Solar Thermal Energy:

Rate of Loss of Heat Energy depends on

(1) Temp difference between two sides

(2) The total area available for flow

(3) The insulating qualities of the material

Solar Thermal Energy:

Reduction of Heat loss

(1) against Conduction: needs insulators

(2) against Convection: double glazing with less mobile gas such as argon, krypton, carbon dioxide (or vacuum?)
  * triple / quadruple glazing

(3) against Radiation: Low-E-coating against normal 90% E

Solar Thermal Energy: Domestic water heating

-가정용 온수 Temp > 60℃, 45℃(x)

– 태양열이용한 온수에너지 CO_2 절감
(1) 0.19kg/ kWh (UK)
(2) 1 kg / kWh (Greece)

Solar Thermal Energy: Active solar heating

- Patent of thermosyphon solar in 1909
- 4000 systems sold by 1920
- solar collectors 57 million m^2 (world) by 2001, 11 million m^2 in USA

Solar Thermal Energy: Wales in 1975
450 mm of wall insulation with small quadruple-glazed windows

Solar Thermal Energy: 2.5% extra cost for construction

Solar Thermal Energy: half gas used

Solar Thermal Energy: saved 800 kWh/year
15% due to thermal buffering of the house
55% due to preheating the ventilation air to the house
30% from normal solar gains

Solar Thermal Energy: Overshading?

Solar Thermal Energy: Solar thermal engine

(1) Archimedes (212BC) with polished bronze shields against Roman ships

(2) Greek navy: 60 men with 1m x 1.5m at 50m in 1973
* Concentration ratio: 60 (vs >1000 in parabolic collector)
** 50 adequate for line focus parabolic trough collector

(3) 200-400 ℃ from line focus parabolic trough collector,
Temp >1500 ℃ from dish system

•Electric range burns wood (1500 W / 30cm^2),

If, solar insolation = 1000 W/m^2,
then solar energy from 1.5m^2 concentrated on 30cm^2 wood is enough to make fire.
In practice, we might need 3m^2 collectors (why?)

Solar Thermal Energy: New solar age

3800℃ at focus of 50cm^2 by eight-story-high parabolic mirror in 1969, for testing of components of space rockets, guided missiles, nuclear reactors

Solar Thermal Energy: Power tower
-With tracking mirrors
-Synthetic oil, molten salt over 500℃
-700℃ near Seville, Spain (www.solarpaces.org)

Solar Thermal Energy: Solar Electricity Generating System (80MW with 464000 m^2 collector area, synthetic oil to 390℃, 18% efficiency over the day)

Solar Thermal Energy: Solar chimney (50kW, 195m high, 240 m in diameter for collector)