

Solar Thermal Energy – New Light on a Mature and Market Ready Technology

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Solar Systems – General Uses

- Solar Thermal
 - Pool Heating
 - Water Heating
 - Space Heating / Air Conditioning
 - Industrial Processes
- Photovoltaic
 - Grid Tie
 - Stand alone power / Back up power
- Lighting
 - Remote signs, Traffic signals, Billboards

Basic Solar System Overview

- **Active systems** use electric pumps, valves, and controllers to circulate water or other heat-transfer fluids through the collectors. They are usually more expensive than passive systems but generally more efficient. Active systems are usually easier to retrofit than passive systems because their storage tanks do not need to be installed above or close to the collectors. If installed using a PV panel to operate the pump, they can operate even during a power outage. Due to the greater complexity of the system, active systems may be more prone to breakdowns than passive systems.
- **Passive systems** come in two types, ICS (integral collector storage) or batch and Thermosyphon. The more common of the two is Thermosyphon. Neither require power to operate and are relatively maintenance free as compared to active types.

Active Systems

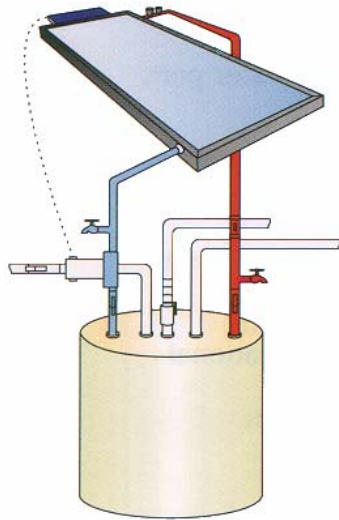
Closed-Loop Active Systems

These systems pump heat-transfer fluids (usually a glycol-water antifreeze mixture) through the collector. Heat exchangers transfer the heat from the fluid to the household water that is stored in tanks. Double-walled heat exchangers prevent contamination of household water. Some standards require double walls when the heat-transfer fluid is anything other than household water. Closed-loop glycol systems are popular in areas subject to extended subzero temperatures because they offer good freeze protection. However, glycol antifreeze systems are more expensive to purchase and install and the glycol must be checked each year and changed every 3 to 10 years, depending on glycol quality and system temperatures.

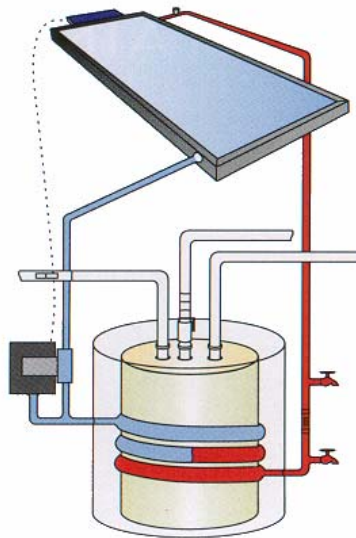
Open-Loop Active systems

Circulate potable water through the collector using pumps and controls. These systems are not suitable for areas with freezing weather or harsh water conditions.

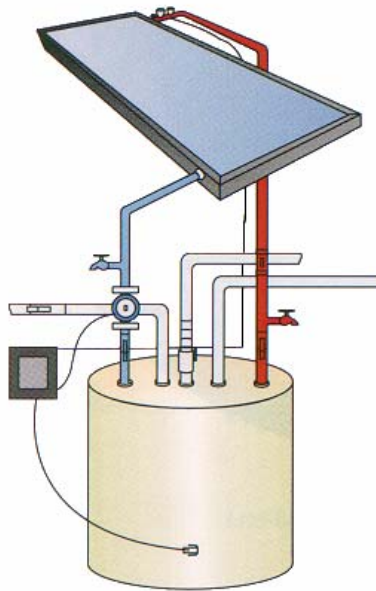
Active System Types



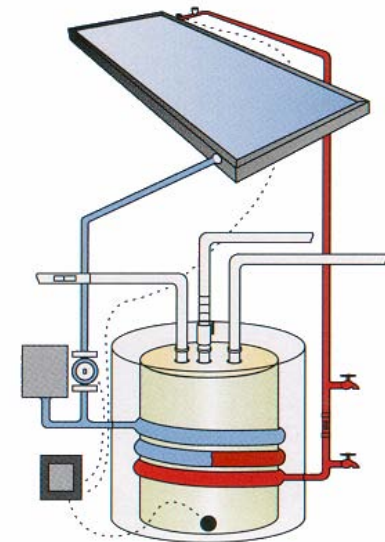
PV OPEN LOOP



PV CLOSED LOOP



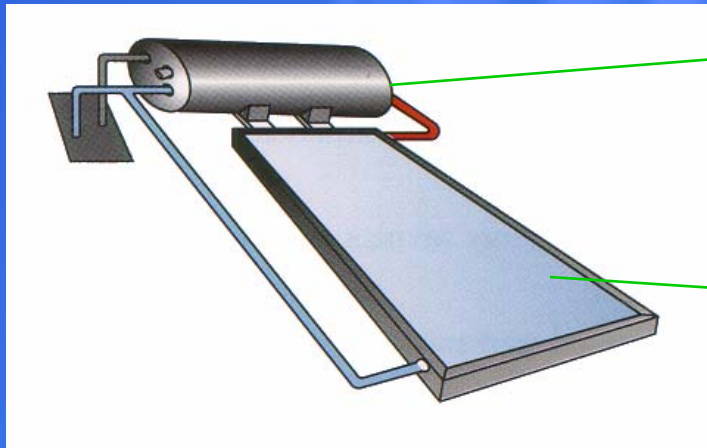
OPEN LOOP



CLOSED LOOP

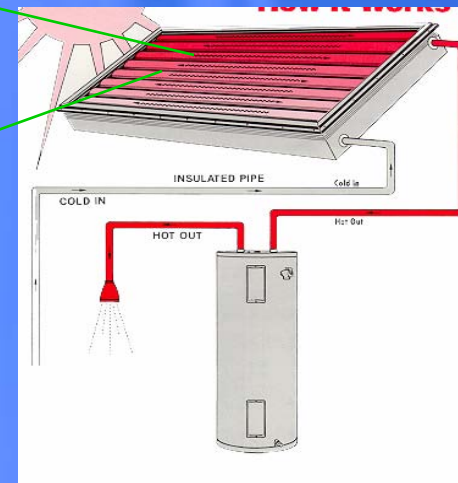
Passive System Types

A thermo-siphon system relies on warm water rising, a phenomenon known as natural convection, to circulate water through the collectors and to the tank. In this type the tank must be located above the collector. As water in the collector heats, it becomes lighter and naturally rises into the tank above. Cooler water in the bottom of the tank flows downwards into the collector establishing circulation. These systems are reliable and relatively inexpensive but require careful planning during installation because the water tanks are heavy. Freezing can be prevented by circulating an antifreeze solution through a heat exchanger in a closed loop.

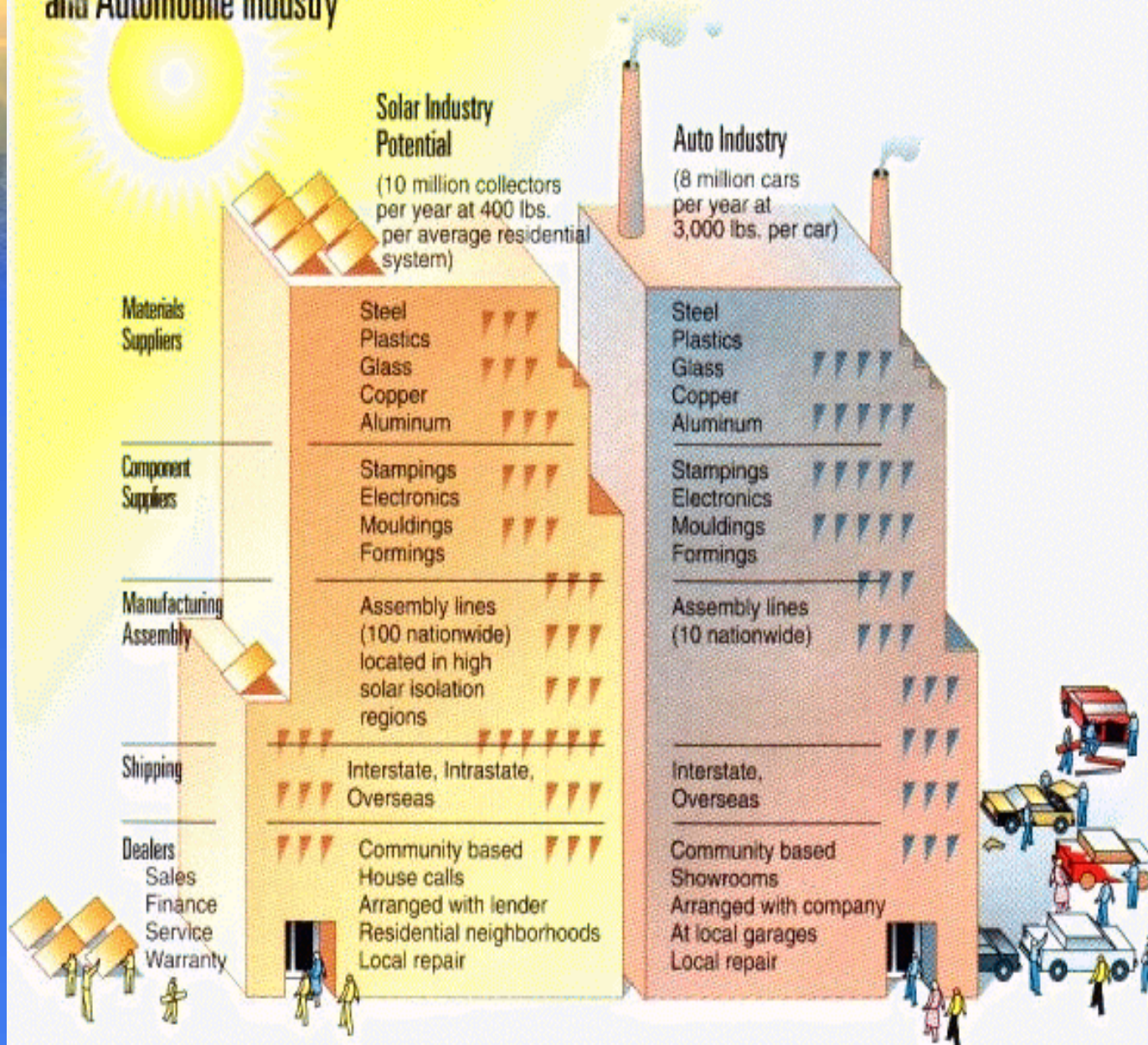


Storage Tank

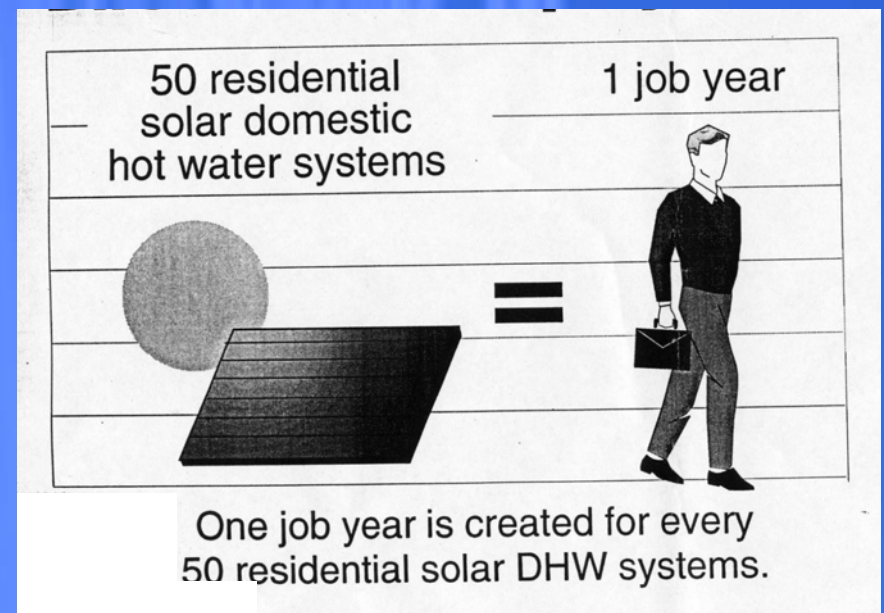
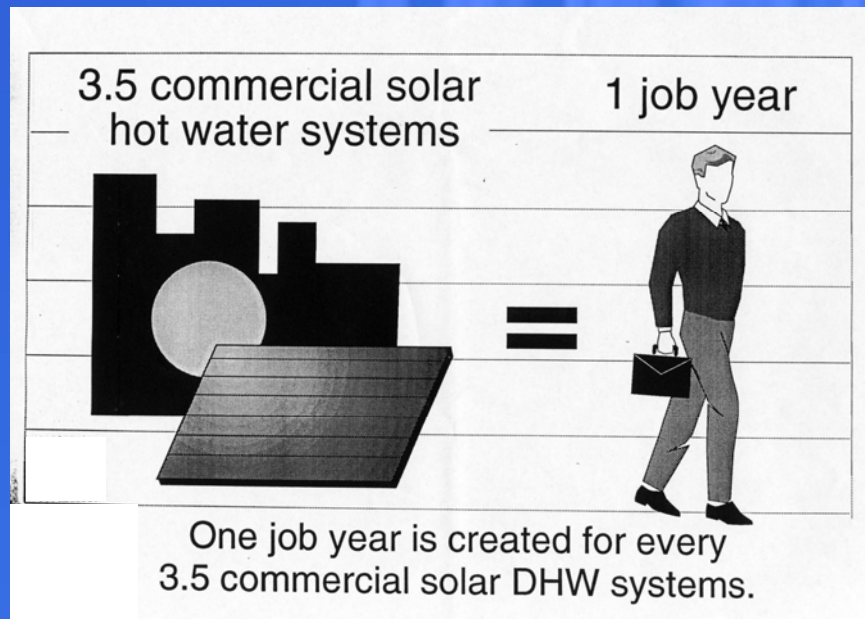
Collector



Employment Comparison Between Solar Industry and Automobile Industry



Job Creation



Employment Impacts: Direct, Indirect, and Induced

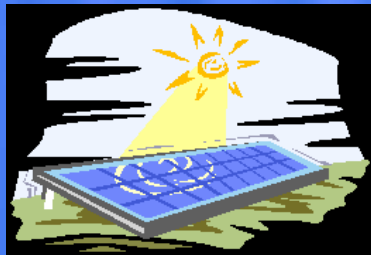


400 MW combined cycle electric
Power Plant

=



1,234 jobs



solar equivalent 200,000
residential systems

=



34,885 jobs

Job values are based on construction/installation, operation, and maintenance over
a 20 year useful life.

The Solar Industry 30+ years

(not the same industry as early and mid 80's)

- Technical Advances
 - High quality materials
 - Minimum maintenance
 - Packaged and engineered systems
- Industry regulation
 - Licensed contractors
 - Training requirements
- System performance testing
 - National and international testing facilities are well established. US and European standards and certifications exist for consumer protection and product durability.

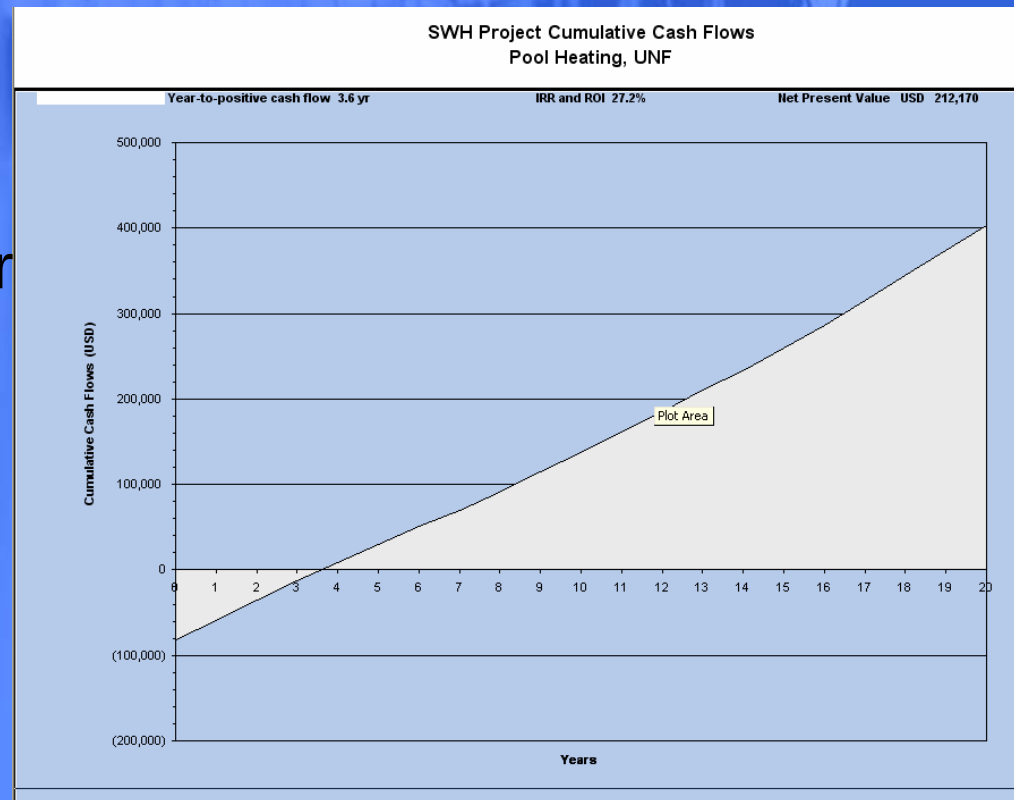
There are many commercial and residential uses of solar water heating



The rooftop solar collectors on this office building provide hot water. Solar water heating is one of the oldest and most reliable renewable energy technologies.

Solar Thermal

- Pool Heating
 - Generally Most Cost Effective Solar Application
 - Systems performance is well understood
 - Product life 20+ years

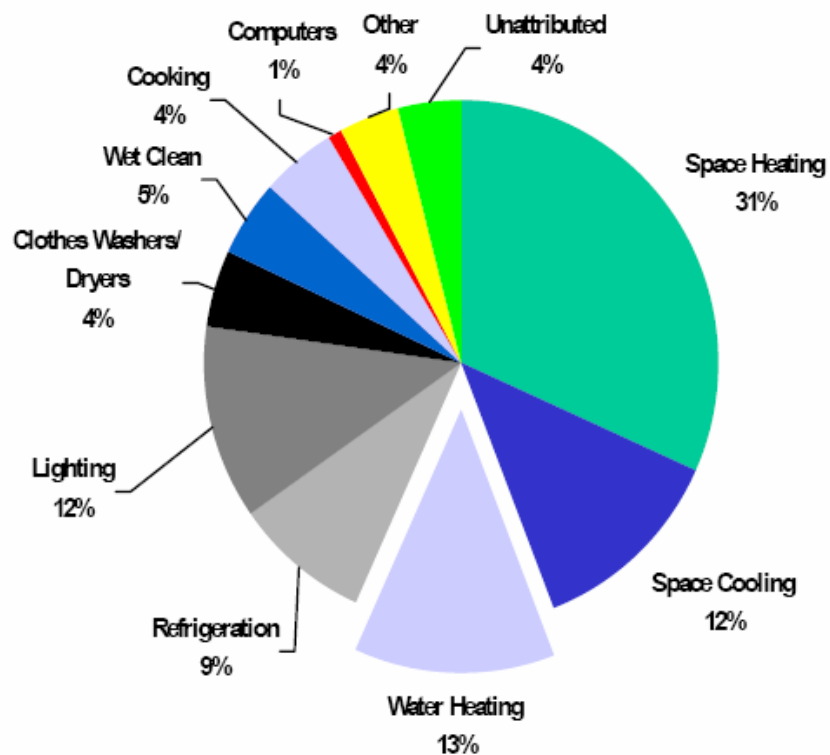


Swimming Pool Heating

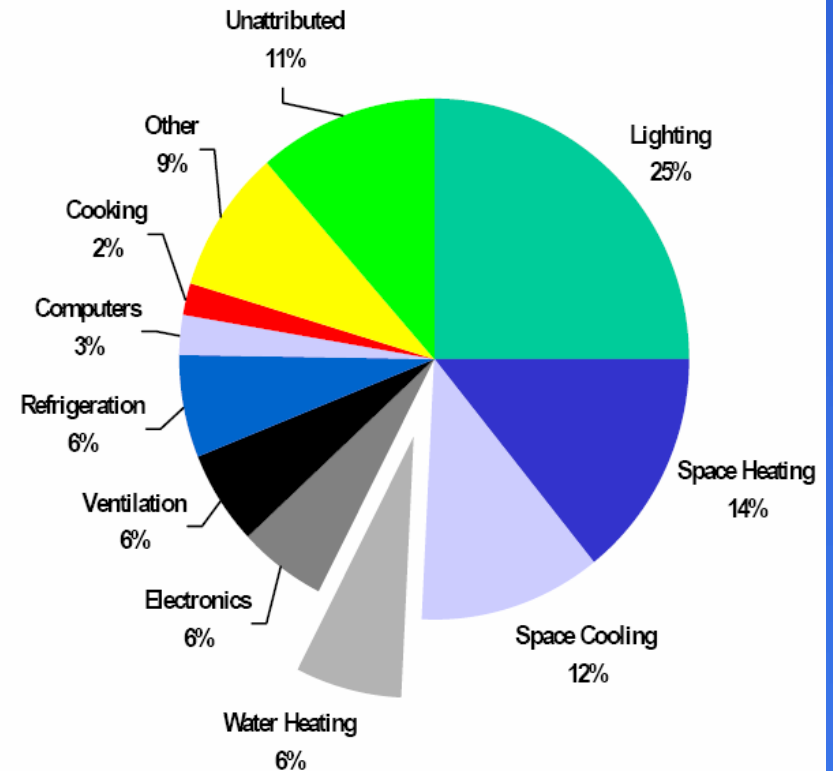
- Pool heating accounts for much of the new sales in the industry ~ 800 MW/year
- In most climates solar pool heating will double the swimming time
- Average residential pool system sells for \$2500 - \$4500
- Will pay for itself over gas heating in 2 to 3 years
- Commercial pool markets are developing rapidly as natural gas prices increase

Water Heating in Buildings

Residential Energy Use



Commercial Energy Use



Water Heating

- Systems designed to contribute to the heating requirement do not replace existing systems
- Offers a hedge to increased fuel prices
- Metered sale of hot water at fixed price cost for contract term

ABB Metering - Your preferred solutions provider

ABB is a world leader in metering solutions. Dating back to 1883, we have delivered more than 350 million electricity, water, energy and gas meters to customers in more than 150 countries. Our 4,000 researchers, engineers, programmers and customer service representatives in more than 100 countries are dedicated to providing competitive and innovative solutions at an excellent value. We do this by offering high-quality products and exceptional customer support.

ABB Metering products and services are designed to meet our customer's strategic objectives. Our products include electricity, water, energy and gas meters.

Energy Metering

In a world where such a large portion of energy consumption goes towards district heating and cooling, a reliable and economical method for energy measurement has become a requirement.

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Solar energy heats the water for this hospital in Tennessee



Lakeland Electric (Florida) is currently
billing for solar thermal energy.
Customer is billed at the same rate per
kWh as electricity.
Energy and TREC's are being sold.





Solar Water Heaters in Residential New Construction

A missed opportunity!

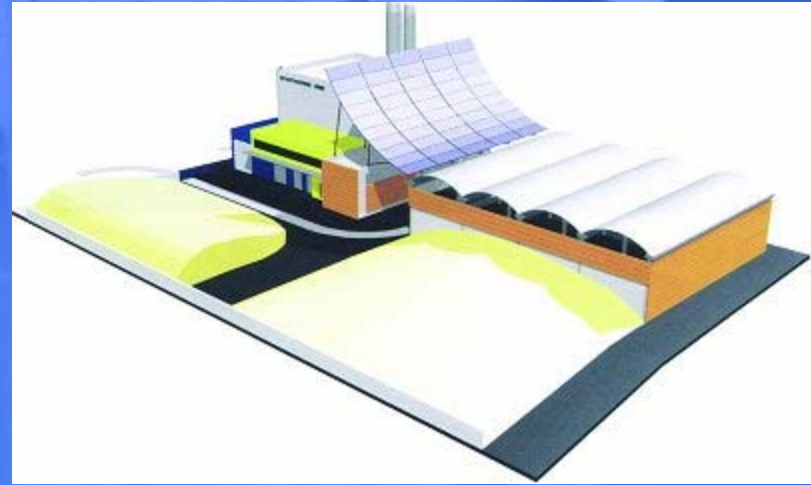
Market research indicated people WILL buy.... You just have to offer it to them.

Source: Report by National Home Builders Assoc.

Solar added to a 30 year Mortgage

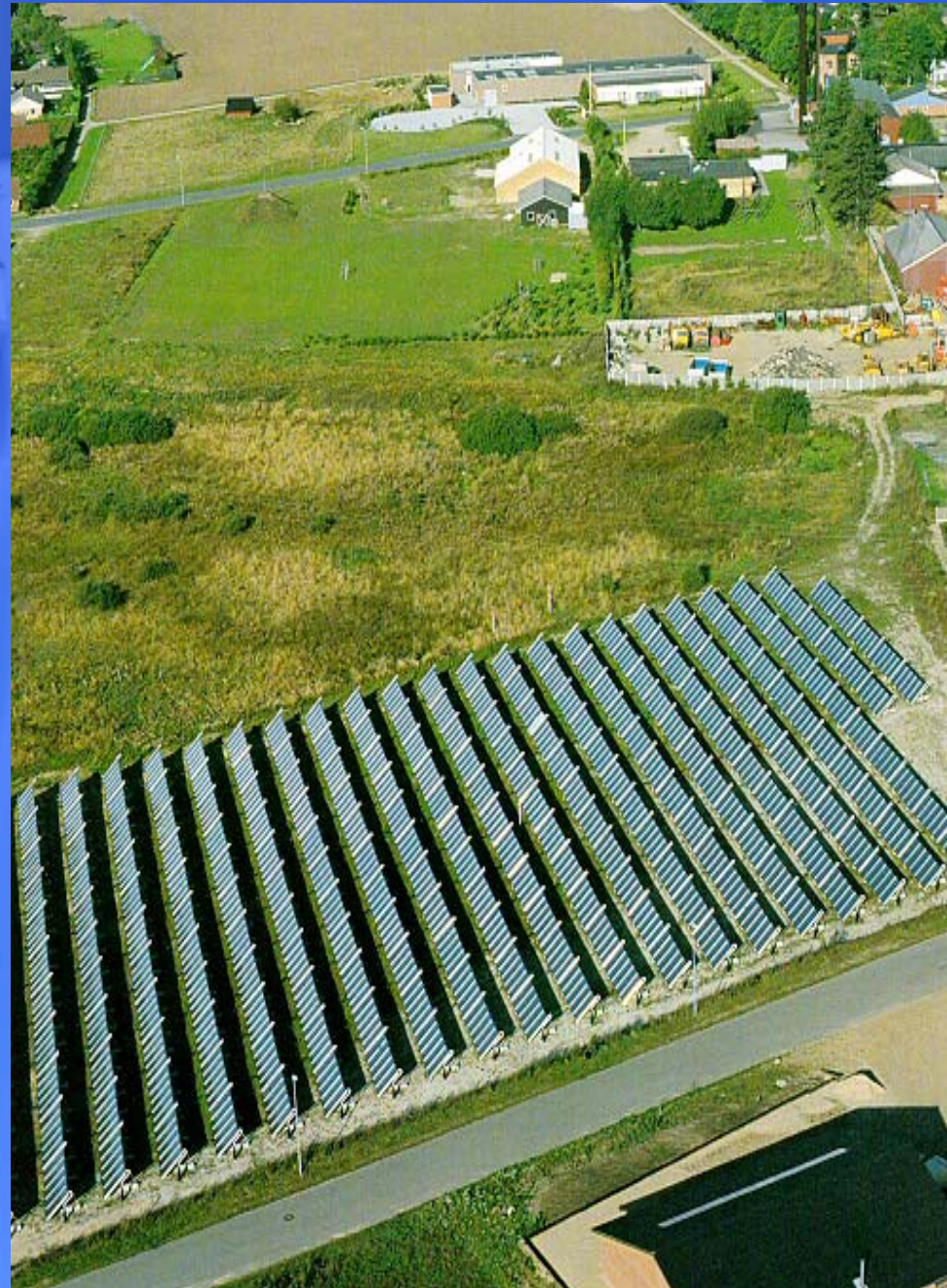
- The payments for a \$150,000 house with and without solar
- Without solar payments are \$1,100
- Add a \$3,500 solar system and the payments are \$1,126...a difference of \$26

Large Scale Solar Thermal



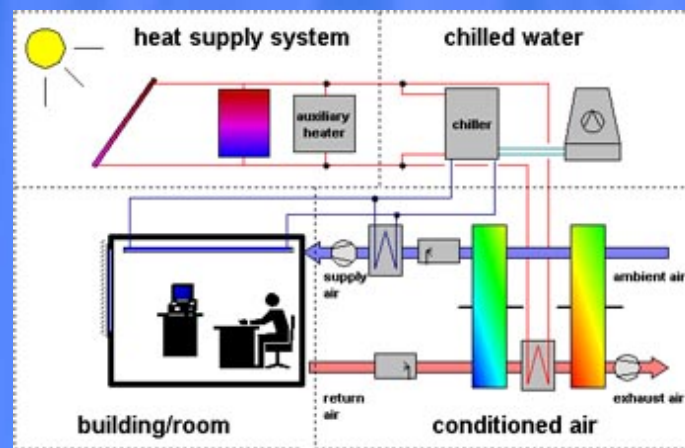
~ 4 000 MWh of generated solar heat annually
> 1 000 tons of CO₂ avoided annually

The town of Ry, Denmark has 1,300 households connected to the District heating plant, which gets its heat from a 3,000 m² solar energy collector field. It supplements the heat from the town's coal-fired plant.



Space Heating and Air Conditioning

- Simple systems that inject thermal energy into a heating loop
- Air Conditioning uses single and double effect absorption technology, an established technology used for decades





SOLAR ARRAY



CPC COLLECTORS

MECHANICAL EQUIPMENT



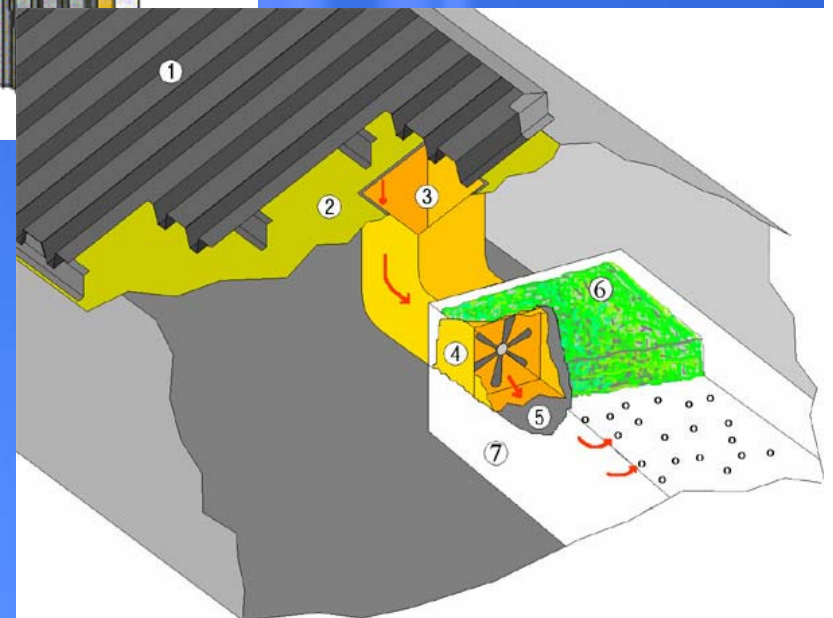
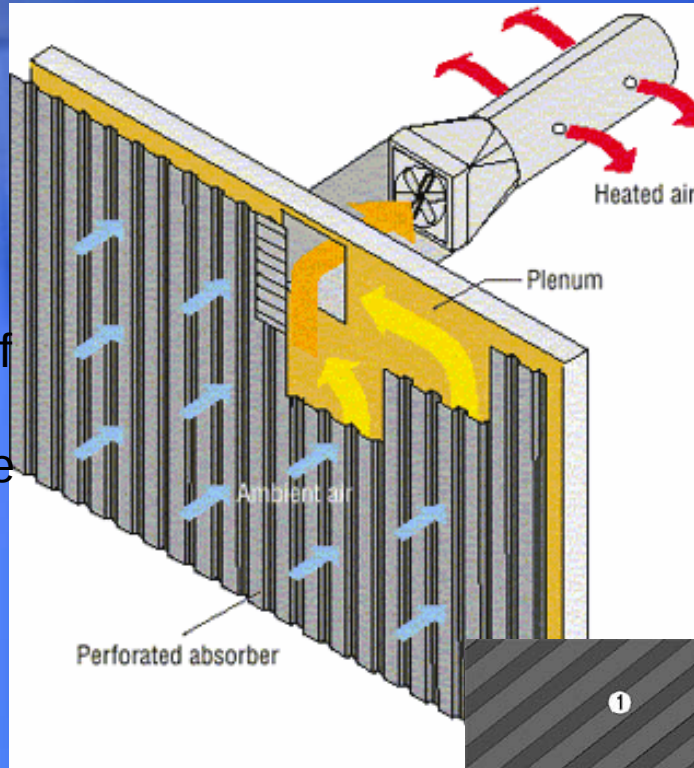
Solar Air Conditioning

Project - 30 Ton -
Sand Hill Austin, TX

Transpired Air Collectors

A fan or blower draws ventilation air into the building through hundreds of tiny holes in the collectors and up through the air space between the collectors and the south wall. The solar energy absorbed by the collectors warms the air flowing through them by as much as 40° F.

- Preheat air for building heating
- Use for crop / timber drying



For a Business to Succeed there must be a Value Proposition

- Solar hot water systems begin to compete with natural gas at a cost of about \$7/MMBTU with electricity at about \$0.03/kWH
- Solar pool systems begin to compete with natural gas at a cost of about \$4/MMBTU

Current National Average Price of Gas \$8 - 11
and Electricity \$0.09 - 0.15

Program Idea

Hybrid Green Pricing / Remote Host



- Install a solar water heater on single family residences (Lakeland Model)
- Install a solar water heater on a “host” site and sell the energy to a condominium or apartment resident
- Install large industrial system and disaggregate to various residential customers or vice versa
- Utility provides brand name, meter reading and billing services
- Solar service company provides installation and service
- Either the utility, solar service company, or a third party fund the hardware



Hot Water: Site Delivered and Sold at Competitive Prices with No Price Increases

- Solar water heating systems installed at the point of use
- Hot water is sold, not the solar energy system
- Two revenue streams: Sale of thermal energy and Tradable Renewable Energy Certificates (TRECs)
- **News!** Third party verification is available from ERT – CRS is considering standards to be adopted in 2006

The Process

Design, Engineering, Construction and Operation

- Initial design cost estimates
- Sell or finance?
- Approval by site owner
- Final engineering and design
- Approval by site owner
- Construction schedule made
- Materials delivered, installed then system start up
- Operation and maintenance performed

Next Steps

1. Site surveys
2. Expression of interest by building owners with acceptable criteria to move forward
3. Assistance from knowledgeable partners to:
 - determine energy load
 - determine cost of energy
 - perform initial feasibility analysis
4. Construction and finance
 - secure financing commitments
 - build the project

Questions?

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