

Solar Electricity: Harnessing the Sun's Immense Power

Fun Sun Facts

At the Surface

Increasing this Power

Quick Summary

A Very Brief History of Solar Cells

Solar "Limitations"

Where is Solar Energy Produced?

Concentrated Solar Power

So how much solar energy do we produce?

Solar Power Barriers in the US

- Solar leasing
- Third party generation
- Current Policies

PREZI

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Fun Sun Facts

- Every hour the Sun hits the Earth with enough energy to power the planet for and entire year
- Additionally, all the energy stored in the Earth's reserves of coal, oil, and natural gas is matched by the energy from just 20 days of sunshine
- This enormous amount of energy emitted by the Sun comes in the form of light and heat
- However, only about half of that energy is available to us at the Earth's Surface

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Incoming solar radiation (340 W/m²)

29% reflected

23% absorbed in the atmosphere

48% absorbed at the surface

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3,285 billion kWh

9 billion kWh/day X 365 days/year

1,000 watts/sq meter X 1 Kilowatt X 1 hour = 1 kWh/sq meter

1,000 watts

1 kWh/sq meter X 9,000,000,000 sq meters = 9 Billion kWh in one hour!

just 20 days of Sun comes in

- However, only about the Earth's Surface

On the Surface

- It has been estimated that during peak sunlight, 1,000 watts per square meter reach the Earth's surface
- Assuming one full hour of peak sunlight:
- According to the CIA's World Factbook, the United States surface area (excluding water) is a little over 9 billion square meters.
- Then multiplying:

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The US electricity consumption totaled nearly 3,856 billion kWh in 2011!

- Assuming we could capture this available energy for one year

9 billion kWh/day X 365 days/year

3,285 billion kWh

PREZI

History

Harnessing this Power

Heat Light

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A Light history lesson...

PREZI



Around
5th
Century
B.C.

Around
11th
Century
A.D.



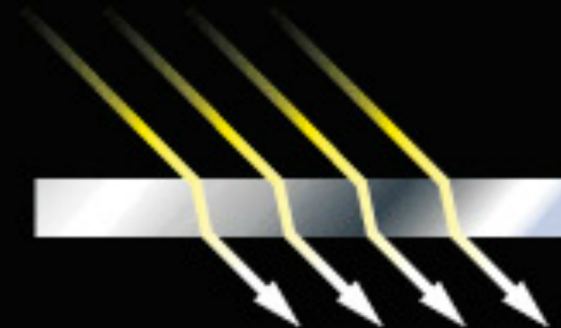
How Light Works



Reflection

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How Light Works

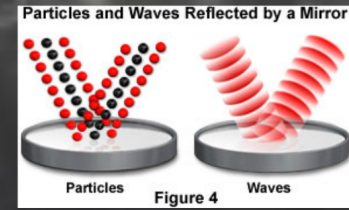
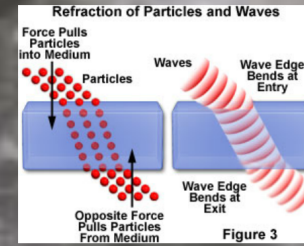


Refraction

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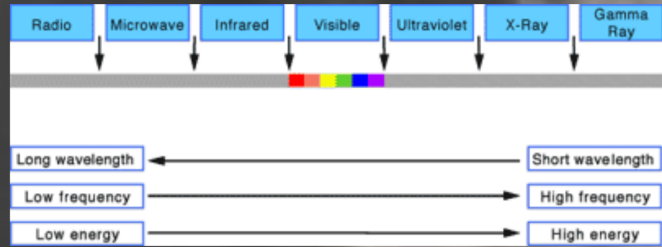
17th Century



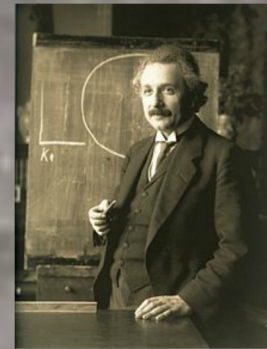
1801



1860



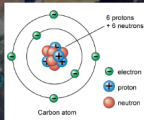
1905



Quick Chemistry

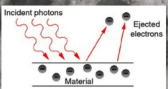
We all know everything is made up of tiny bits of matter called atoms

- a) Which contains a proton, a neutron, and an electron
- b) Because of the attractive force between the electron and the proton, energy is required to free an electron from the atom

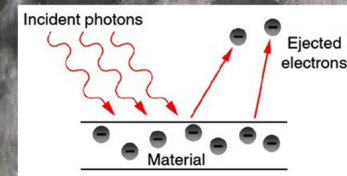


- c) One way in which an electron can become free from the atom is through the photoelectric effect

Light and Matter



Light and Matter

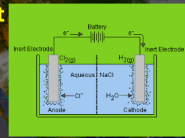


A Very Brief History of Solar Energy

1839 - Edmond Becquerel discovered the photoelectric effect while working with selenium

A Very Brief history of Solar Cells

- 1839 - Edmond Becquerel discovered the photoelectric effect while working with electrolytic cells

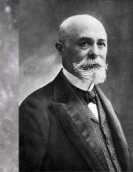


- 1873 - Willoughby Smith discovered the photoconductivity of selenium



History Cont..

- 1876 - Williams Adams and Richard Day discovered that selenium can produce electricity
- 1883 - Charles Fritts created the first working solar cell



- 1883 to Present - Many scientists improved on Fritt's original design to get more efficient solar panels

Solar Limitations?

- For semiconductors the optimal efficiency is 33.7%
- Roof and Panel Pitch
- Shade
- Temperature

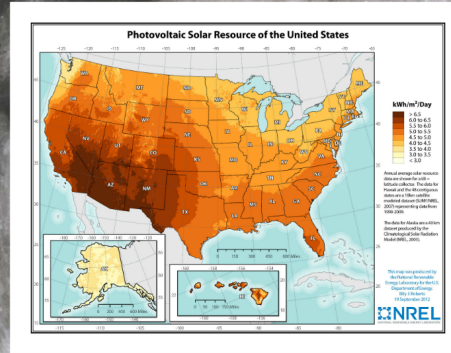
Pros Cons

- Solar energy does not produce CO₂
- Solar panels can be located anywhere
- Does not need to be hooked up to the grid
- Although there is a high initial cost, overtime it will pay for itself
- Amount of Sunlight is not constant (i.e cant produce during night)
- Requires a large surface area to generate large amounts of energy
- Initial cost of solar panel

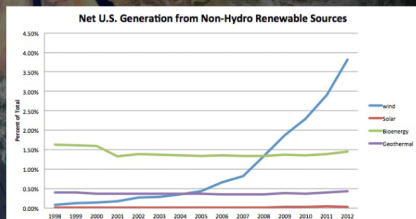
Where is Solar Energy Produced?

- Solar energy can be produced anywhere the Sun shines
- Arizona is on track to be one of world's largest Solar Power Facilities
- Hundreds of thousands of houses and buildings around the world have PV systems on their roofs
- By far the most installed megawatts of solar power occur in Germany

efficiency



So how much solar energy do we produce?



Missing Data

- EIA only required to include 1 MW facilities
- Even if required to report less than 1 MW facilities, some system owners might not report how much they produce

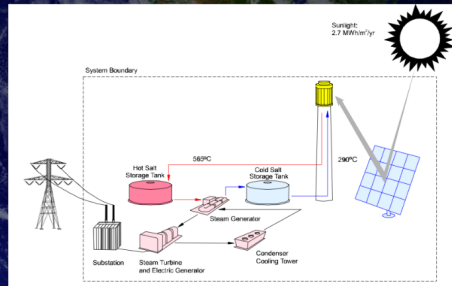
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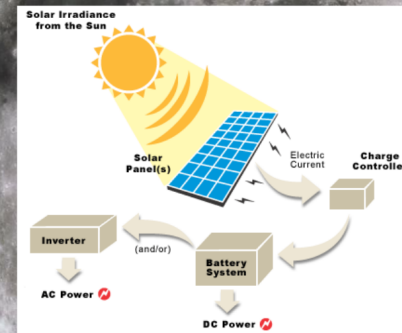
Difficult to estimate!!!

However, an adjusted estimate came out to be 4,737 GWh of Power

Concentrated Solar Power



Solar PV



Solar Power Barriers in SC

- Solar leasing
- Third party generation
- Current Policies

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