

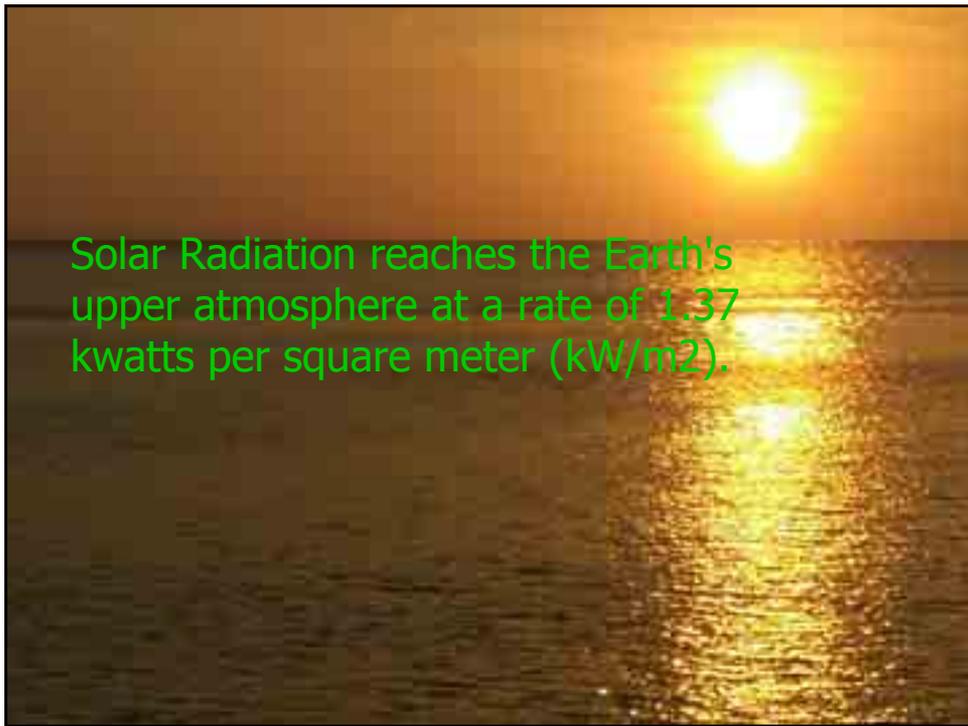
Solar power is the technology of obtaining usable energy from the light of the Sun. *Solar* energy has been used in many traditional technologies for centuries, and has come into widespread use where other power supplies are absent, such as in remote locations and in space.



Availability of solar energy

There is no shortage of solar-derived energy on Earth. Indeed the storages and flows of energy on the planet are very large relative to human needs.

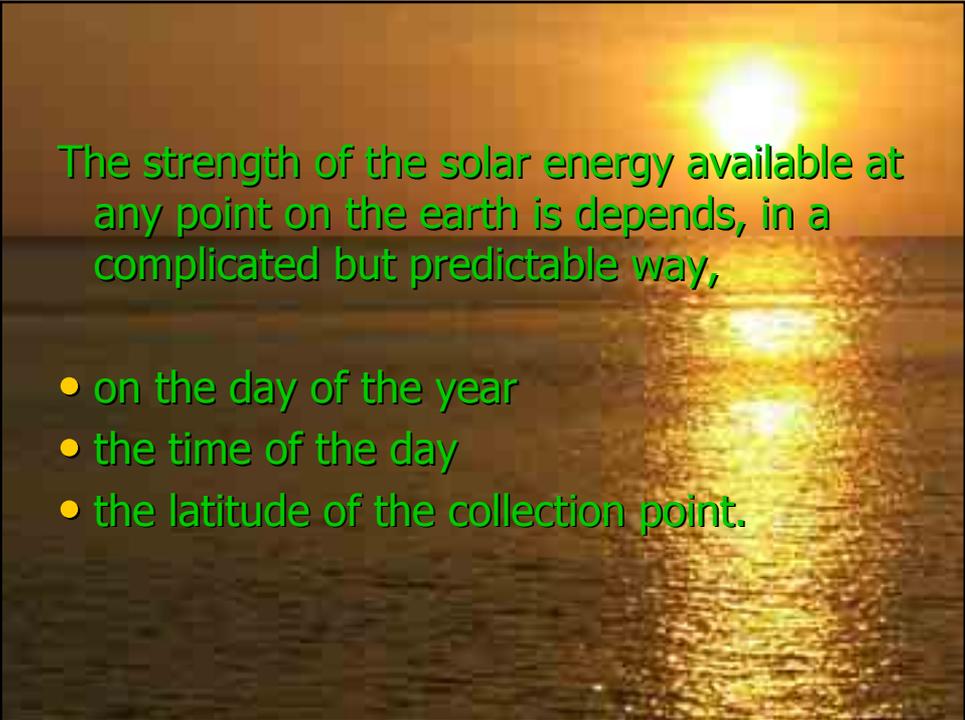
The amount of solar energy intercepted by the Earth every minute is greater than the amount of energy the world uses in fossil fuels each year.



Solar Radiation reaches the Earth's upper atmosphere at a rate of 1.37 kwatts per square meter (kW/m^2).

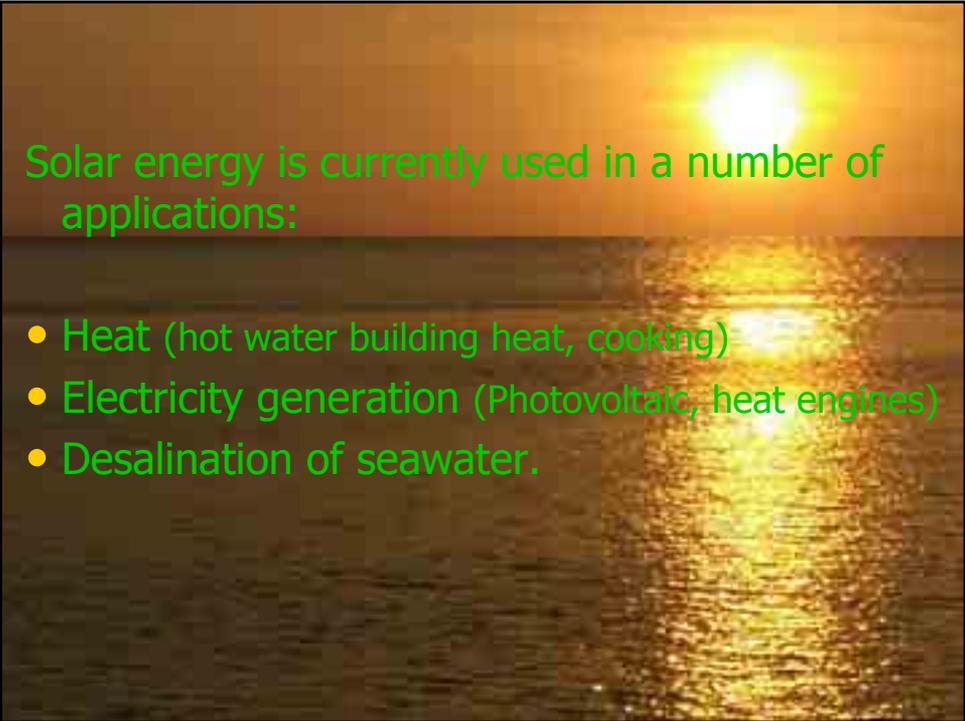


Tropical oceans absorb 560 trillion gigajoules (GJ) of solar energy each year, equivalent to 1,600 times the world's annual energy use.



The strength of the solar energy available at any point on the earth depends, in a complicated but predictable way,

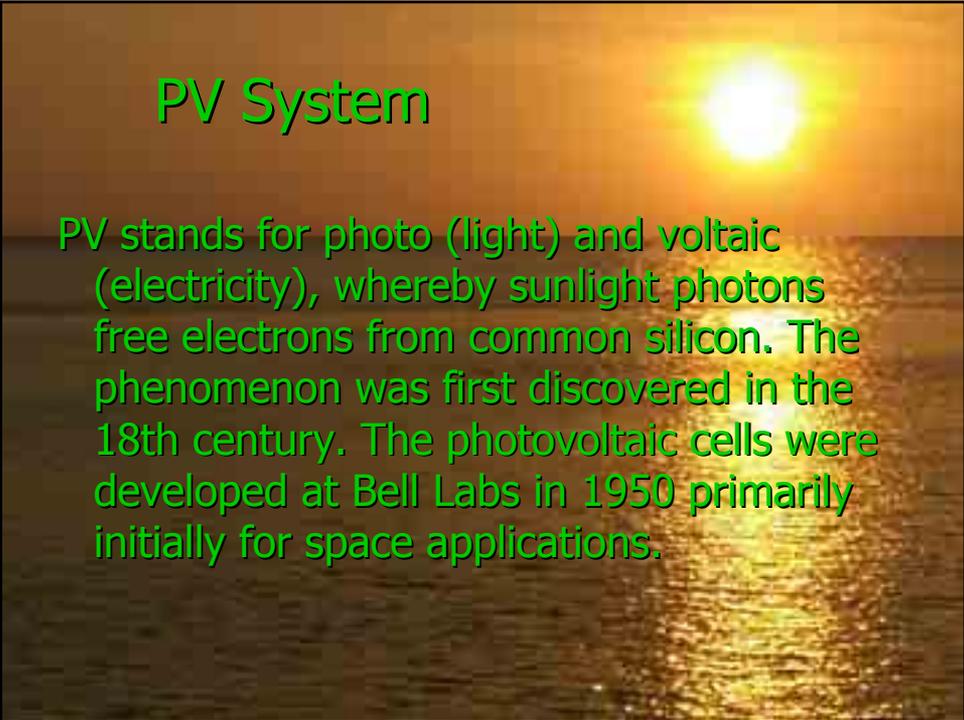
- on the day of the year
- the time of the day
- the latitude of the collection point.



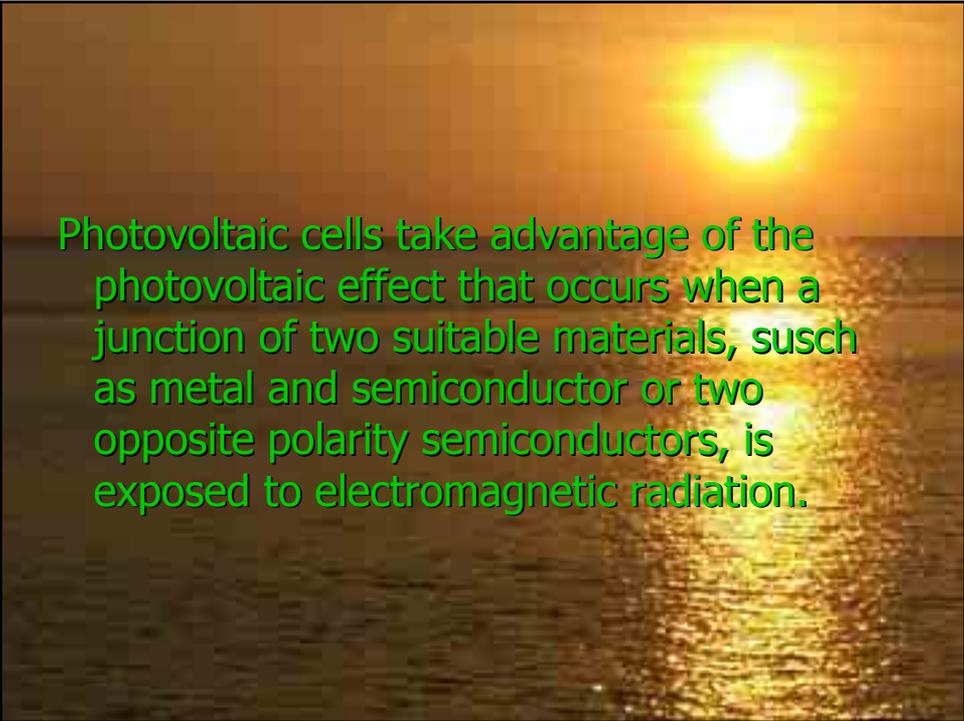
Solar energy is currently used in a number of applications:

- Heat (hot water building heat, cooking)
- Electricity generation (Photovoltaic, heat engines)
- Desalination of seawater.

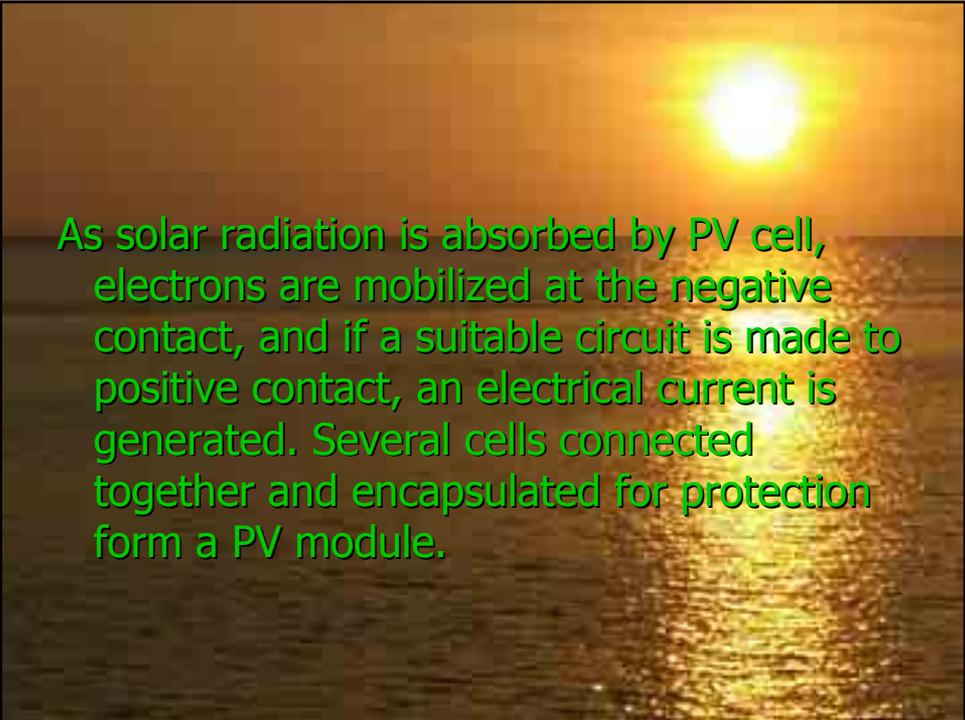
PV System

A photograph of a sunset over a body of water. The sun is a bright, glowing orb in the upper right quadrant, casting a shimmering path of light across the water's surface. The sky is a gradient of orange and yellow, and the water is dark with many small, bright reflections.

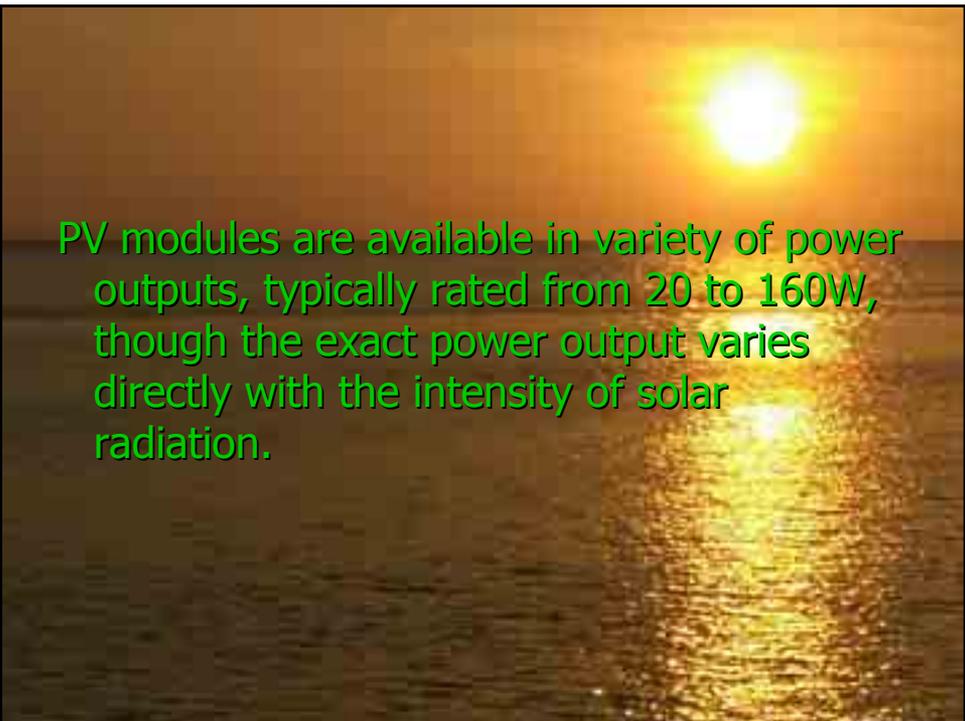
PV stands for photo (light) and voltaic (electricity), whereby sunlight photons free electrons from common silicon. The phenomenon was first discovered in the 18th century. The photovoltaic cells were developed at Bell Labs in 1950 primarily initially for space applications.

A photograph of a sunset over a body of water, identical to the one above. The sun is a bright, glowing orb in the upper right quadrant, casting a shimmering path of light across the water's surface. The sky is a gradient of orange and yellow, and the water is dark with many small, bright reflections.

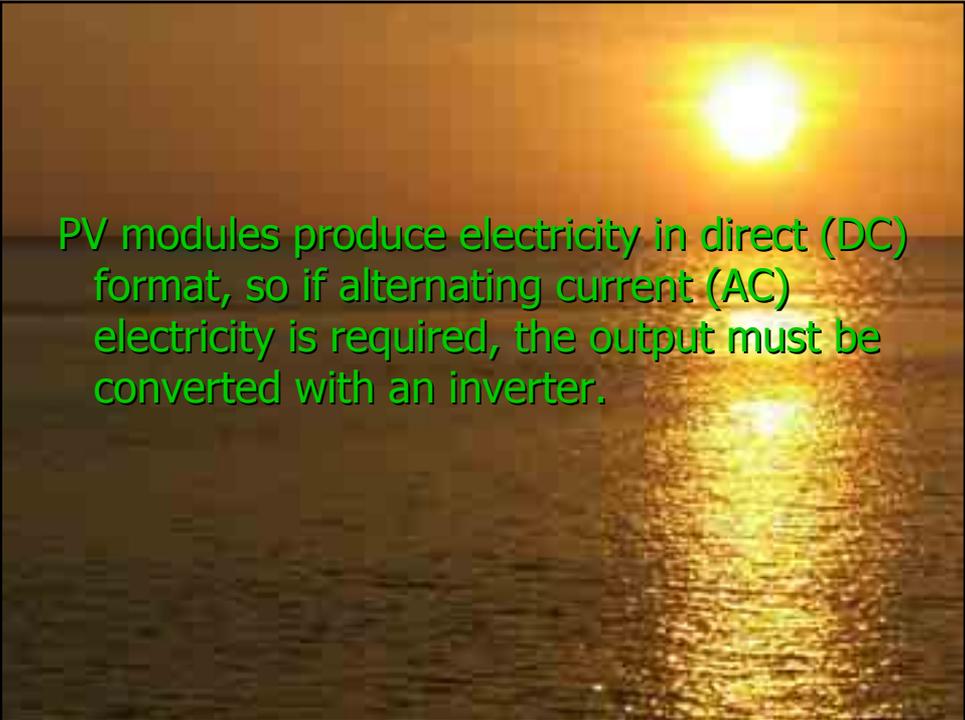
Photovoltaic cells take advantage of the photovoltaic effect that occurs when a junction of two suitable materials, such as metal and semiconductor or two opposite polarity semiconductors, is exposed to electromagnetic radiation.



As solar radiation is absorbed by PV cell, electrons are mobilized at the negative contact, and if a suitable circuit is made to positive contact, an electrical current is generated. Several cells connected together and encapsulated for protection form a PV module.



PV modules are available in variety of power outputs, typically rated from 20 to 160W, though the exact power output varies directly with the intensity of solar radiation.

A photograph of a bright sun setting over a body of water, with the sun's reflection shimmering on the surface. The sky is a warm orange and yellow.

PV modules produce electricity in direct (DC) format, so if alternating current (AC) electricity is required, the output must be converted with an inverter.

A photograph showing a close-up view of several blue solar panels. The panels are arranged in a grid pattern, with white lines separating them. The sun is visible in the upper right corner, casting a bright glow.

Set of Solar Modules

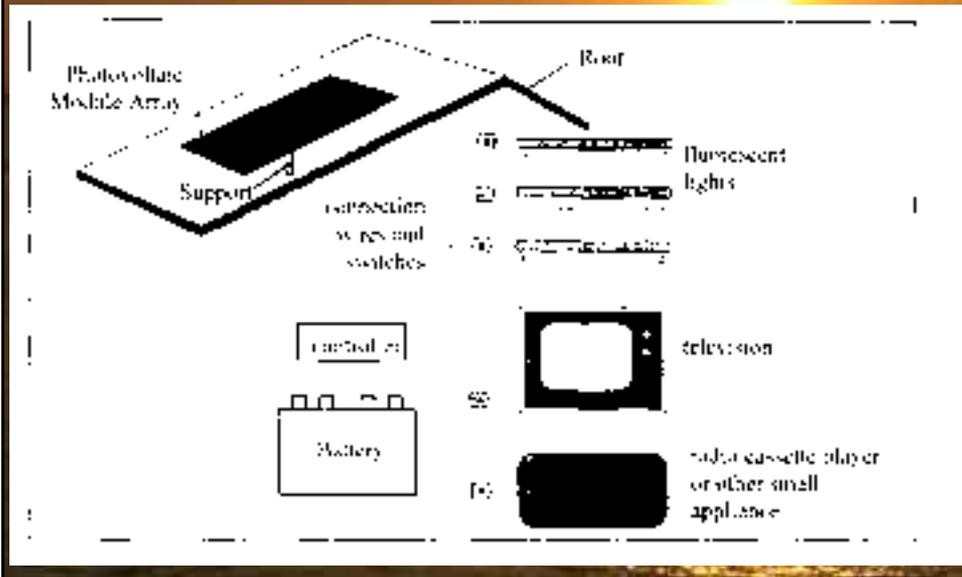
PV Modules

Crystalline cell modules with 36 cells are basically used with charge controller.

Typical Solar System Components

- PV Module
- Solar Controller
- Battery
- Load
- Switches and wires

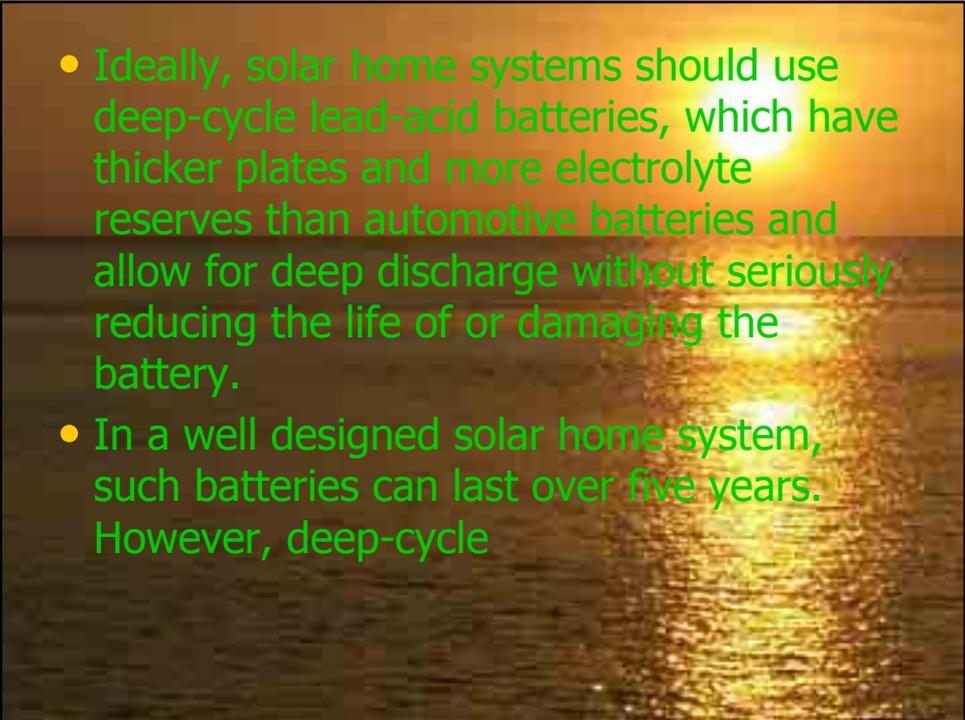
Typical Solar System Components



Battery.

The battery that is most often used in solar home systems is a lead-acid battery of the type used in automobiles, sized to operate for up to three cloudy days.

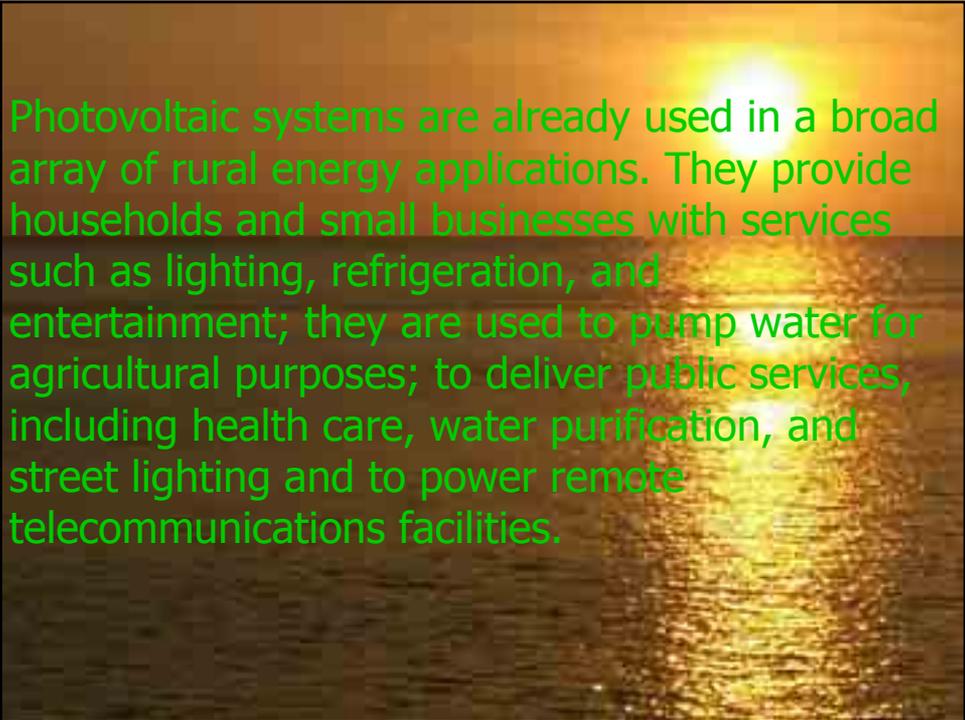
Automotive batteries are often used because they are relatively inexpensive and available locally.

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- Ideally, solar home systems should use deep-cycle lead-acid batteries, which have thicker plates and more electrolyte reserves than automotive batteries and allow for deep discharge without seriously reducing the life of or damaging the battery.
 - In a well designed solar home system, such batteries can last over five years. However, deep-cycle



Charge and Load Controller.

The charge and load controller prevents system overload or overcharging.

A photograph of a sunset over a body of water. The sun is a bright, glowing orb in the upper right quadrant, casting a shimmering path of light across the dark, rippling water. The sky is a gradient of orange and yellow, fading into a darker blue at the top.

Photovoltaic systems are already used in a broad array of rural energy applications. They provide households and small businesses with services such as lighting, refrigeration, and entertainment; they are used to pump water for agricultural purposes; to deliver public services, including health care, water purification, and street lighting and to power remote telecommunications facilities.

Advantages of solar power

- The 89 petawatts of sunlight reaching the earth's surface is plentiful compared to the 15 terawatts of average power consumed by humans.

Additionally, solar electric generation has the highest power density (global mean of 170 W/m²) among renewable energies.

Advantages of solar power

- Solar power is pollution free during use. Production end wastes and emissions are manageable using existing pollution controls.

Advantages of solar power

- Facilities can operate with little maintenance or intervention after initial setup.

Advantages of solar power

- Solar electric generation is economically competitive where grid connection or fuel transport is difficult, costly or impossible. Examples include satellites, island communities, remote locations and ocean vessels.

Advantages of solar power

- When grid connected, solar electric generation can displace the highest cost electricity during times of peak demand (in most climatic regions), can reduce grid loading, and can eliminate the need for local battery power for use in times of darkness and high local demand; such application is encouraged by net metering. Time-of-use net metering can be highly favorable to small photovoltaic systems.

Advantages of solar power

- Grid connected solar electricity can be used locally thus minimizing transmission/distribution losses (approximately 7.2%).

Advantages of solar power

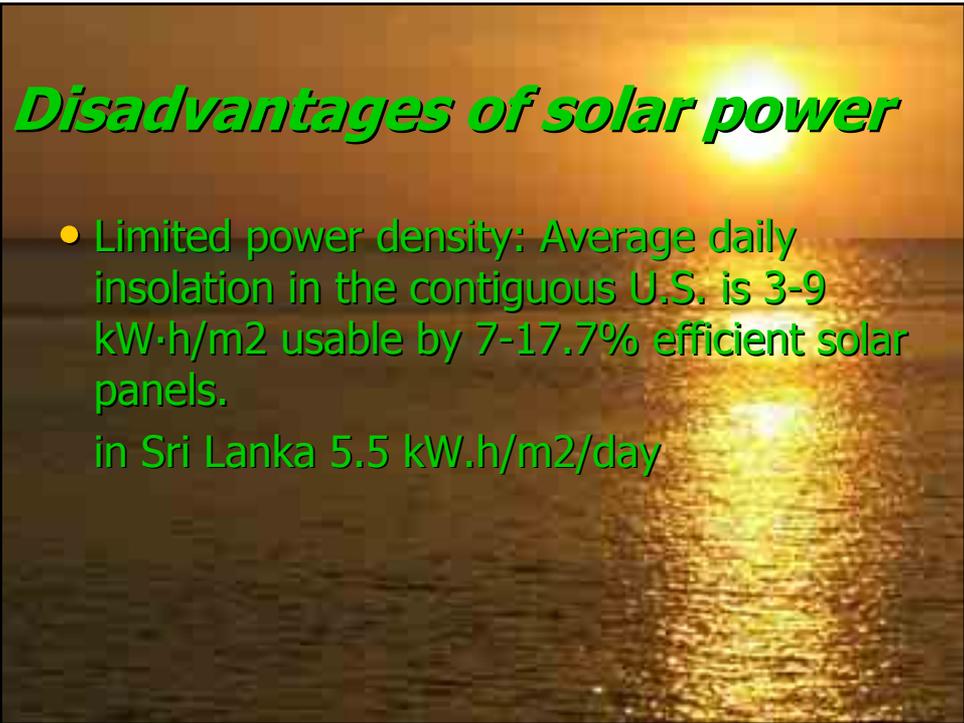
- Once the initial capital cost of building a solar power plant has been spent, operating costs are low when compared to existing power technologies.

Disadvantages of solar power

A photograph of a sunset over a body of water. The sun is low on the horizon, creating a bright, shimmering reflection on the water's surface. The sky is a mix of orange and yellow, and the water is dark with some ripples.

- Solar electricity is expensive compared to grid electricity.

Disadvantages of solar power

A photograph of a sunset over a body of water, identical to the one above. The sun is low on the horizon, creating a bright, shimmering reflection on the water's surface. The sky is a mix of orange and yellow, and the water is dark with some ripples.

- Limited power density: Average daily insolation in the contiguous U.S. is 3-9 kW·h/m² usable by 7-17.7% efficient solar panels.
in Sri Lanka 5.5 kW.h/m²/day

A photograph of a sunset over a body of water. The sun is low on the horizon, creating a bright orange and yellow glow. The sun's light reflects off the water's surface, creating a shimmering path of light that leads from the horizon towards the viewer. The sky is a mix of orange, yellow, and a hint of blue.

Disadvantages of solar power

- To get enough energy for larger applications, a large number of photovoltaic cells is needed. This increases the cost of the technology and requires a large plot of land.

A photograph of a sunset over a body of water. The sun is low on the horizon, creating a bright orange and yellow glow. The sun's light reflects off the water's surface, creating a shimmering path of light that leads from the horizon towards the viewer. The sky is a mix of orange, yellow, and a hint of blue.

Disadvantages of solar power

- Like electricity from nuclear or fossil fuel plants, it can only realistically be used to power transport vehicles by converting light energy into another form of stored energy (e.g. battery stored electricity or by electrolyzing water to produce hydrogen) suitable for transport.



Disadvantages of solar power

- Solar cells produce DC which must be converted to AC when used in currently existing distribution grids. This incurs an energy loss of 4-12%.



PV systems are safer, environment friendly and more convenient than kerosene lanterns and dry cell or automotive batteries which are widely used in developing countries for lighting and to power small appliances.

Solar Applications in Sri Lanka

- Home Lighting Systems
75,000 solar home systems installed
- 5,000 Solar Drip Irrigation Systems
- IT Education for Rural School
100 computer labs
- community based systems
500 units of drinking water, primary health care, vaccine storage, lighting
- Solar water pumping

Solar Drip Irrigation



Community
Solar
Drinking
water



Solar Powered Health Clinic



Community Water Supply



Solar Powered Computer Lab



Solar Powered Computer Lab



Thank You

