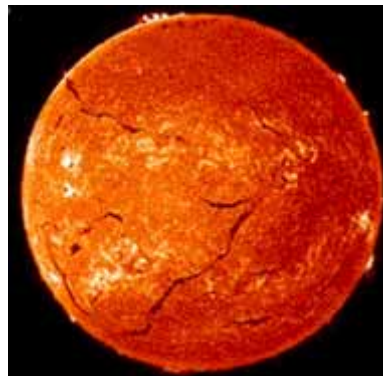




## **SOLAR ENERGY – *what is it?***

The solar energy that prostrates in the surface of the earth is solar radiation produced from sun. Through space, it reaches almost immutable on the upper layer of atmosphere of our planet, but while it passes from atmosphere becomes subject of important alterations, because of the constitution of atmosphere.



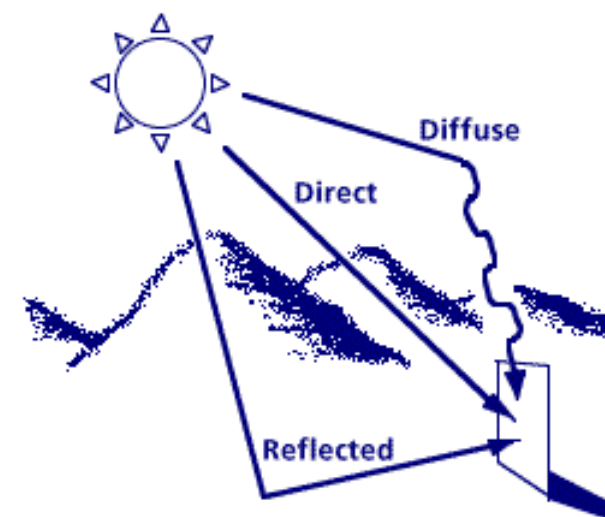
SUN



– The solar radiation that prostrates in a point of the earth's surface in a given moment of time is characterized by the intensity and the direction of prostration.

– Only a small part of radiation that emanates immediately from the sun (direct solar radiation) reaches the surface of the earth, while the rest of it either it is absorbed by the components of atmosphere or it is reflected again towards space or towards the ground.

– The radiation that prostrates on the surface of the earth after successive reflections does not have concrete direction and is called diffuse radiation.





## METHODS FOR DIRECT EXPLOITATION OF SOLAR ENERGY



Solar energy is a primary, soft and renewable source of energy which indirectly gives genesis in three other soft and renewable sources of energy: hydraulic, aeolian and energy from biomass.

We will only see the methods of direct energy exploitation of solar radiation that reaches the surface of the earth.

The solar radiation can be used for:

- Direct production of heat, with energetic and passive solar systems
  - If the produced heat is of a high temperature, it can be used for steam production and then for mechanic energy (with steam-turbines).
  - the mechanic energy can be transformed in electric energy. In this case we refer to thermic production of electricity with the help of solar energy
- Direct production of electric energy, with the exploitation of photovoltaic phenomenon.



We usually distinguish:

- Thermic and Thermic Electric applications
  - Electric or Photovoltaic applications
- of solar energy

In thermic applications it occurs exploitation of the thermic energy that comes from solar radiation

While,

In electric applications it is used the quantum energy carried in solar radiation.



## THERMAL APPLICATIONS OF SOLAR ENERGY



Thermal applications of solar energy are distinguished in applications of low, medium and high temperature.

The applications of low and medium temperature include the energetic and passive systems of heat production from sun:

- We call *energetic* the systems or the solar installations in which the transportation of collected solar heat is realised with the circulation of thermic liquid (with the help of pump or fan). Consequently, these systems depend from an additional source of energy, mainly electricity, for their operation.
- On the contrary, *passive* systems function autonomously and the energy circulates with a natural flow, as the free synagogue which depends only from the differences of temperature and density created in certain points of a system.



The solar systems that are used for the production of heat even if they are differentiated considerably they have certain common parts:

1. System of collection and transformation of thermic radiation in heat (collector)
2. System of heat storage
3. System of attribution of stored energy for use
4. System of control



## WATER HEATING

In many regions of our planet, solar systems that heat water for use, also known as solar systems H.W.U. (Hot Water of Use), can cover from 50 to 100% of demand for hot water in residences.

They are constituted by two basic parts: the collector and the storage container. However there are many differences in their planning and are usually distinguished in open (immediately) or closed (indirectly) circle, passively (with natural circulation) or energetic (with pumps for water circulation).

Almost all solar systems require an auxiliary heating source for periods with small solar radiation regarding the demand.

Solar systems have a big initial purchase and installation cost in relation to the conventional systems but have small to null operational cost.



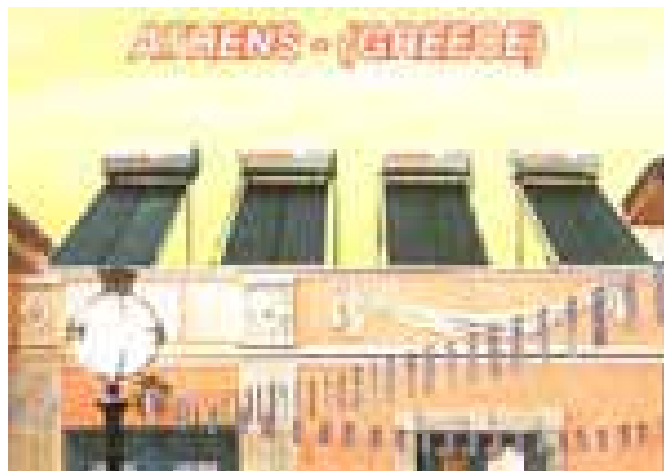
Solar systems H.W.U. use directly solar energy for heating water or any other thermic liquid, like mixture of water with antifreeze.

This is achieved with solar collectors, which are usually installed on the roofs of buildings. The hot water is then stored in a reservoir, same as in other systems for water heating.

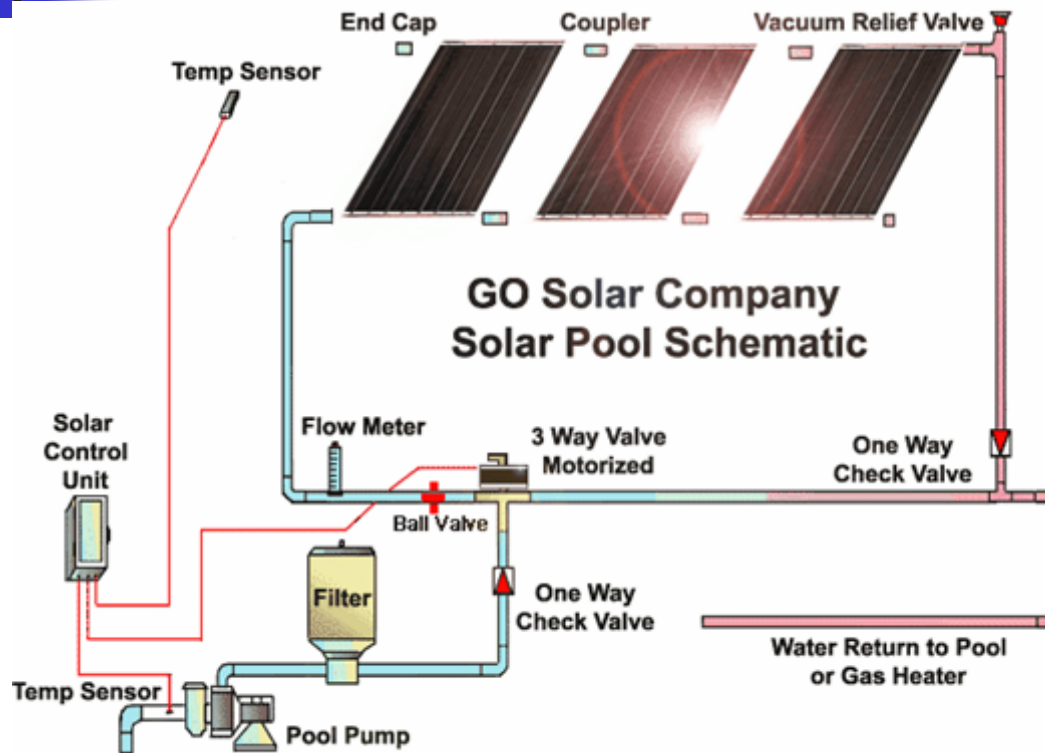
These systems are competitive in heating water for domestic use and water for swimming-pools.



## EXAMPLES OF HEATING WATER FOR USE



# EXAMPLES OF HEATING WATER FOR SWIMMING POOLS





# HEATING OF SPACES

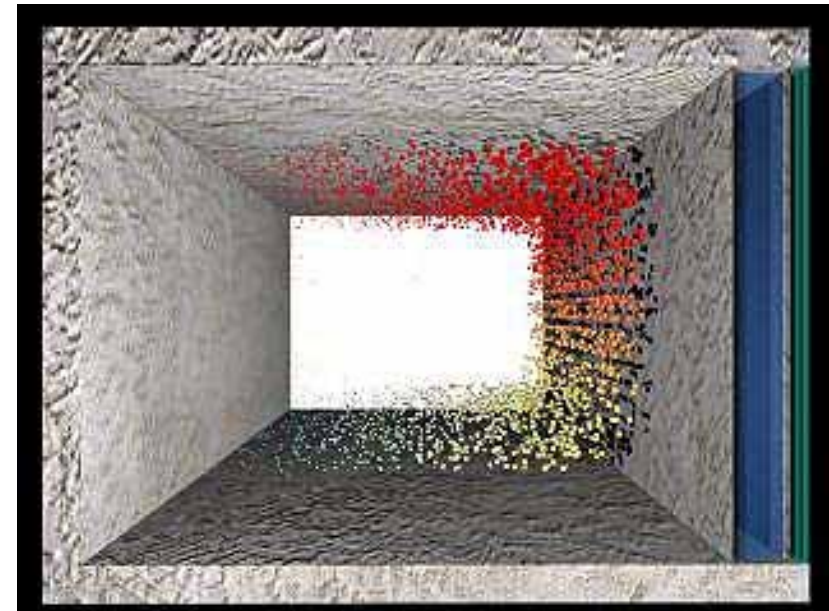
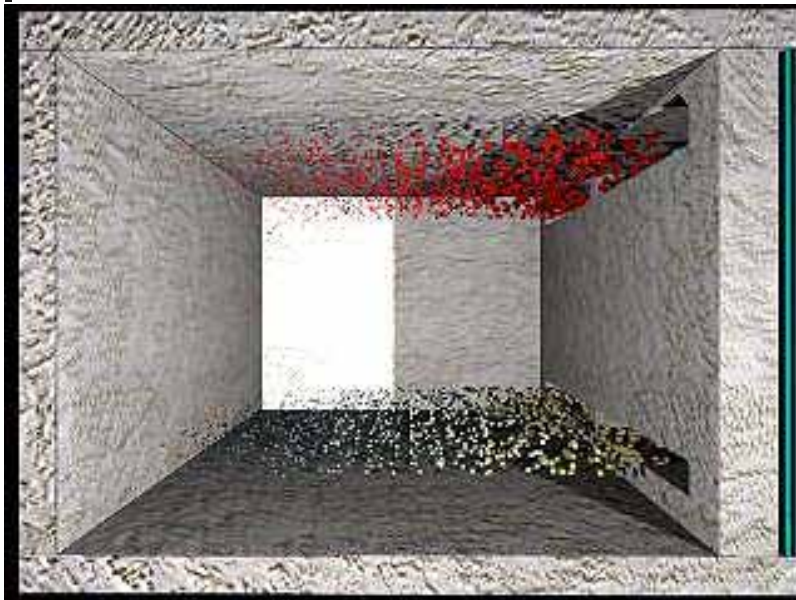
## Passive systems

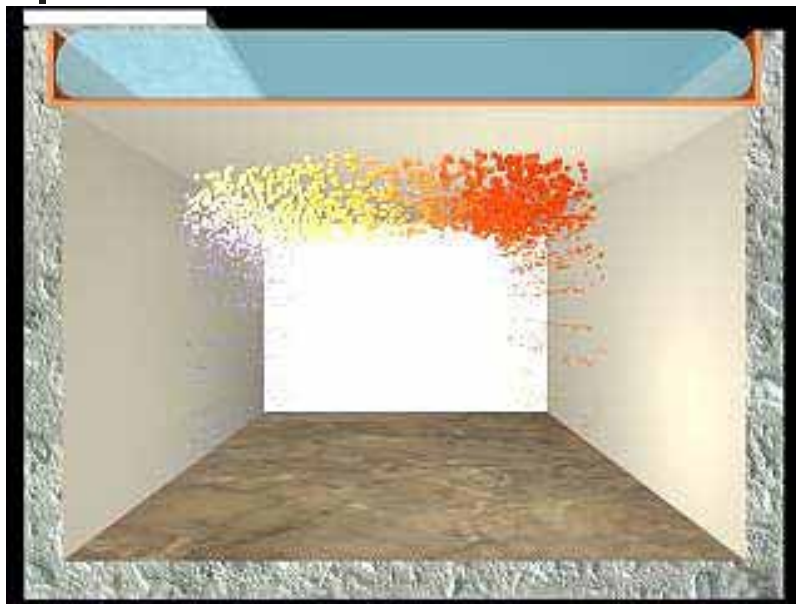
- *Trombe* wall
- Systems of direct profit with openings for the entry of solar radiation
- Walls of thermic passage (murs diode-thermique)
- Translucent walls

## Energetic systems

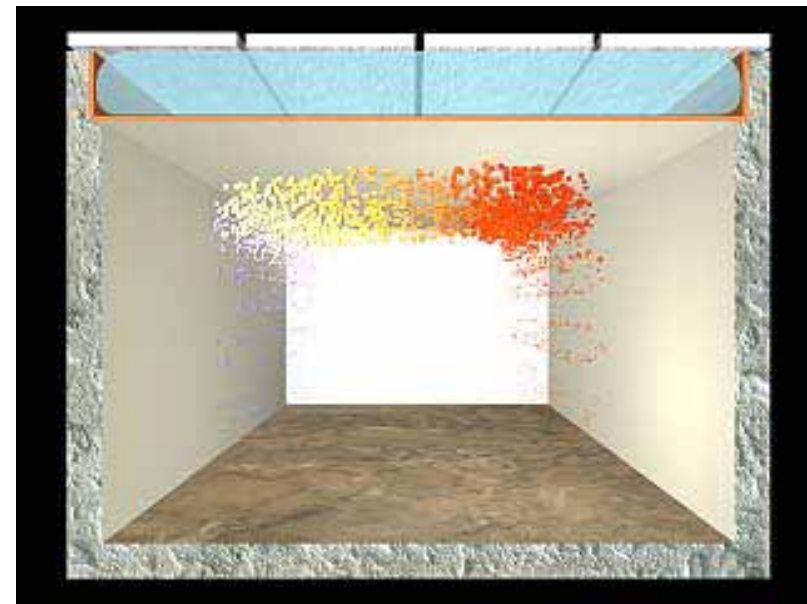


## TROMBE WALL





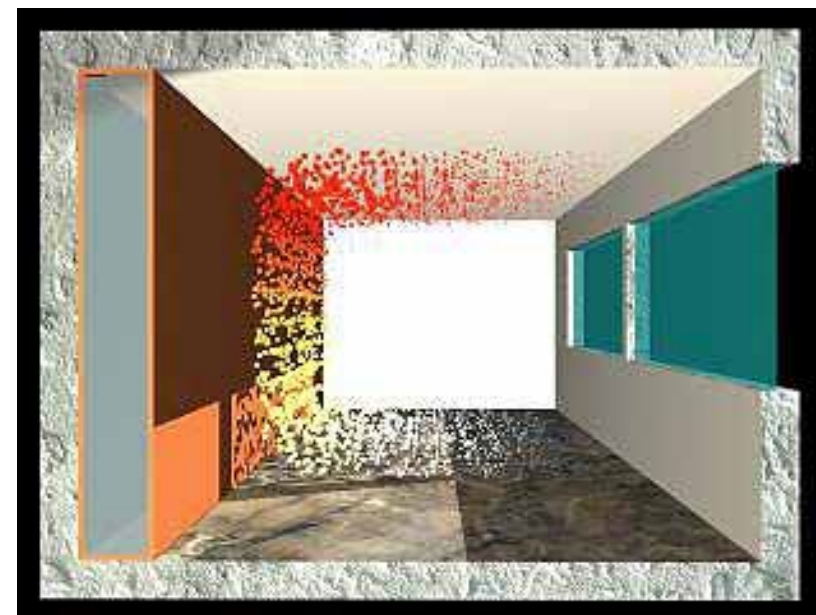
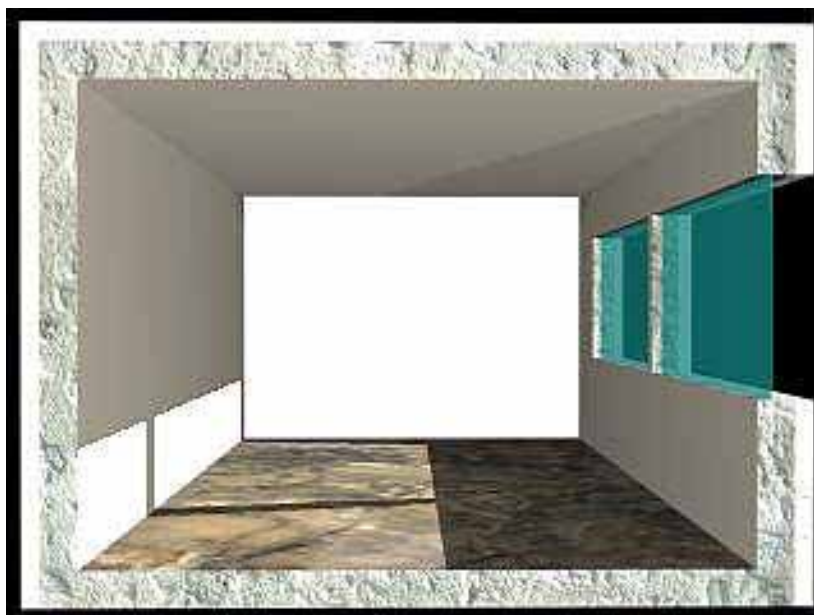
day

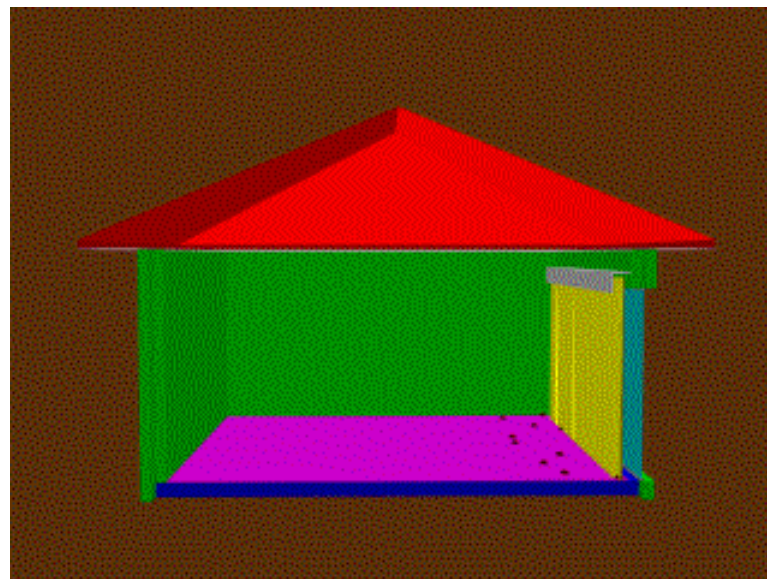
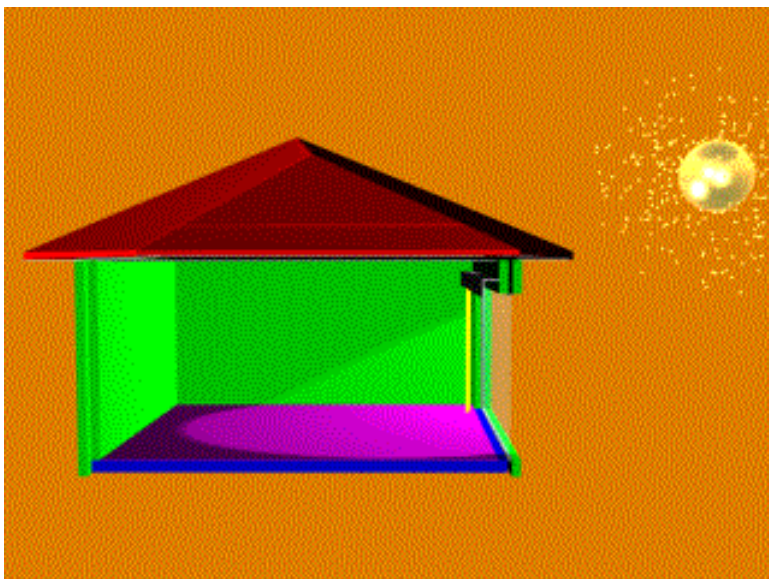
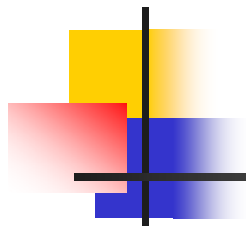


night



## SYSTEMS OF DIRECT PROFIT WITH OPENINGS FOR THE ENTRY OF SOLAR RADIATION





# **BIOCLIMATIC CONSTRUCTION OF EXHIBITION SPACE - OFFICES**

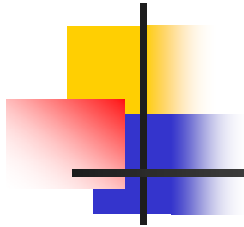
## **REGIONAL ENERGY CENTRE OF THESSALY**





## OLD FACTORY COMPLEX OF *TSALAPATAS*





## SOLAR CHIMNEYS



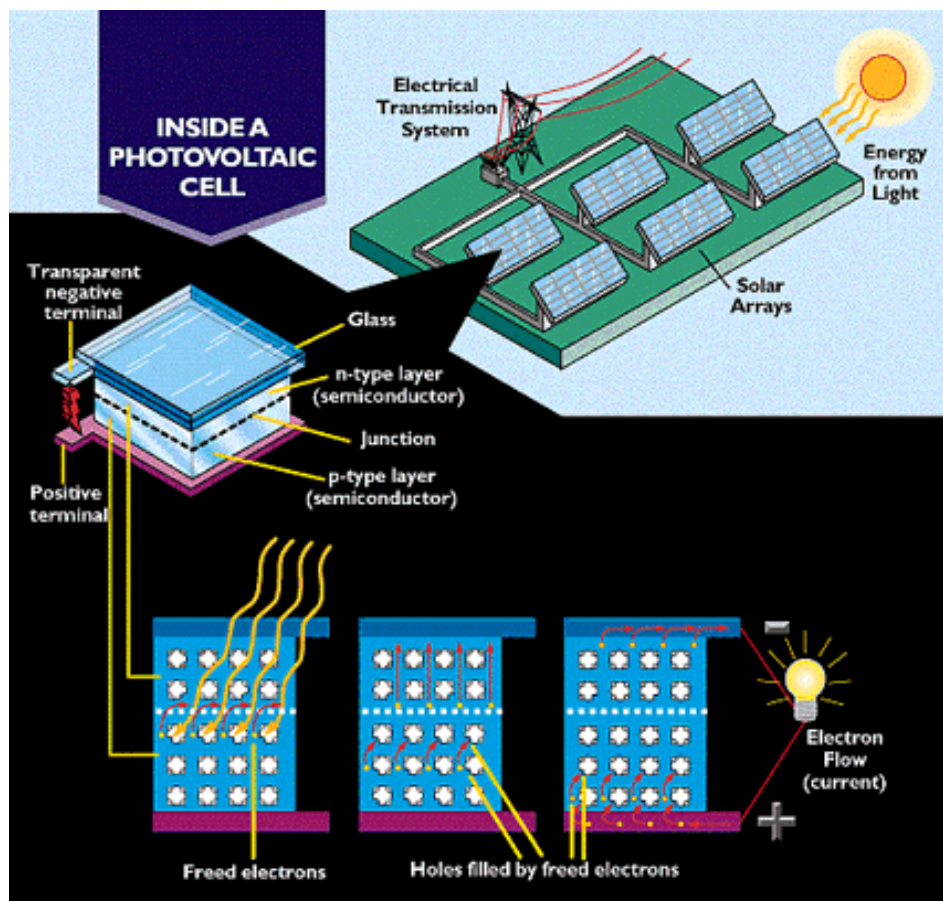
# DIRECT PRODUCTION OF ELECTRICITY FROM SOLAR ENERGY

## (PHOTOVOLTAIC SYSTEMS)



The direct transformation of solar energy in electric is realised with photovoltaic cells whom the operation is based on “photovoltaic phenomenon”.  
Photovoltaic cells are crystal-diodes constituted by semiconductors

# FUNCTION



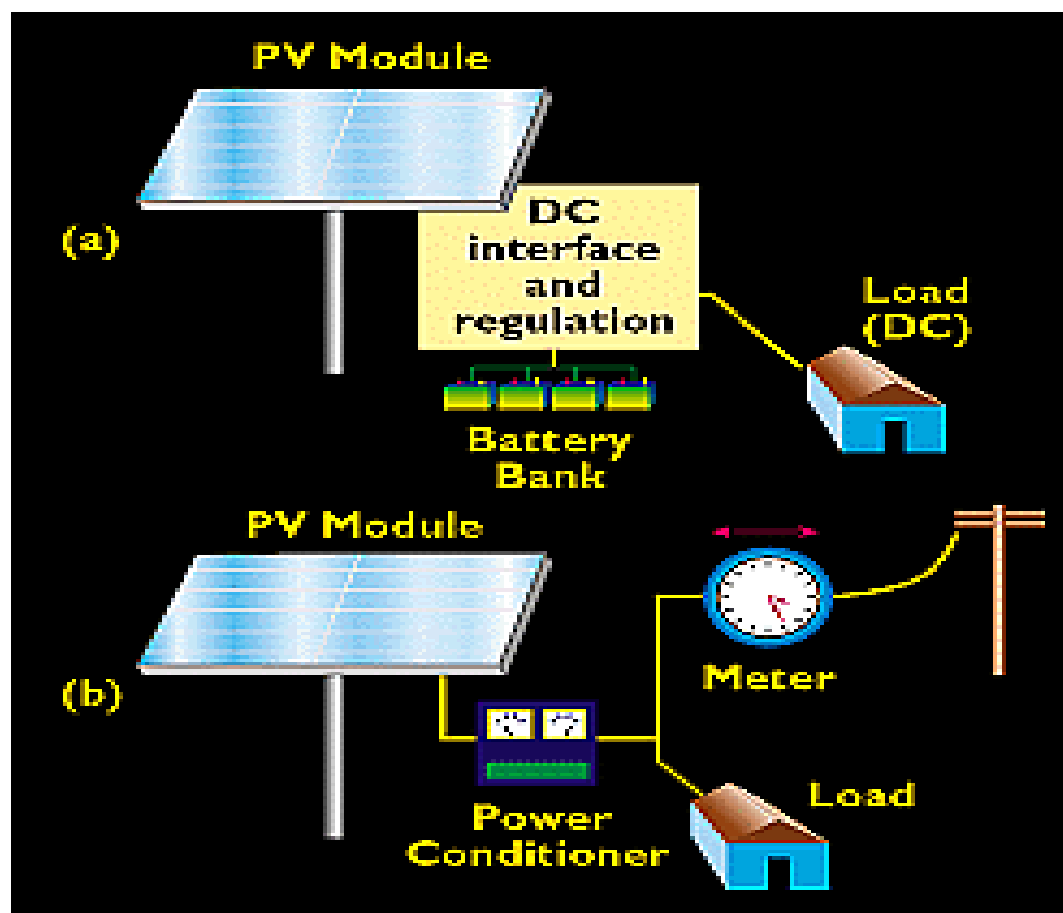


## PARTS OF A PHOTOVOLTAIC SYSTEM

A Photovoltaic System consists of 3 sub-systems:

- the photovoltaic elements (light - DC)
- the demand of electric energy (Load)
- the control system (Balance Of System, BOS)

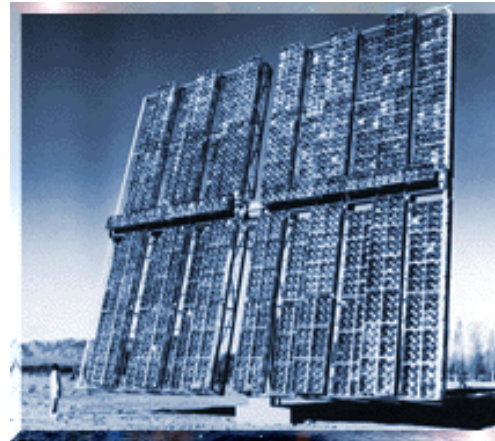
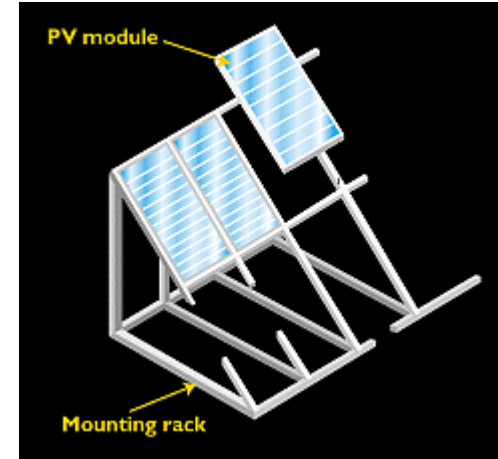
## SIMPLE ARRANGEMENT OF PV





## STORAGE BATTARIES

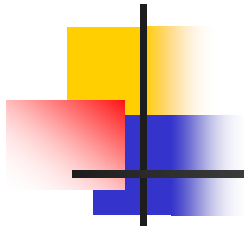
## SUPPORT SYSTEM



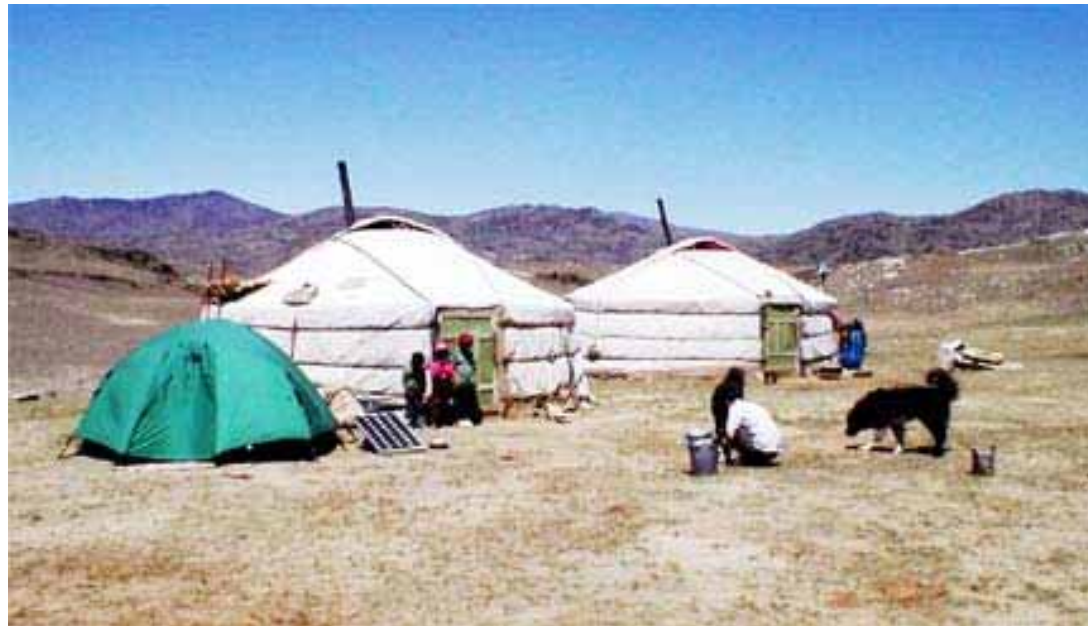


## USE OF PV ON ELECTRIC CARS





It goes everywhere





## ROAD LIGHTING





## FLAT SYSTEMS

1. Surface of collection of solar rays equal with the surface of absorption
2. Operation in low temperatures (<math><150^{\circ}\text{C}</math>)
3. Big percentage of losses, low thermic performance
4. Exploitation of direct and diffuse radiation
5. No particular requirements for the resistance and quality of materials
6. Simplified technology and manufacture
7. Lack of moving parts to follow the sun.
8. Low cost of manufacture
9. Small cost of maintenance
10. Small sensibility in meteorological circumstances



## COLLECTIVE SYSTEMS

1. Surface of ray collection much bigger than the surface of absorption (concentration of rays)
2. Operation in higher temperatures ( $>200^{\circ}\text{C}$ )
3. Smaller losses, higher thermic performance
4. Exploitation of only direct radiation
5. Materials durable in high temperatures are required
6. High technology and complicated manufacture
7. Complicated and precise mechanisms are required in order the system watches the sun and his movement
8. High cost of manufacture
9. Big cost of maintenance
10. Sensibility of big installations in winds, hail, etc.