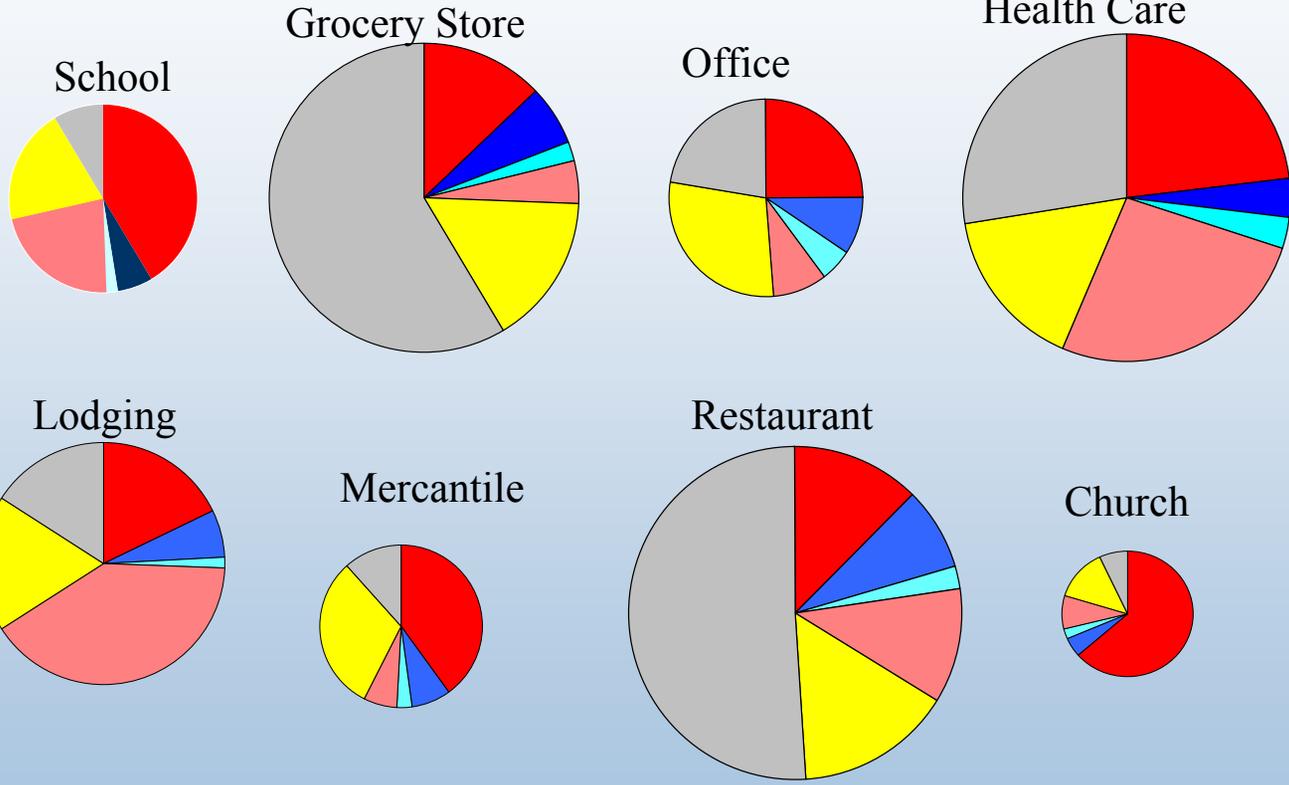


Solar Thermal Technology & Applications

Building Hot Water Energy Use average 125 kBtu/sf/year



Energy for Water Heating	
	kBtu/sf/year
Office	8.7
Mercantile	5.1
Education	17.4
Health Care	63.0
Lodging	51.4
Pub Assembly	17.5
Food Service	27.5
Warehouse	2.0
Food sales	9.1
Public Safety	23.4
Other	15.3
All Buildings	13.8

■ Heating
 ■ Cooling
 ■ Ventilation
 ■ Hot Water
 ■ Lights
 ■ Equipment

Solar Water Heating Is Not New!

- Before the advent of gas pipelines and electric utilities, the technology gained footholds in Florida and California before the 1920's
- Over 1,000,000 systems are in use in American homes and business
- The technology is in widespread use in:
 - Caribbean basin
 - Israel
 - Japan
 - China
 - Greece
 - Australia



Technical And Economic Viability Of A Solar System Depends Upon:

- Amount of annual sunshine
- Capital cost of the solar system
- Prices of conventional fuels
- Solar system annual O&M cost
- Annual energy requirement and energy use profile
- Temperature and amount of hot water (kWh produced)
- Rate at which conventional fuels are escalating in price
- Other (e.g. legislative mandates, tax credits)

Solar Hot Water is Worth Investigating When:

1. Hot water is used in large amounts, daily (absolutely or in terms of gallons per person per day) -- 365 days per year
2. Hot water is produced using electricity and it costs at least \$0.055/kwh, or hot water is produced using gas or oil costing at least \$8.00/million BTU
3. Tax credits or rebates are available
4. The building is properly oriented with respect to the sun
5. Space is available (on the roof?) for the solar panels
6. There is no need to worry about aesthetics
7. Good-to-excellent solar resource

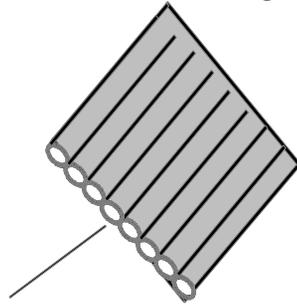
Solar Thermal Applications

- **Low Temperature (> 30C)**
 - Swimming pool heating
 - Ventilation air preheating
- **Medium Temperature (30C – 100C)**
 - Domestic water and space heating
 - Commercial cafeterias, laundries, hotels
 - Industrial process heating
- **High Temperature (> 100C)**
 - Industrial process heating
 - Electricity generation
- **Solar thermal and photovoltaics working together**

Collector Types

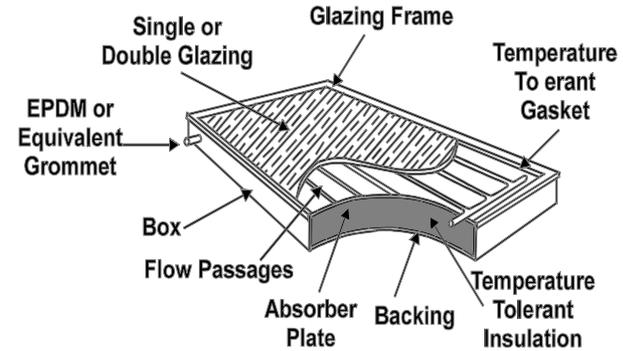
Unglazed EPDM Collector

Extruded "Mat" with Flow Passages

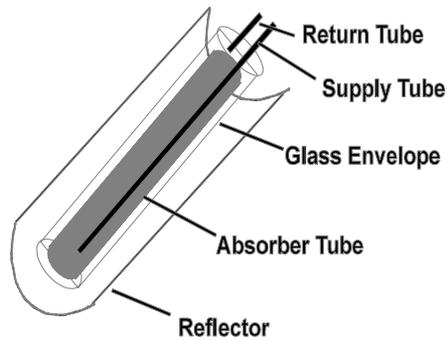


Flow from Manifold Through Passages

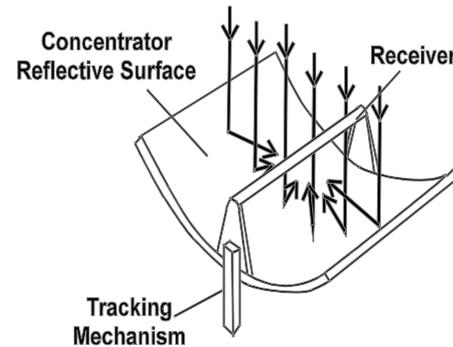
Flat Plate



Evacuated Tubes



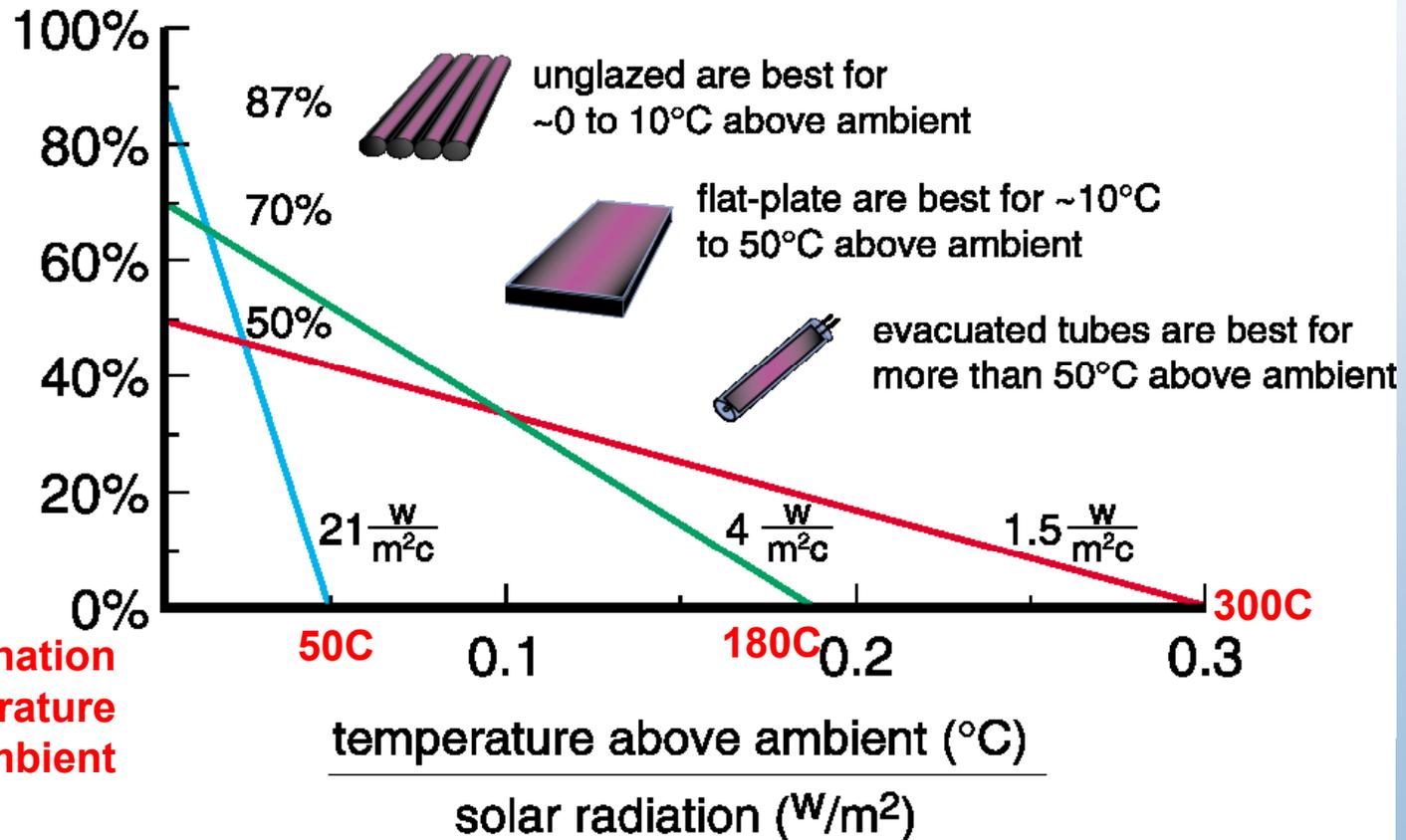
Parabolic Trough



Which collector is best depends on the temperature...

Efficiency=

% of solar captured
by collector



Solar Rating and Certification Corp.



Contact information

Solar Rating and Certification
Corporation

c/o FSEC, 1679 Clearlake Road
Cocoa, FL 32922-5703

Voice (321)638-1537

Fax (321)638-1010

E-mail: srcc@fsec.ucf.edu

- An independent nonprofit organization that tests performance and certifies almost every solar heater on the market today.
- Reports efficiency and annual performance for different climates and temperature uses.

Typical Low Temperature Application



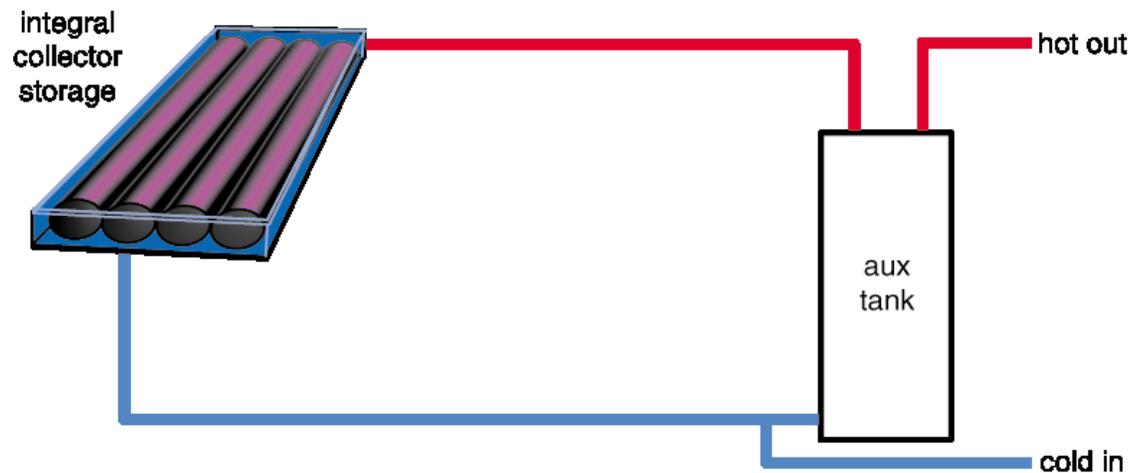
Low Temperature Example:

Barnes Field House, Fort Huachuca, AZ



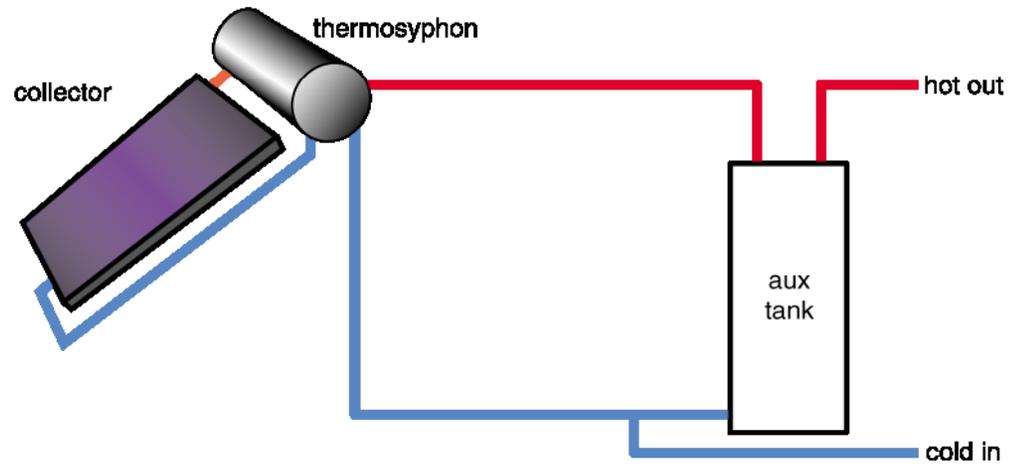
- 2,000 square feet of unglazed collectors
- 3,500 square feet indoor pool
- Installed cost of \$35,000
- Meets 49% of pool heating load
- Saves 835 million Btu/year of natural gas
- Annual savings of \$5,400
- Installed by the Army in June, 1980.

Passive, Integral Collector Storage (ICS) Direct System



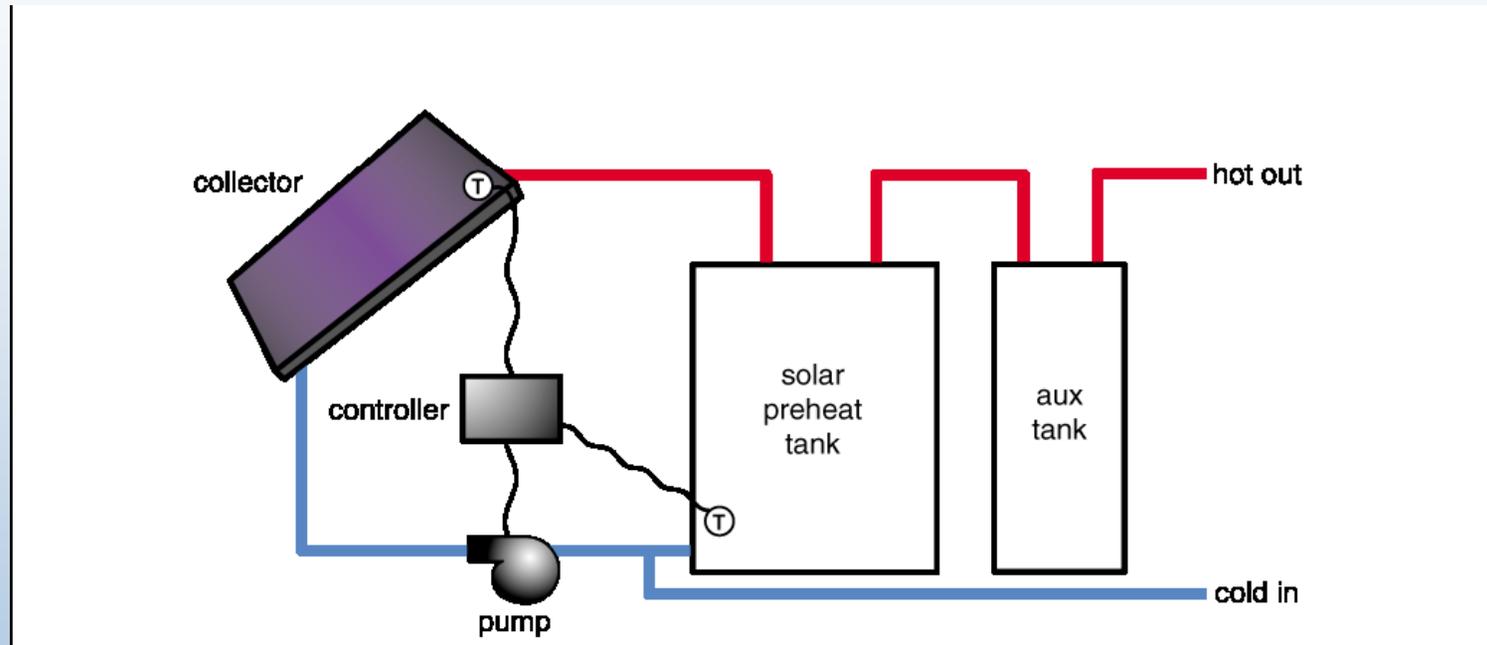
- Moderate freeze protection (pipes at risk)
- Minimal hard water tolerance
- Very low maintenance requirements

Passive, Thermosyphon, Direct System



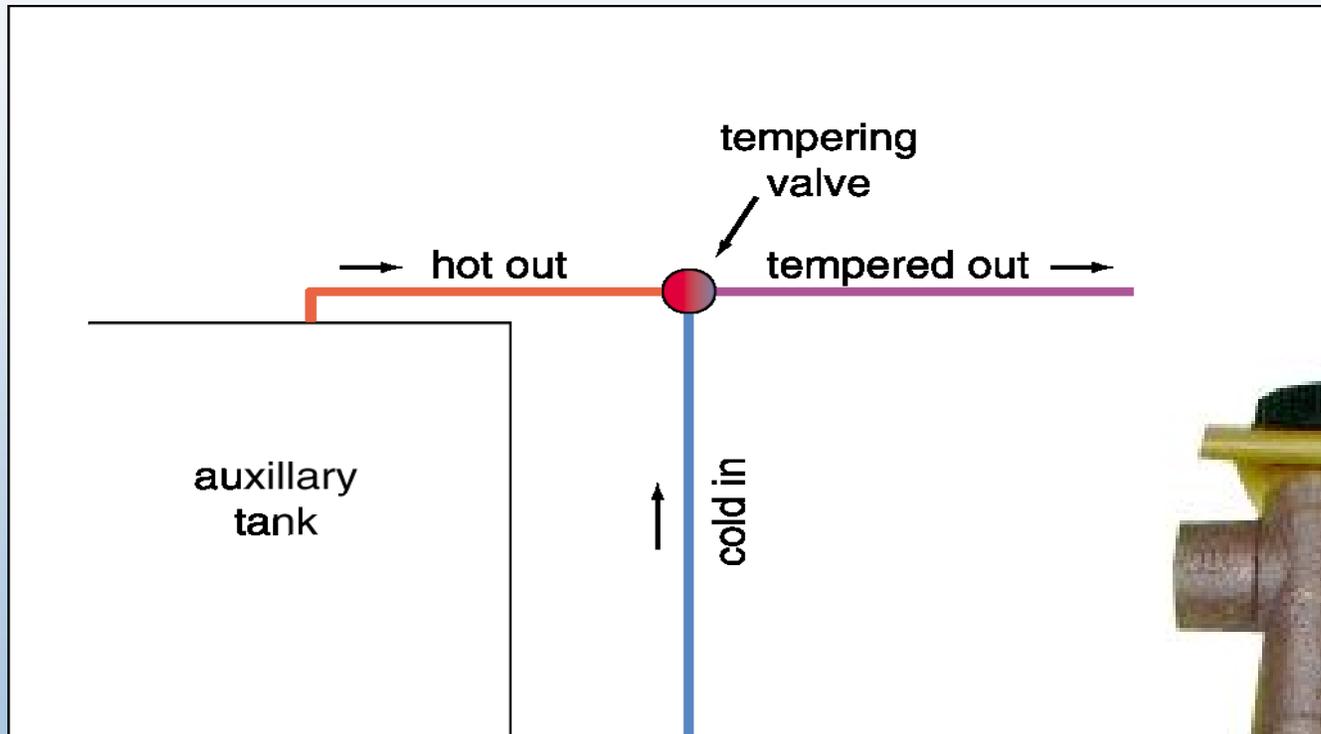
- Auxiliary element can also be in tank above collector, eliminating the auxiliary tank altogether.
- No freeze protection
- Minimal hard water tolerance
- Low maintenance requirements

Active, Open-loop, Pumped Direct System



- No freeze protection
- Minimal hard water tolerance
- High maintenance requirements

Tempering Valve to Prevent Scalding: Extremely Important for Safety!



Mid-Temperature Example:

Chickasaw National Recreation Area, OK



Small Comfort Stations

- 195 square feet of flat plate collectors
- 500 gallon storage volume
- Cost \$7,804
- Delivers 9,394 kWh/year
- Saves \$867 / year



Large Comfort Stations

- 484 square feet of flat plate collectors
- 1000 gallon storage volume
- Cost \$16,100
- Delivers 18,194 kWh/year
- Saves \$1,789 / year

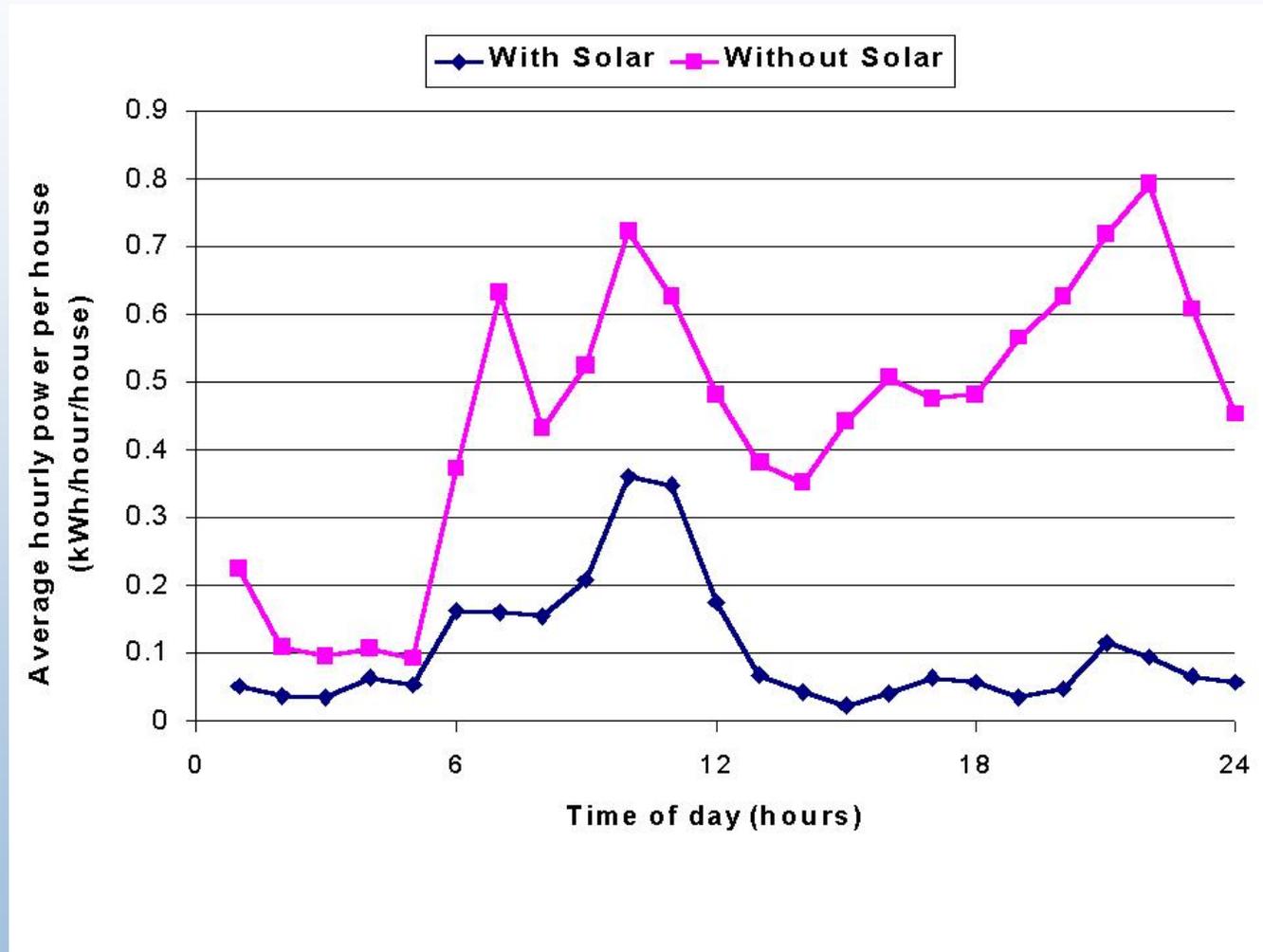
Mid Temperature Example:

USCG Kiai Kai Hale Housing Area, Honolulu HI



- 62 units installed 1998
- Active (pumped), Direct systems
- Average cost \$4,000 per system
- 80 sf per system
- \$800 per system HECO rebate
- Savings of 9,700 kWh/year and \$822/year per system
- Simple Payback 4 years (with rebate)

USCG Housing, Honolulu HI





Mazatlan, Mexico; El Cid Mega Resort

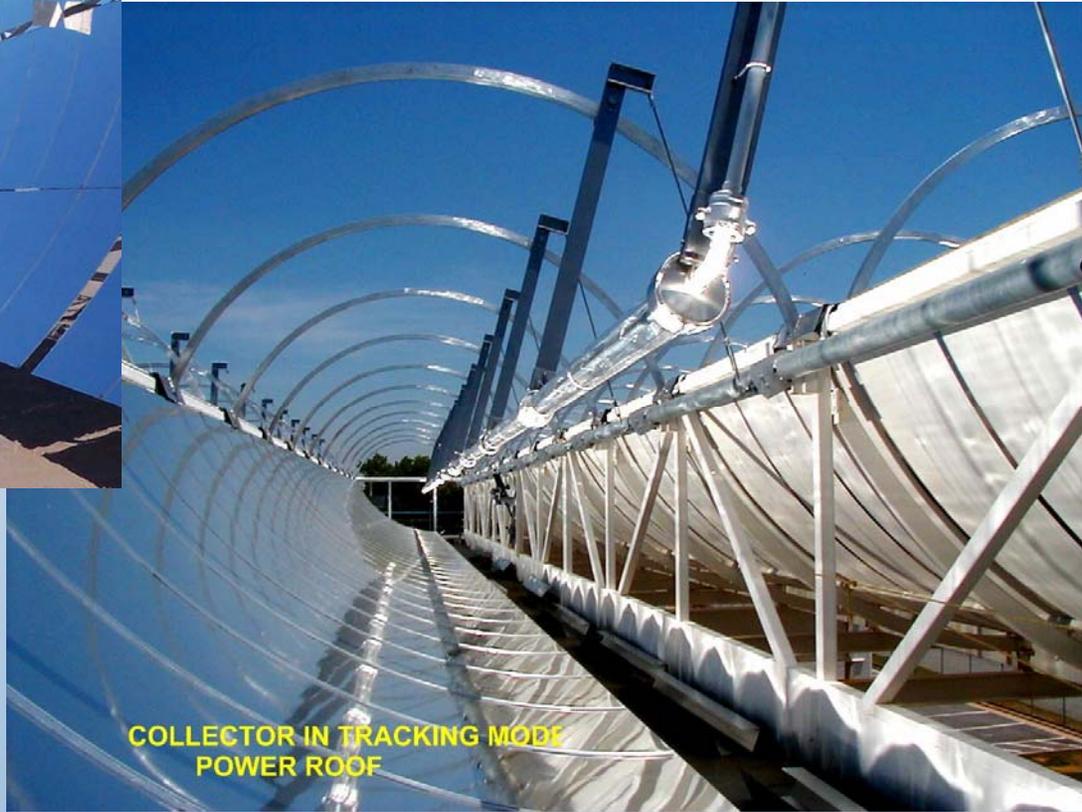


High Temperature Example:

Phoenix Federal Correctional Institution



- 17,040 square feet of parabolic trough collectors
- 23,000 gallon storage tank
- Installed cost of \$650,000
- Delivered 87.1% of the water heating load in 1999.
- Saved \$77,805 in 1999 Utility Costs.
- Financed, Installed (1998) and Operated under Energy Savings Performance Contract with Industrial Solar Technology, Inc.
- The prison pays IST for energy delivered by the solar system at a rate equal to 90% of the utility rate (10% guaranteed savings), over 20 years.



Promising Potential Candidates For Solar Water Heating Systems

1. Residential

- Single family homes
- Low-income or subsidized homes and housing developments
- Apartment buildings with central boilers

2. Commercial

- Casinos, Hotels and motels
- Health care facilities
- Restaurants
- Spas, pools and health clubs

3. Government

- Single family housing units
- Food service facilities
- Correctional facilities
- Hospitals and clinics
- Dormitories
- Recreational facilities/swimming pools

Procuring Solar Water Heating Systems

- Look for the best opportunities within your Tribe:
 - Large water heating loads.
 - High cost of backup energy.
 - Constant loads throughout week and year.
 - Area for collectors.
 - Facility “champions.”

Requirements for Success

- Appropriate Application (Provide a Reasonable Payback)
- Proven Design
- Freeze Protection
- Properly Sized (undersized, not oversized)
- Require No Manual Intervention
- Operational Indicators or Monitoring
- Conservation First
- Verify Load
- Performance Guarantee
- Require Operations and Maintenance Manual and Training
- Acceptance Test

A Tribal Energy Service Organization (TESO) could:

- Establish a basis for local economic development
- Save homeowners, renters, and housing departments money
- Help reestablish pride of ownership (personal sovereignty) through energy independence
- Aggregate community for lower-cost financing
- Provide steady employment that goes hand-in-hand with home efficiency and weatherization improvements.

Help in implementing your solar water heating project:

- Solar Energy Industries Association and local chapters.
- Experienced private-sector suppliers & installers.
- National Laboratories.
- State energy offices.

Resources and References

- **American Society of Heating, Air Conditioning and Refrigeration Engineers, Inc.**
 - ASHRAE 90003 -- Active Solar Heating Design Manual
 - ASHRAE 90336 -- Guidance for Preparing Active Solar Heating Systems Operation and Maintenance Manuals
 - ASHRAE 90346 -- Active Solar Heating Systems Installation Manual
- **Solar Rating and Certification Corporation**
 - SRCC-OG-300-91 -- Operating Guidelines and Minimum Standards for Certifying Solar Water Heating Systems