

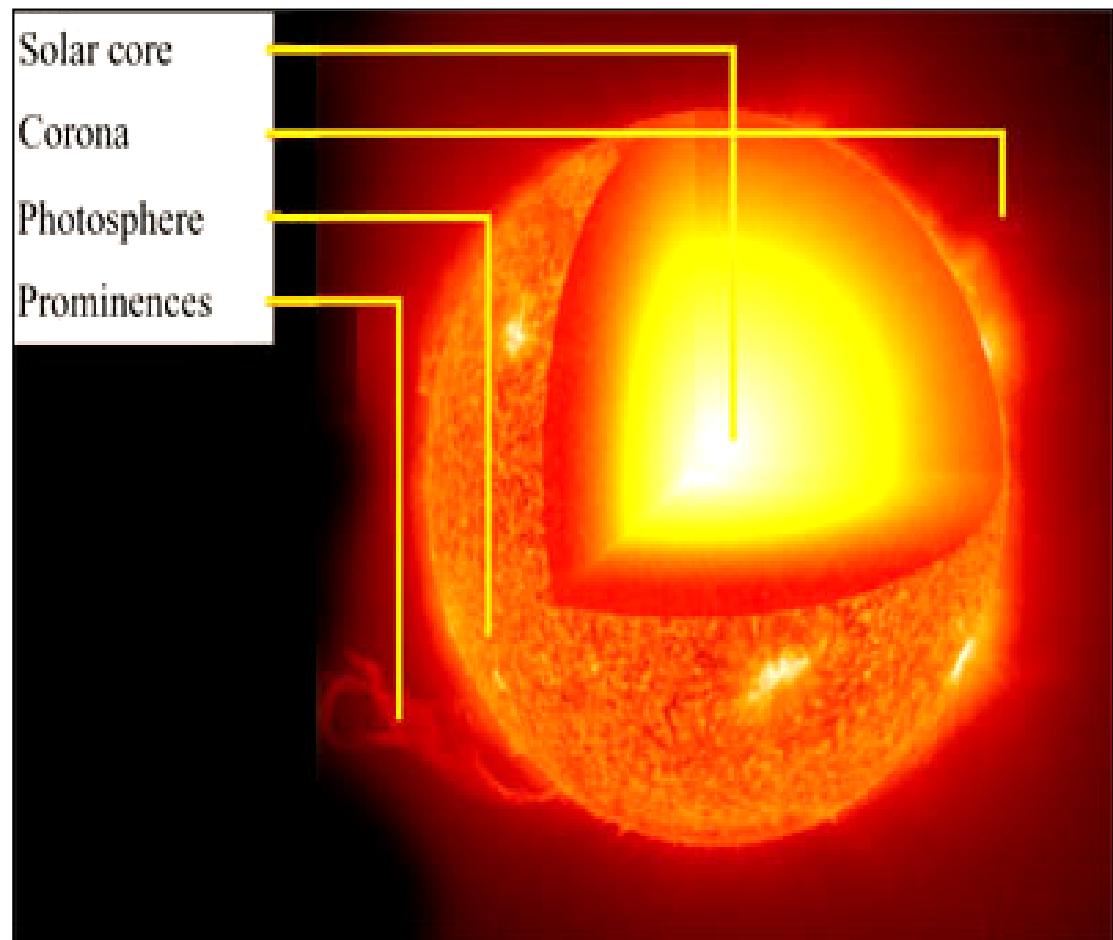
# Solar Energy



RENEWABLE & SUSTAINABLE  
ENERGY STUDIES

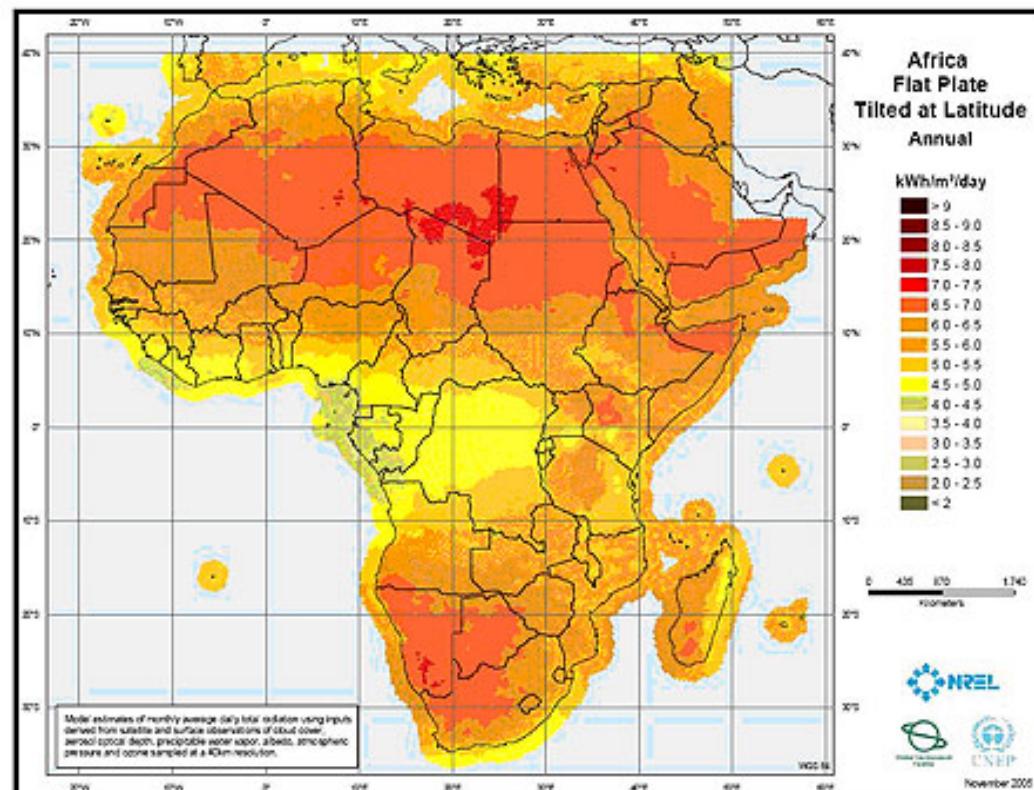
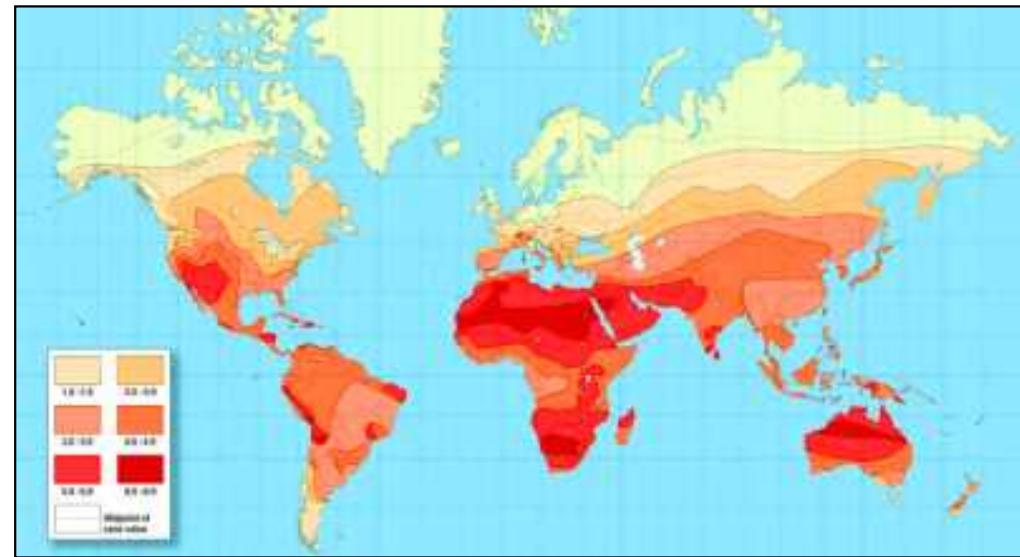
# Solar Energy

- Sun is a **star**
- **Source of energy** in the sun is at its **core**
- This energy is **released** into space primarily as **electromagnetic radiation**
- We experience this **radiation** as **heat** and **light**



**The Sun**

**Every hour,  
enough sunlight energy  
reaches the Earth  
to meet the world's energy  
demand  
for a whole year**



The **dark red spot**, roughly over the highlands of **South Africa** indicates the spot of **highest solar insolation** in the world. **South Africa** has the **perfect** climate for solar energy

**How Powerful is it?**

# Solar Energy

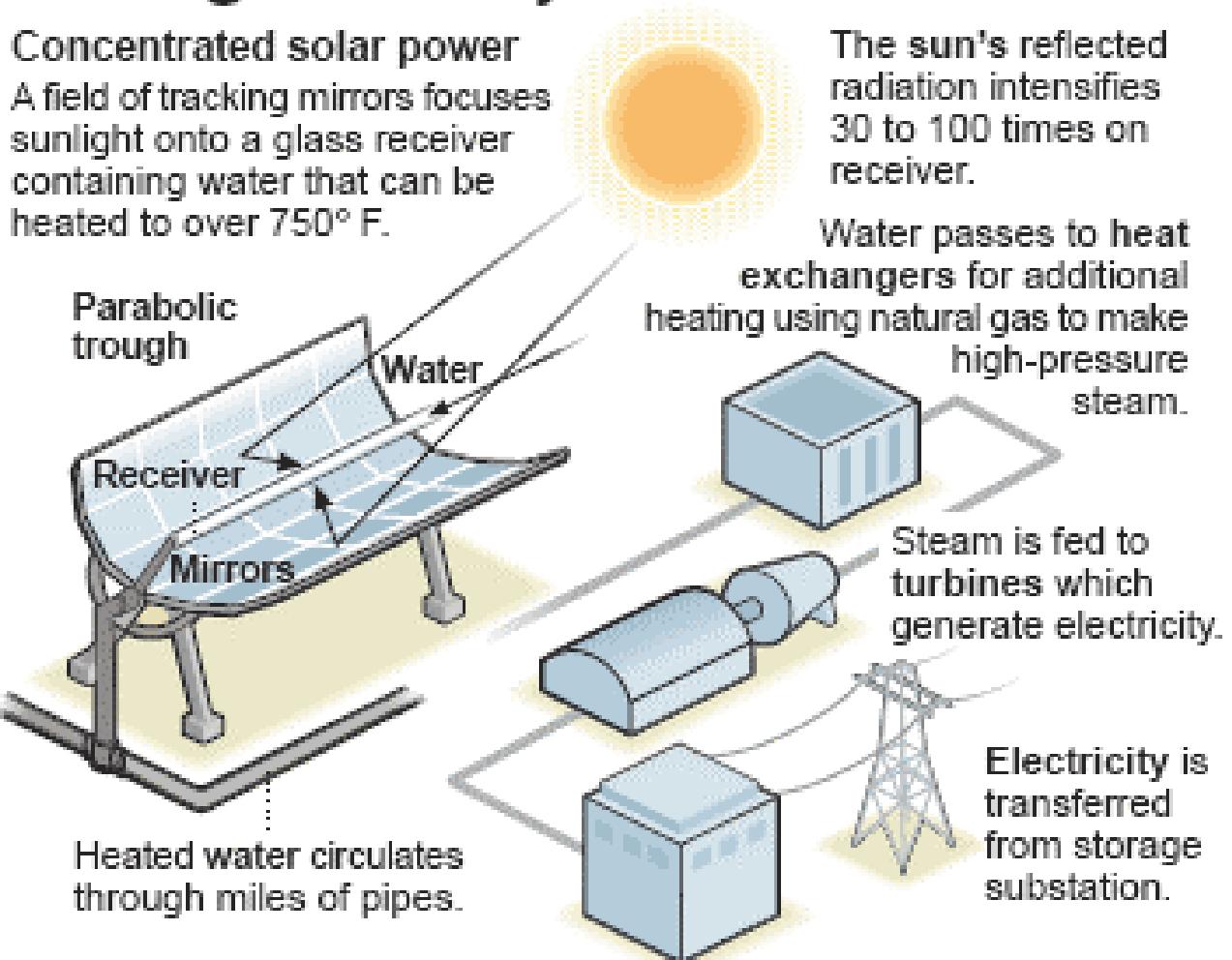
## Three main uses of solar energy:

- Heating of water
- Solar thermal power station
- Photovoltaic panels

## Making electricity from the sun's heat

### Concentrated solar power

A field of tracking mirrors focuses sunlight onto a glass receiver containing water that can be heated to over 750° F.



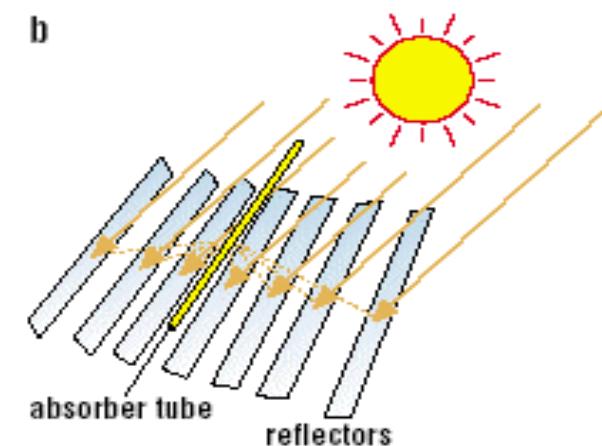
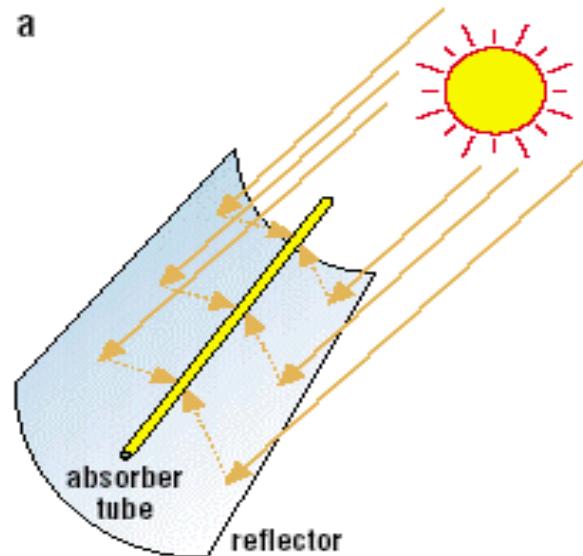
SOURCES: Energy Information Administration; Schott Corporation

AP

Solar Energy

# Concentrated Solar Thermal Power Plants

**Solar energy**  
is concentrated to  
a central receiver

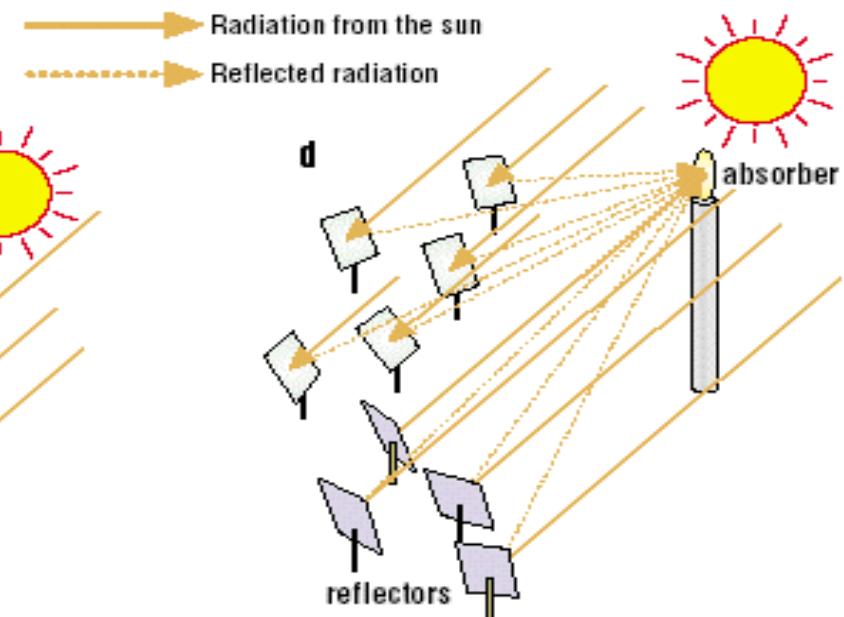
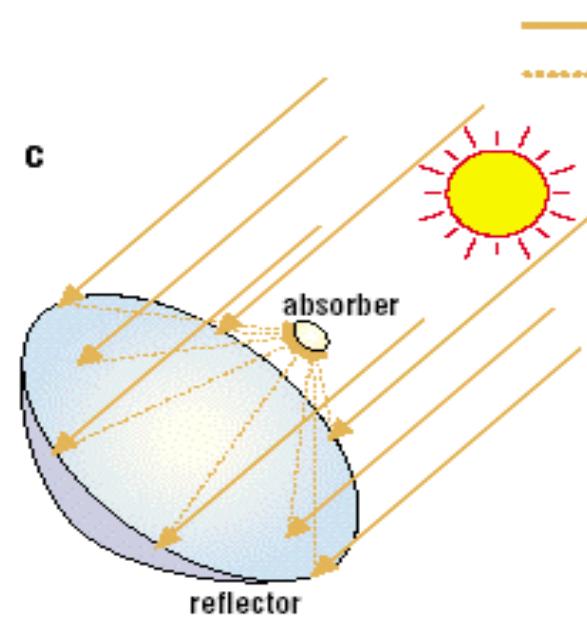


**a. Parabolic Through**

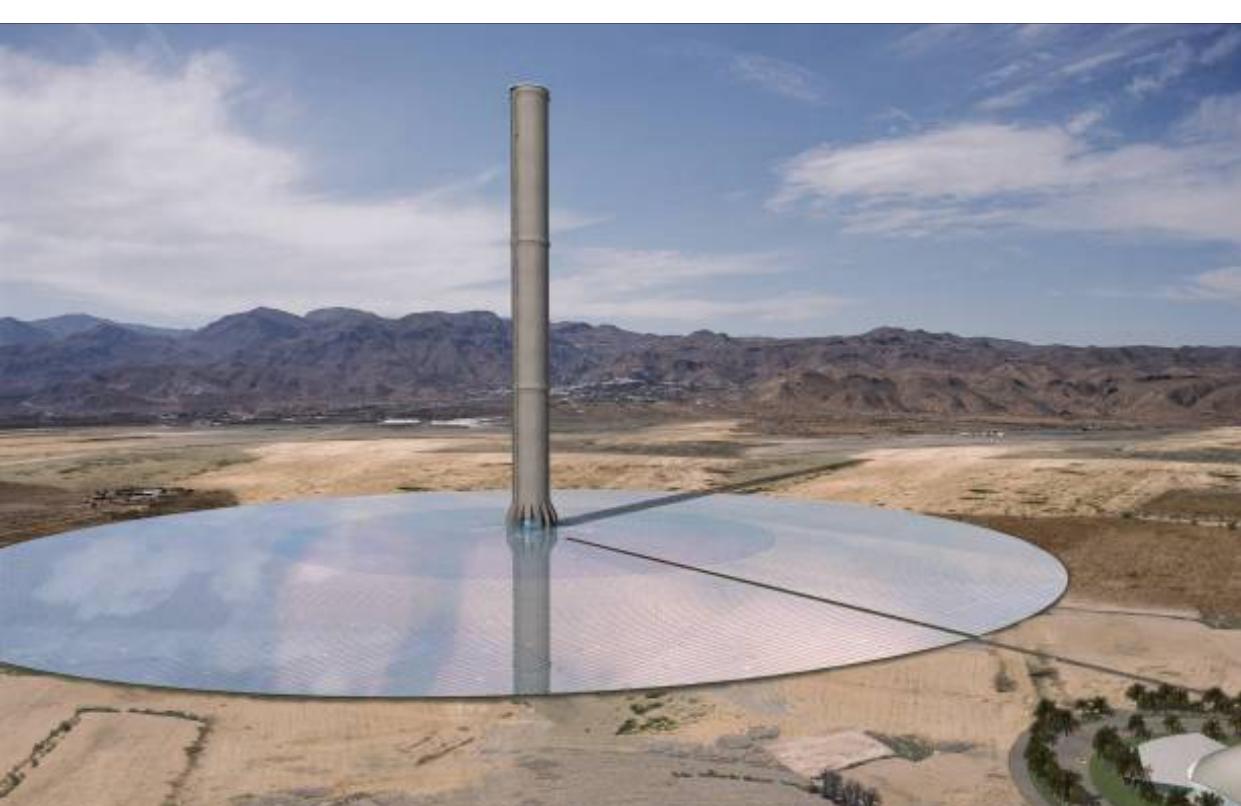
**b. Fresnel**

**c. Parabolic Dish**

**d. Central Receiver**



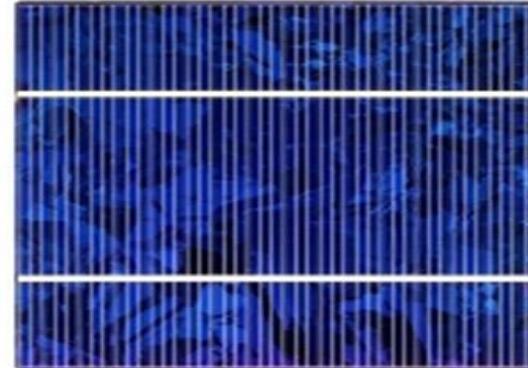
**Concentrated Solar Energy**



# Solar Thermal Power Plants

# Photovoltaic Effect

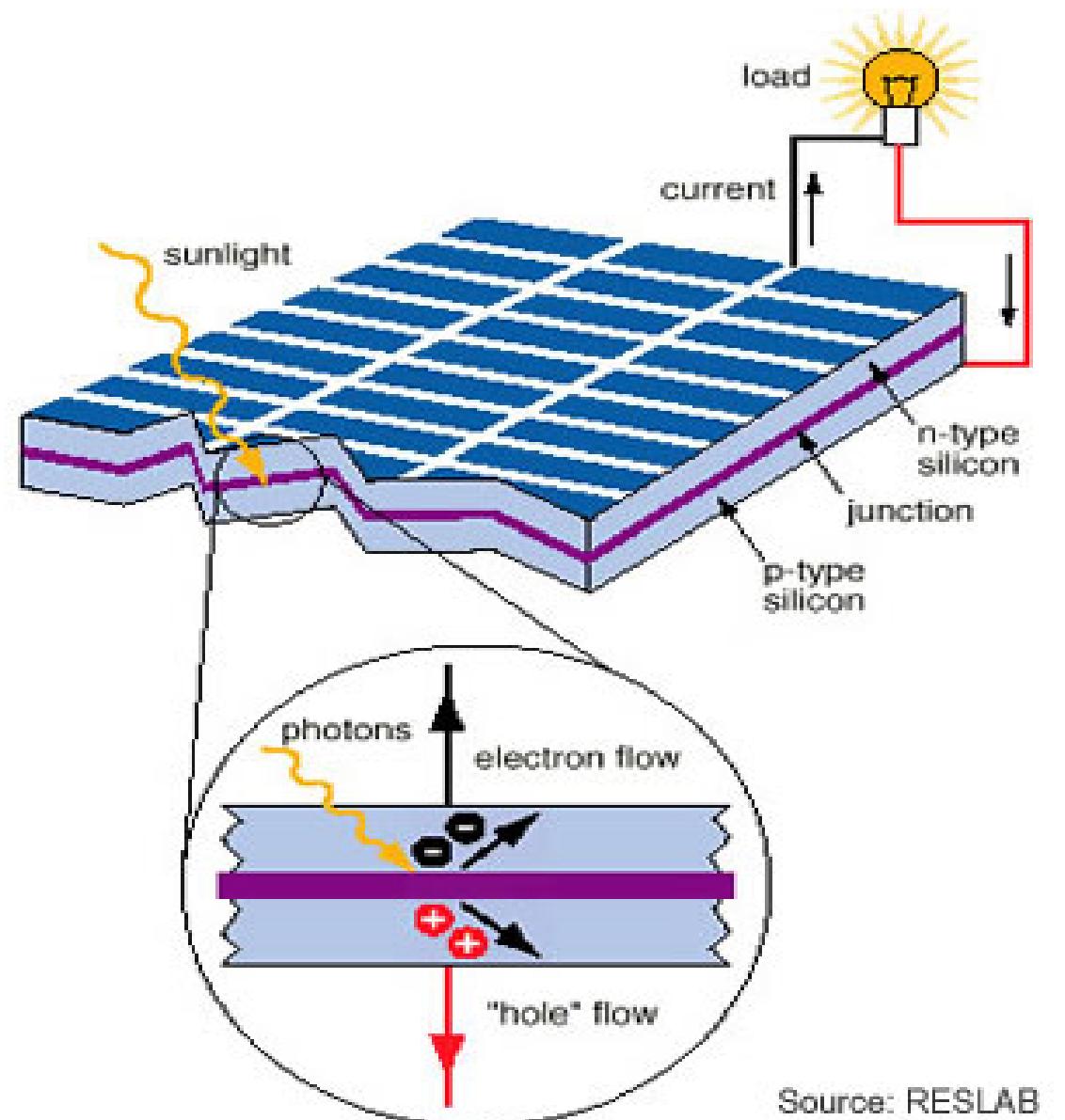
- **Converting solar energy** to **electrical energy** by means of solar cells = **photovoltaic effect**
- **Photovoltaic panel** is a **group** of **solar cells**
- **Solar cells** are predominantly made from **silicon**



**Photovoltaic Effect**

# Photovoltaic Panels

- PV panels consist of **semiconductors**
- PV cells have two layers of semiconductors, one **positively charged** and one **negatively charged**
- When **light shines** on semiconductor, the **electric field across the junction** between these two layers causes **electricity** to flow
- The greater the intensity of light, the greater the flow of electricity



Source: RESLAB

Photovoltaic Panels



**Photovoltaic Power Plants**

[www.sasunshine.co](http://www.sasunshine.co)

# Solar Water Heating

- **Indirect system** uses **heat transfer fluid** to move heat from solar collector to tank
- **Direct solar systems heat the water**

Water in direct system circulated in two ways:

- **Active system circulation pump transfer** heat from collector to solar storage tank
- **Passive system no pump or control system** to transfer heat to storage tank

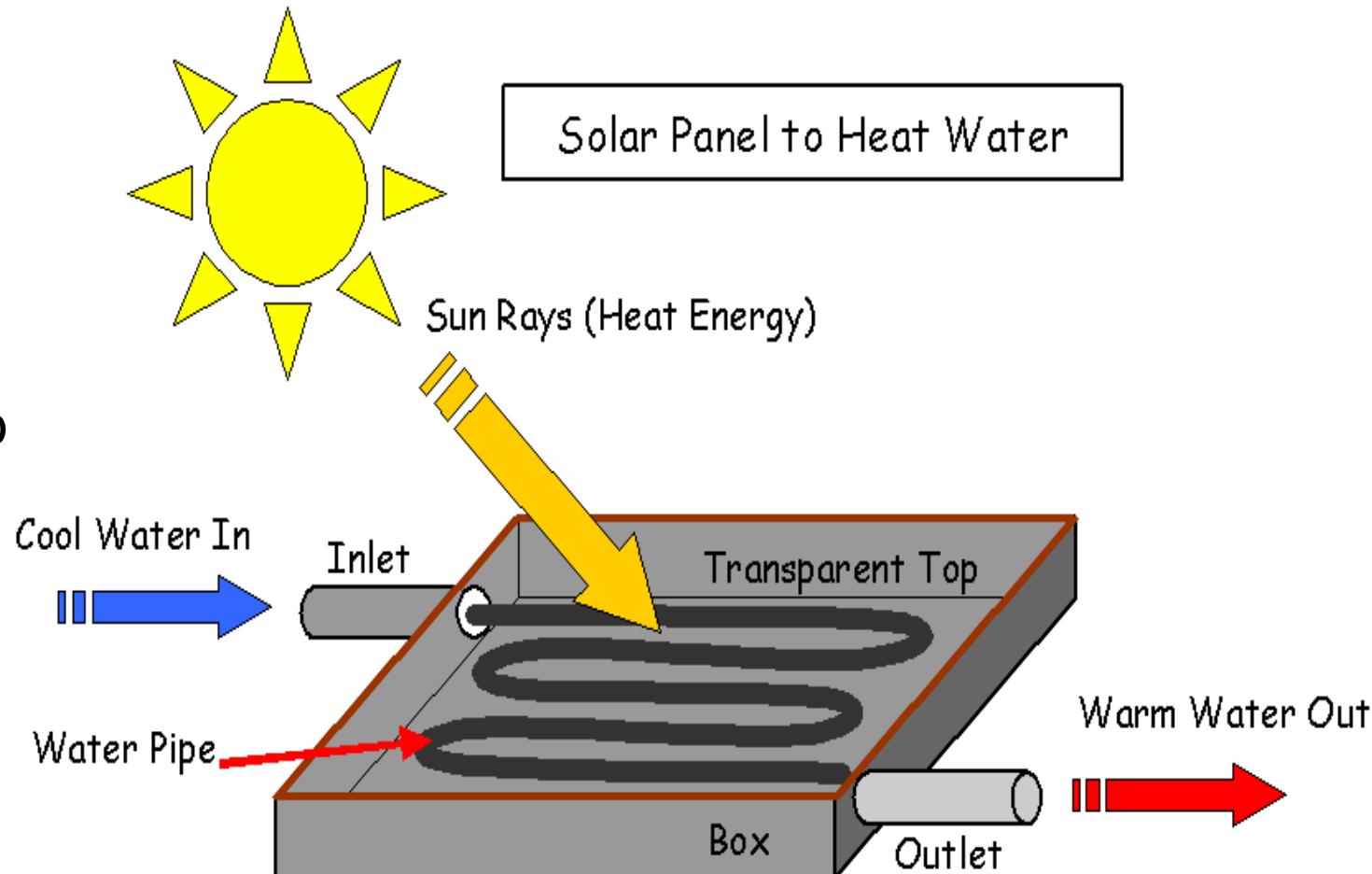
- **Two types** of solar collectors:  
**Flat panel**  
**Evacuated Tube system**



**Solar Water Heating**

# Solar Flat Panel

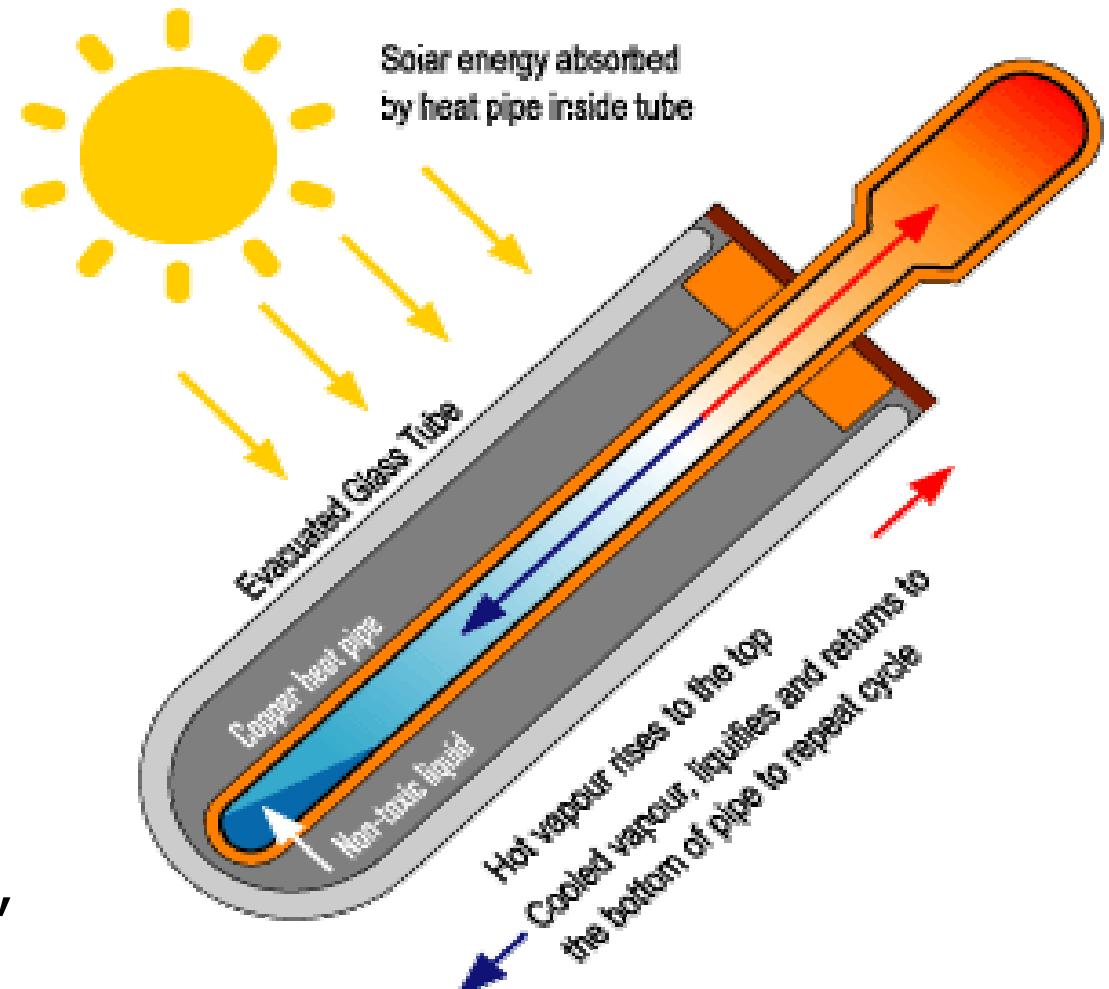
- Sun heats up water contained in dark vessel
- Can be used from domestic **hot water** and **space heating** to **swimming pool** heating, **solar-assisted** cooling, **industrial process** and **desalination** of drinking water



**Solar Flat Panel**

# Evacuated Tube System

- **Absorber** inside vacuum tube **absorbs radiation** from **sun** and heats up fluid inside
- Additional radiation is picked up from **reflector** behind tubes
- Whatever the angle of sun the **round shape** of vacuum tube allows it to reach absorber
- On **cloudy day**, when light is coming from many angles , vacuum tube collector can still be effective



Evacuated Tube System