterior lighting
- Interior lighting
- Cooling
- Ventilation
- Other

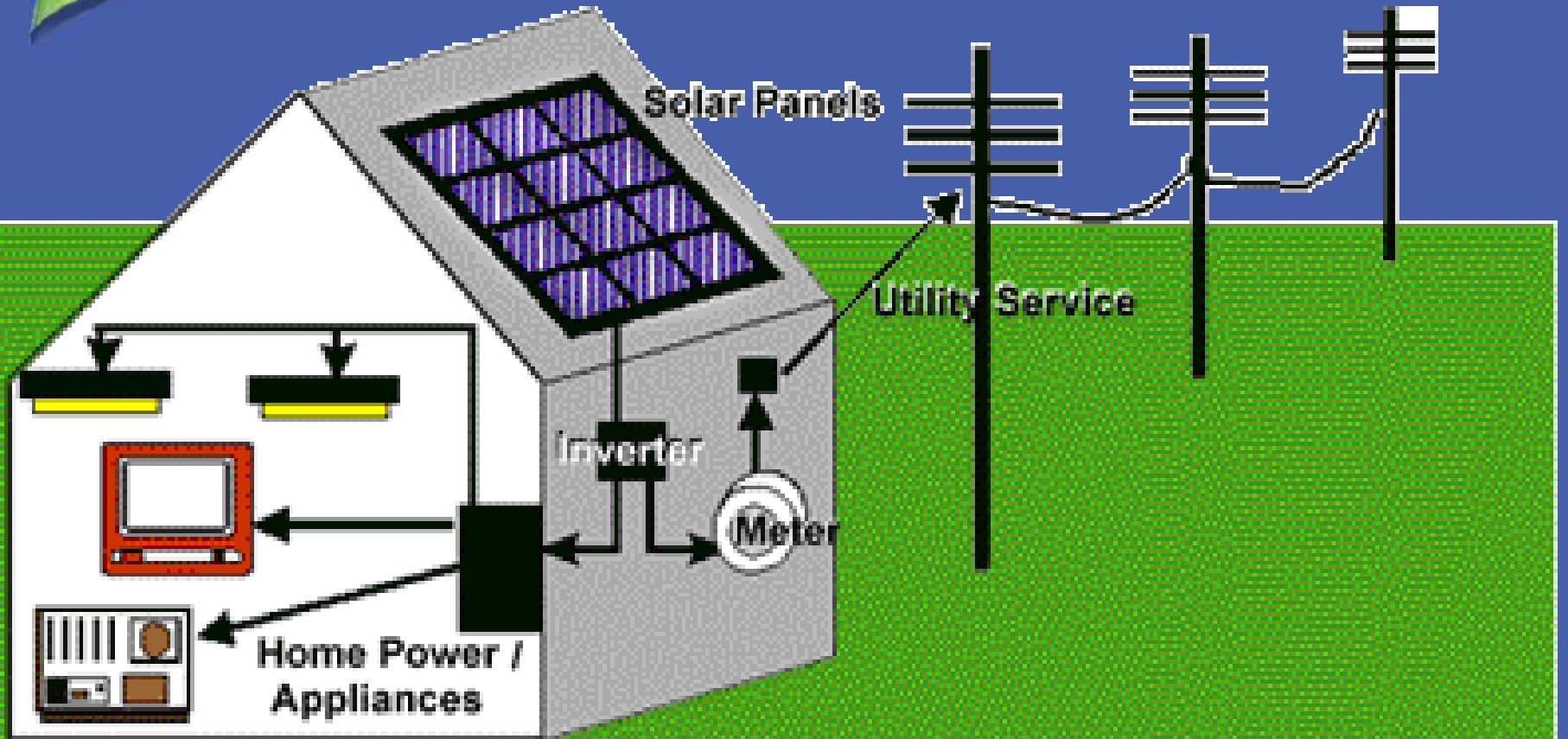


Notes: kW = kilowatt.

a. 24-hour period = midnight to midnight.

© E Source; data from ITRON

Grid Storage

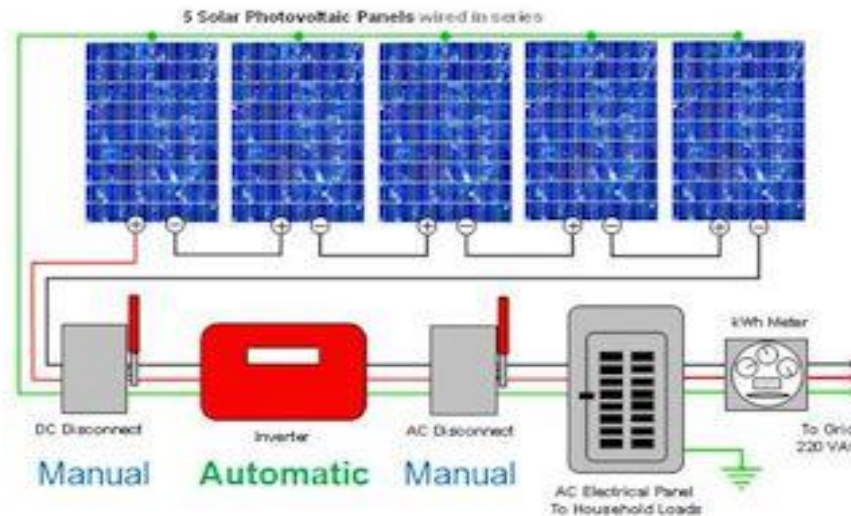


Residential Grid-Connected PV System

Anti-Islanding

PV Anti-Islanding

- All utility-interactive systems use a safety feature known as “anti-islanding” to prevent the solar array from remaining connected to the electric utility when the grid is down



Becoming your own Utility

Investment of energy generation

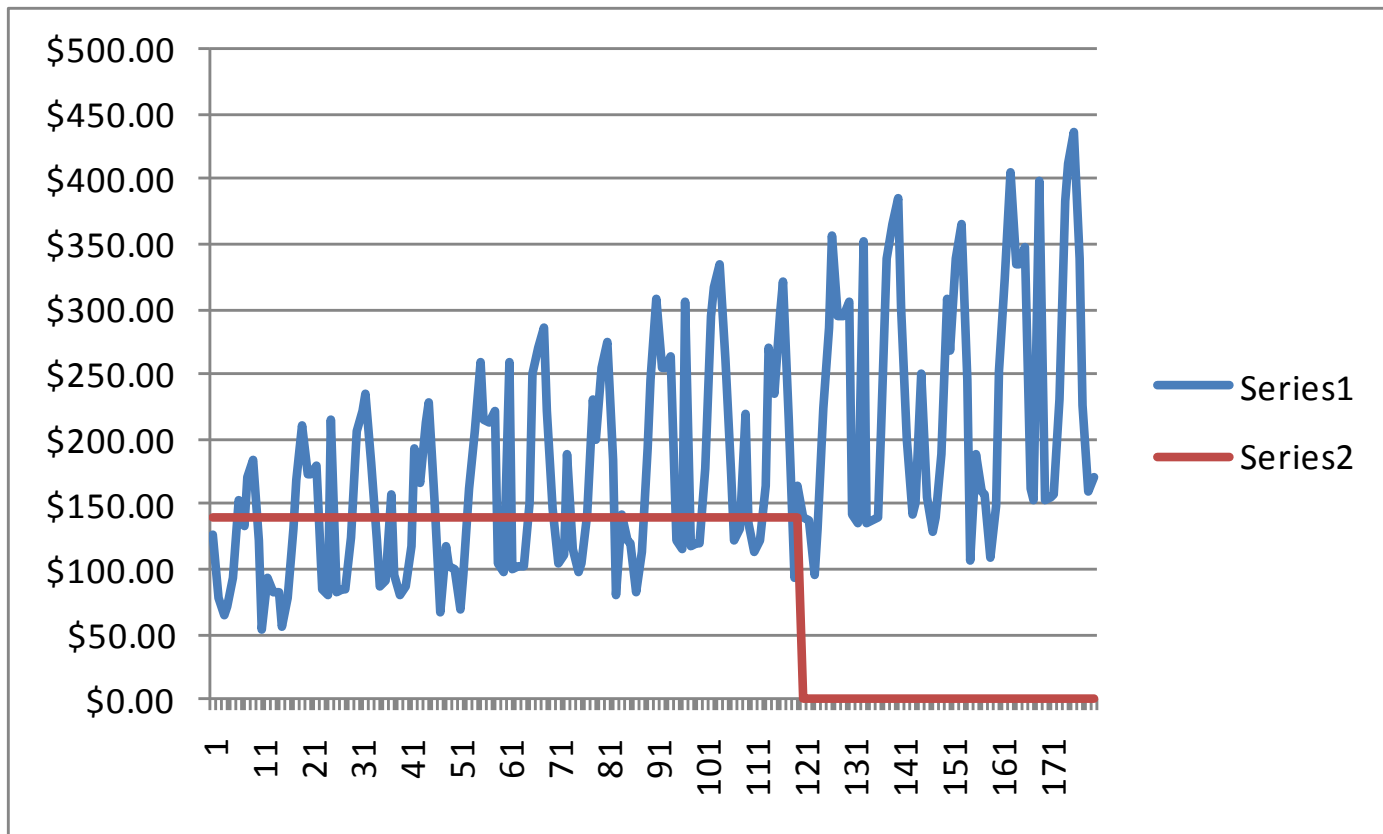


When you install solar
on your home

You become your own
utility



Cost of Fuel vs. Cost of Money



The cost of home ownership



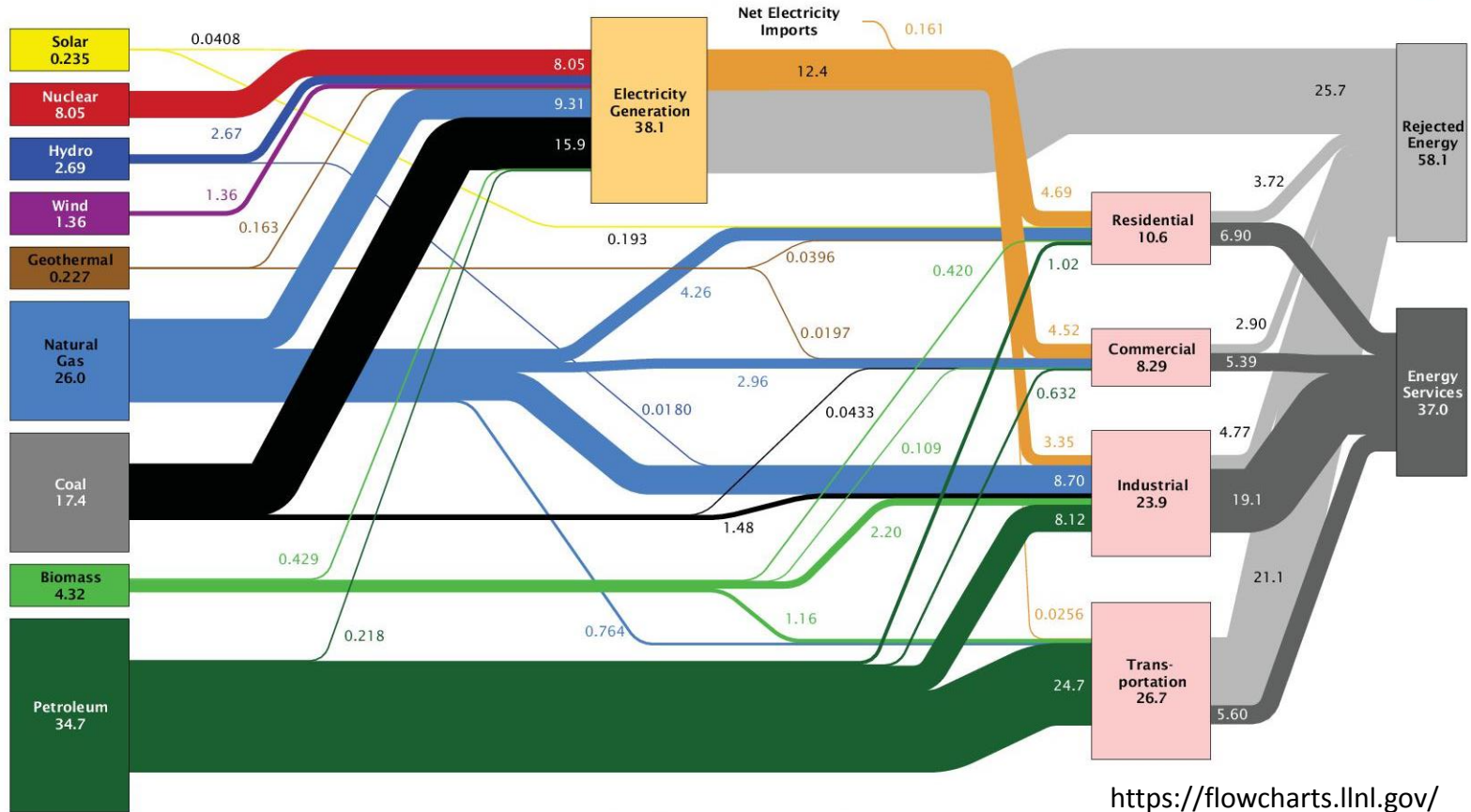


Thank You

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