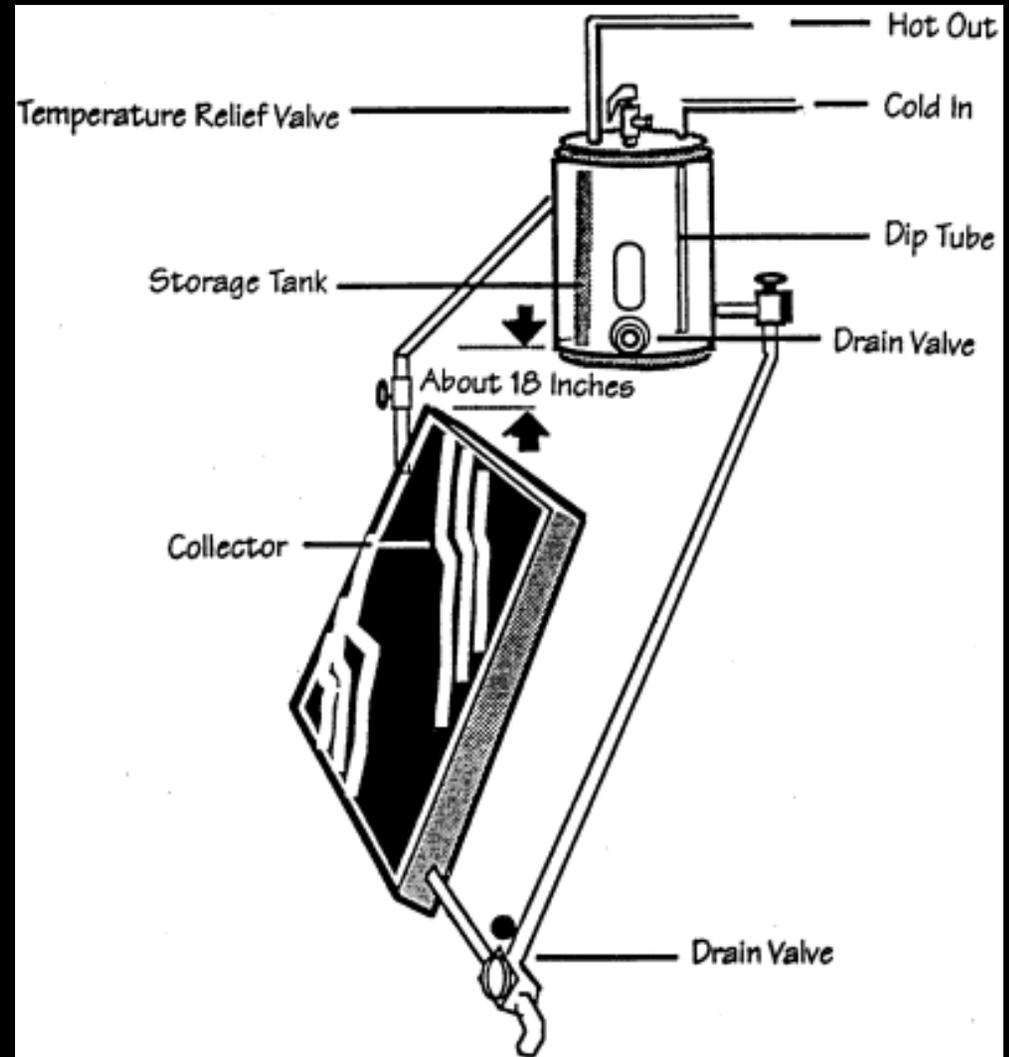


# Solar Thermal

# Solar hot water:

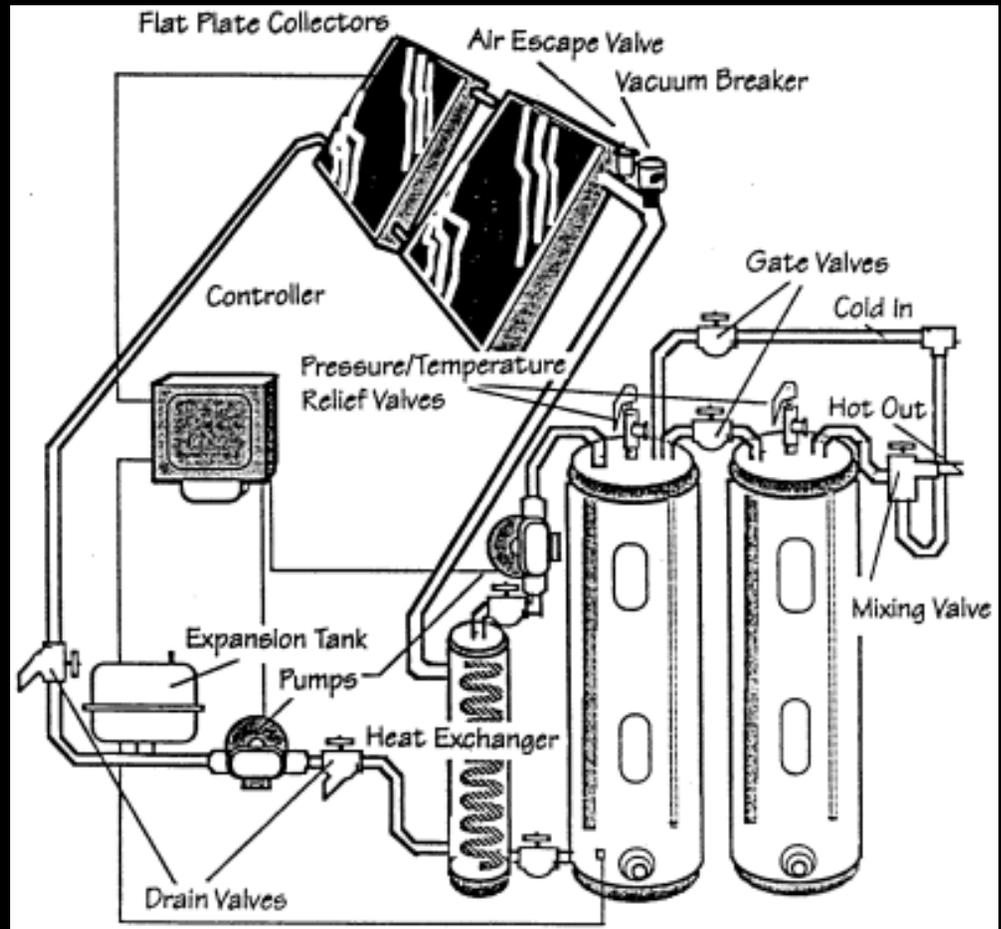
Solar hot water systems use the sun's energy to heat water for a variety of residential and business uses.

Sunlight passing through glass or plastic glazing strikes a light absorbing material. The material converts the sunlight into heat, which is prevented from escaping by the glazing.

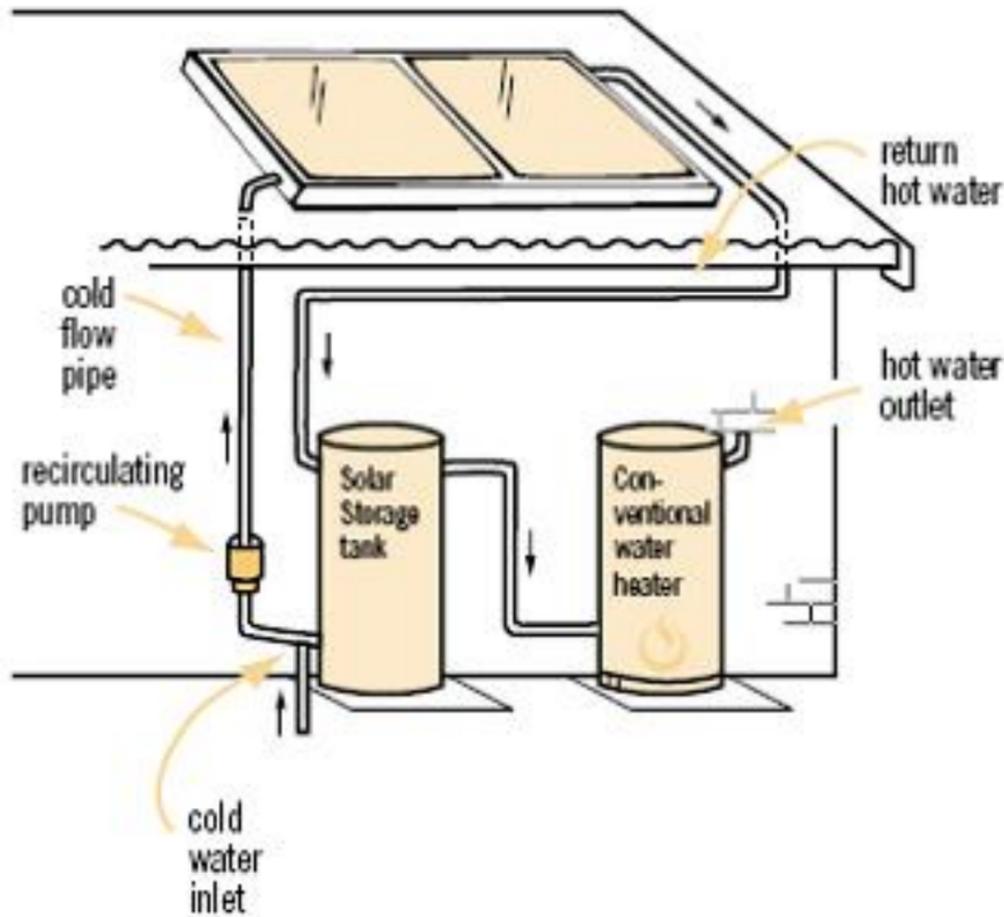


# Solar hot water systems:

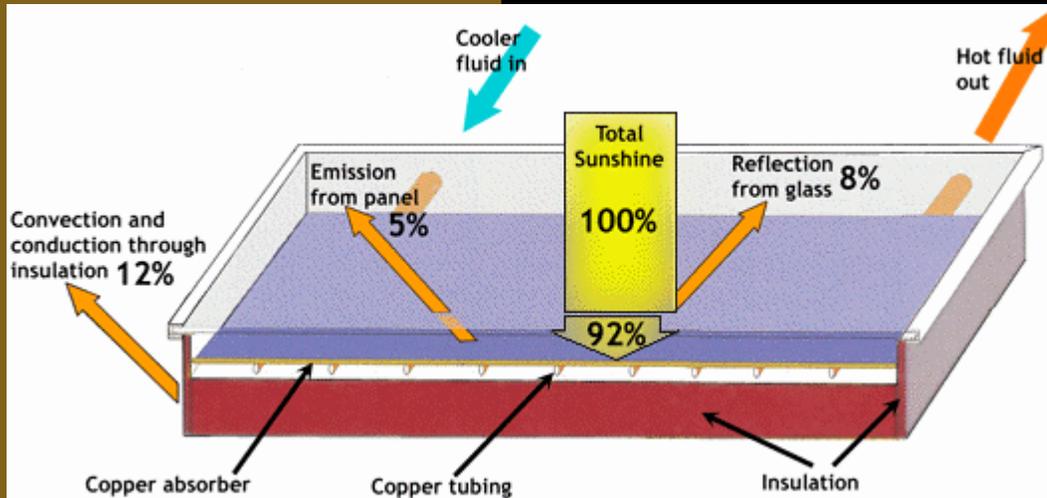
The most common types of solar collectors used in solar water heating are flat plate and evacuated tube collectors. A flat plate collector consists of a shallow rectangular box with a transparent glass or plastic window covering a flat black plate. The black plate is attached to a series of tubes through which water or some other transfer fluid passes. An evacuated tube collector consists of several individual glass tubes, each containing a black metal pipe. The transfer fluid flows through these pipes. The space between the pipe and the glass tube is evacuated, in other words, the air is removed.







# Flat plate collectors:

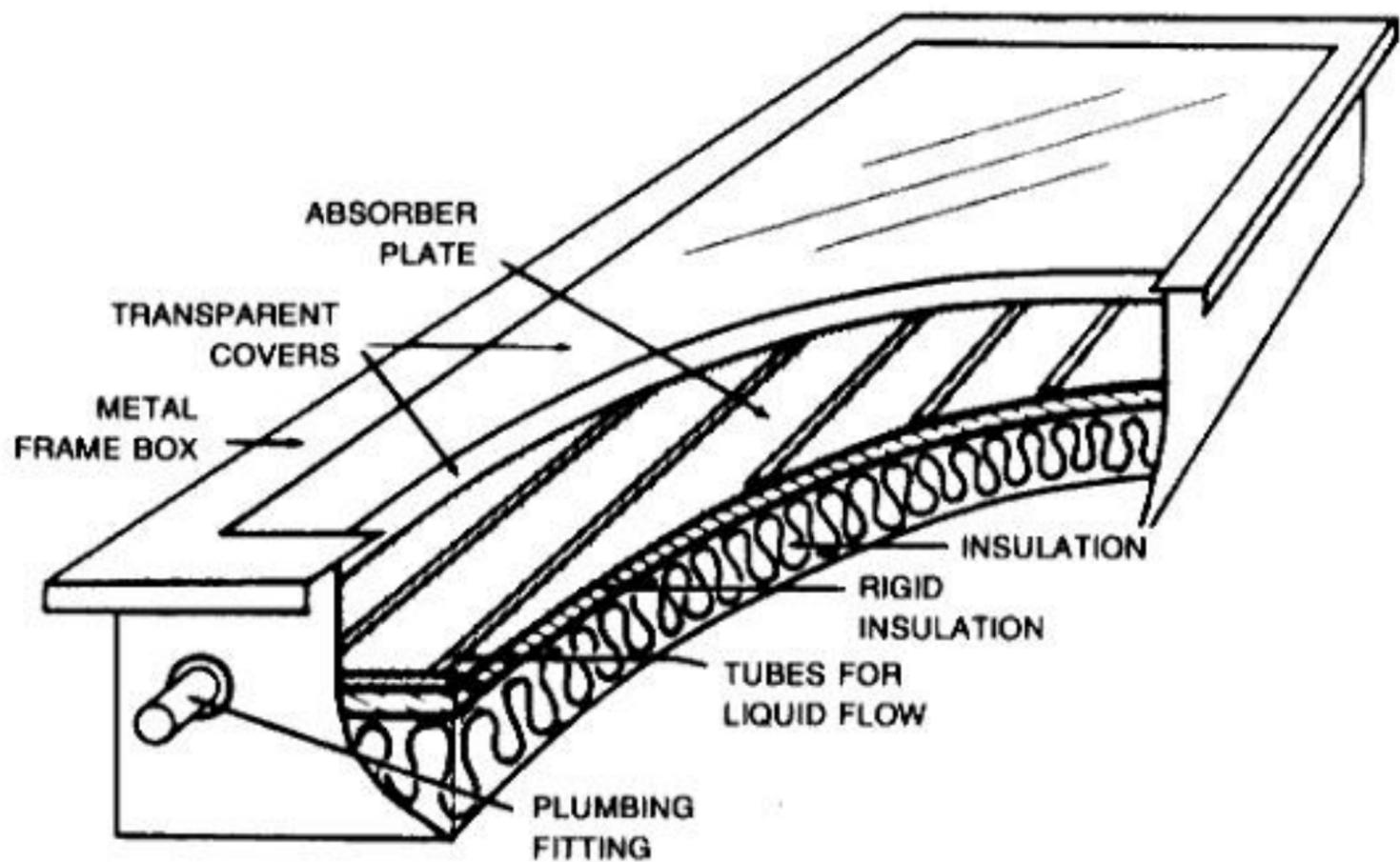


Allow one square metre of collector for every 45-50 litres of hot water to be stored.



## Typical daily hot water usage

<i>Appliance</i>	<i>Volume (litres)</i>
standard sized bath	60
shower	15-60
washing machine	50
kitchen sink	15
bathroom washbasin	5









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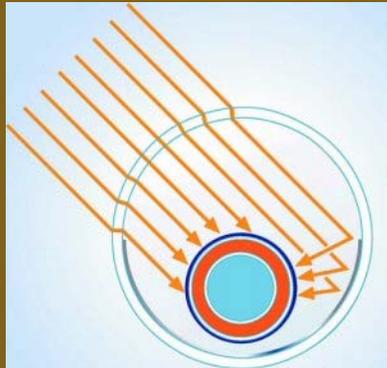
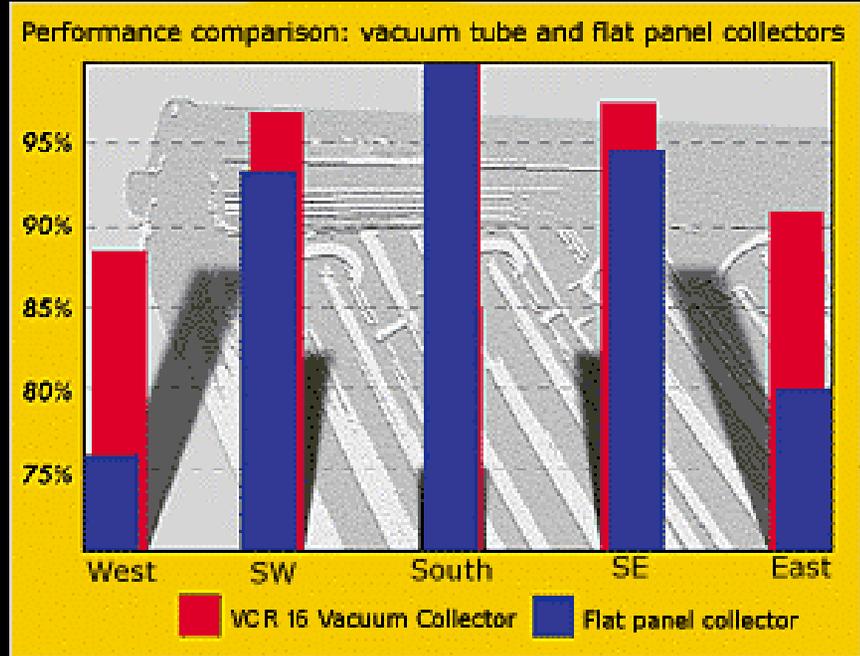




## Vacuum tube collectors:



The vacuum tube collector uses a series of glass tubes that act like thermos bottles. The glass allows the light through, which heats up the fluid inside the inner tube. The vacuum between the layers of glass prevents that heat from escaping back to the atmosphere on cold days.



On warm, sunny days, the performance of the vacuum collector is equal to that of the flat collector. But it will increasingly outperform the flat collector as the outside temperature decreases or light levels are reduced.







pv

# Solar power systems:

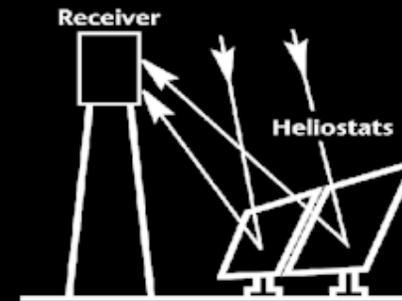
Solar power systems use concentrated solar radiation as a high temperature energy source to produce electrical power.

These clean energy technologies are appropriate for regions where direct solar radiation is high. The first commercial plants have been in operation in California, U.S. since the mid-1980s, providing the 354 megawatts of the world's lowest-cost solar power.

The many types of systems under development (including parabolic troughs, power towers, and dish/engine systems) for different markets vary according to the concentration devices, energy conversion methods, storage options and other design variables.



# Utility-scale power towers



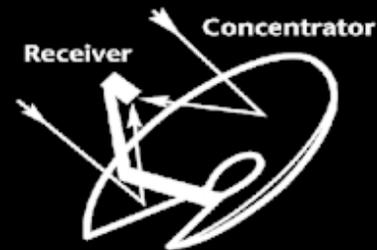
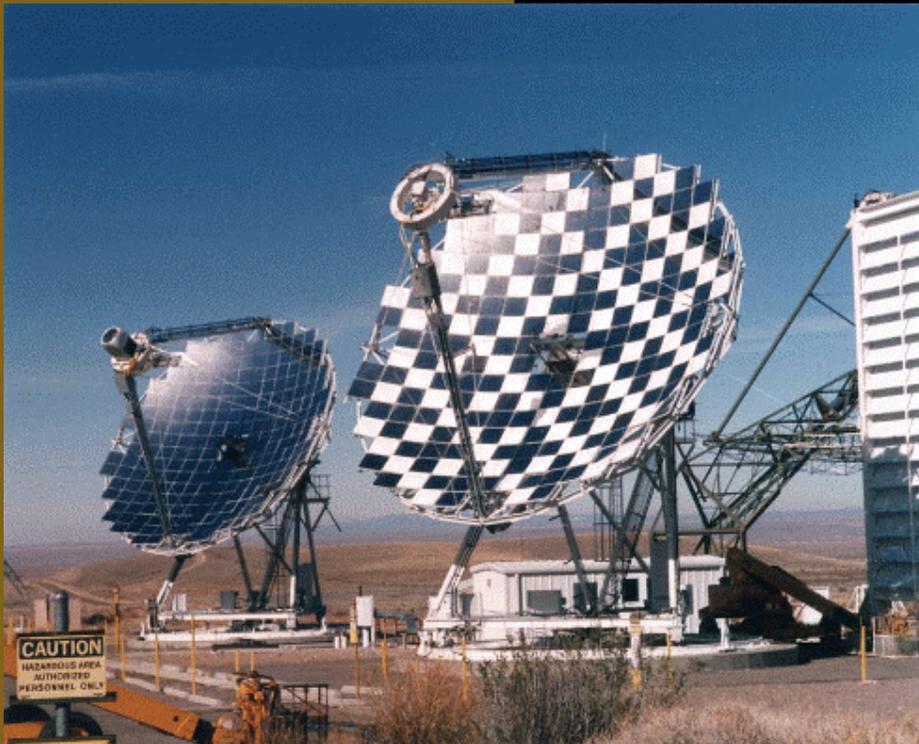
## Utility-Scale Solar Power Towers

Sun•Lab provides technical oversight to Solar Two, which is validating molten-salt power tower technology for utility applications. This technology offers

- cost-effective storage and dispatchability for peaking operation
- scalable power—up to 200 megawatts
- potentially the lowest cost solar electricity

Power towers

# Dish systems:



## Dish/Stirling Systems

Sun•Lab engineers are working with industry to bring these promising solar electric systems to commercial readiness. These systems

- have demonstrated solar-to-electric efficiencies up to 29%
- offer modular technology for demands from 25 kilowatts to 10s of megawatts of electricity
- can be hybridized with fossil fuel systems to provide power when the sun is not shining

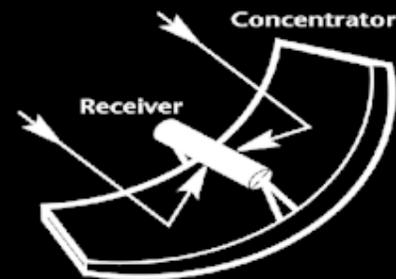
dishes



To optimize efficiency, these panels rotate to track the sun, directing the solar power to a tower that converts the light to electricity via a chemical conversion process.

Flat tracking panels

# Parabolic trough systems:



## Parabolic Trough Systems

The Department of Energy's Solar Thermal Program helped develop solar thermal trough technology, which currently has demonstrated 80 plant-years of operation. These systems offer

- practical, fielded operating experience
- 18% peak, 11% annual efficiency
- reasonable operating costs
- easy hybridization

Parabolic troughs



Solar trough



