

# DOWNLOAD PDF PERFORMANCE OF HOT WATER PANEL HEATING SYSTEMS

## Chapter 1 : Water heating - Wikipedia

*Excerpt from Performance of Hot-Water Panel Heating Systems in High-Rise Apartments of the Chicago Housing Authority The Chicago Housing Authority constructs and operates a large number of high-rise apartment buildings for low-income families in metropolitan Chicago.*

Instant hot water dispenser and Electric water boiler The inside of a hydraulically operated two-stage tankless heater, heated by 3-phase electric power. Tankless water heaters are also called instantaneous, continuous flow, inline, flash, on-demand, or instant-on water heaters are gaining in popularity. Copper heat exchangers are preferred in these units because of their high thermal conductivity and ease of fabrication. Tankless heaters may be installed throughout a household at more than one point-of-use POU, far from a central water heater, or larger centralized models may still be used to provide all the hot water requirements for an entire house. The main advantages of tankless water heaters are a plentiful continuous flow of hot water as compared to a limited flow of continuously heated hot water from conventional tank water heaters, and potential energy savings under some conditions. The main disadvantage is their much higher initial costs, a US study in Minnesota study reported a 10 year payback for the tankless water heaters. In some places, they are called multipoint heaters, geysers or ascots. In Australia and New Zealand they are called instantaneous hot water units. In Argentina they are called calefones. In that country calefones use gas instead of electricity. A similar wood-fired appliance was known as the chip heater. A common arrangement where hot-water space heating is employed, is for a boiler to also heat potable water, providing a continuous supply of hot water without extra equipment. Appliances that can supply both space-heating and domestic hot water are called combination or combi boilers. Though on-demand heaters provide a continuous supply of domestic hot water, the rate at which they can produce it is limited by the thermodynamics of heating water from the available fuel supplies.

Electric shower heads[ edit ] An example of a dangerously installed electric shower head in Guatemala. An electric shower head has an electric heating element which heats water as it passes through. These self-heating shower heads are specialized point-of-use POU tankless water heaters, and are widely used in some countries. Invented in Brazil in the 1950s and used frequently since the 1960s, the electric shower is a home appliance often seen in South American countries due to the higher costs of gas distribution. Earlier models were made of chromed copper or brass, which were expensive, but since the 1970s, units made of injected plastics are popular due to low prices similar to that of a hair dryer. Electric showers have a simple electric system, working like a coffee maker, but with a larger water flow. A flow switch turns on the device when water flows through it. Once the water is stopped, the device turns off automatically. An ordinary electric shower often has three heat settings: Energy usage[ edit ] The power consumption of electric showers in the maximum heating setting is about 5 kW. The lower costs with electric showers compared to the higher costs with boilers is due to the time of use: Electric showers may save energy compared to electric tank heaters, which lose some standby heat. The heating element of an electric shower is immersed in the water stream, using a nichrome resistance element which is sheathed and electrically isolated, like the ones used in oil heaters, radiators or clothes irons, providing safety. Due to electrical safety standards, modern electric showers are made of plastic instead of using metallic casings like in the past. As an electrical appliance that uses more electric current than a washer or a dryer, an electric shower installation requires careful planning, and generally is intended to be wired directly from the electrical distribution box with a dedicated circuit breaker and ground system. A poorly installed system with old aluminum wires or bad connections may be dangerous, as the wires can overheat or electric current may leak via the water stream through the body of the user to earth.

Solar water heating Increasingly, solar powered water heaters are being used. Their solar collectors are installed outside dwellings, typically on the roof or walls or nearby, and the potable hot water storage tank is typically a pre-existing or new conventional water heater, or a water heater specifically designed for solar thermal. The most basic solar thermal models are the direct-gain type, in which the potable water is directly sent into the collector. Many such systems are said

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to use integrated collector storage ICS , as direct-gain systems typically have storage integrated within the collector. Heating water directly is inherently more efficient than heating it indirectly via heat exchangers, but such systems offer very limited freeze protection if any , can easily heat water to temperatures unsafe for domestic use, and ICS systems suffer from severe heat loss on cold nights and cold, cloudy days. After collecting heat in the panels, the heat transfer fluid flows through a heat exchanger , transferring its heat to the potable hot water. When the panels are cooler than the storage tank or when the storage tank has already reached its maximum temperature, the controller in closed-loop systems stops the circulation pumps. In a drainback system, the water drains into a storage tank contained in conditioned or semi-conditioned space, protected from freezing temperatures. Flat panel collectors are typically used in closed-loop systems. Flat panels are regularly used in both pure water and antifreeze systems. Placed in a rack, evacuated tube collectors form a row of glass tubes, each containing absorption fins attached to a central heat-conducting rod copper or condensation-driven. Geothermal heating[ edit ] In countries like Iceland and New Zealand , and other volcanic regions, water heating may be done using geothermal heating , rather than combustion. Gravity-fed system[ edit ] Where a space-heating water boiler is employed, the traditional arrangement in the UK is to use boiler-heated primary water to heat potable secondary water contained in a cylindrical vessel usually made of copper – which is supplied from a cold water storage vessel or container, usually in the roof space of the building. This produces a fairly steady supply of DHW Domestic Hot Water at low static pressure head but usually with a good flow. In most other parts of the world, water heating appliances do not use a cold water storage vessel or container, but heat water at pressures close to that of the incoming mains water supply. Other improvements[ edit ] Other improvements to water heaters include check valve devices at their inlet and outlet, cycle timers, electronic ignition in the case of fuel-using models, sealed air intake systems in the case of fuel-using models, and pipe insulation. The sealed air-intake system types are sometimes called "band- joist " intake units. The exhaust gases of combustion are cooled and are mechanically ventilated either through the roof or through an exterior wall. At high combustion efficiencies a drain must be supplied to handle the water condensed out of the combustion products, which are primarily carbon dioxide and water vapor. In traditional plumbing in the UK, the space-heating boiler is set up to heat a separate hot water cylinder or water heater for potable hot water. Such water heaters are often fitted with an auxiliary electrical immersion heater for use if the boiler is out of action for a time. Residential combustion water heaters manufactured since in the United States have been redesigned to resist ignition of flammable vapors and incorporate a thermal cutoff switch, per ANSI Z The first feature attempts to prevent vapors from flammable liquids and gases in the vicinity of the heater from being ignited and thus causing a house fire or explosion. The second feature prevents tank overheating due to unusual combustion conditions. These safety requirements were made in response to homeowners storing, or spilling, gasoline or other flammable liquids near their water heaters and causing fires. Since most of the new designs incorporate some type of flame arrestor screen, they require monitoring to make sure they do not become clogged with lint or dust, reducing the availability of air for combustion. If the flame arrestor becomes clogged, the thermal cutoff may act to shut down the heater. A wetback stove NZ , wetback heater NZ , or back boiler UK , is a simple household secondary water heater using incidental heat. It typically consists of a hot water pipe running behind a fireplace or stove rather than hot water storage , and has no facility to limit the heating. Modern wetbacks may run the pipe in a more sophisticated design to assist heat-exchange. In London, England, in , a painter named Benjamin Waddy Maughan invented the first instantaneous domestic water heater that did not use solid fuel. Hot water then flowed into a sink or tub. The invention was somewhat dangerous because there was no flue to remove heated gases from the bathroom. A water heater is still sometimes called a geyser in the UK. The first automatic, storage tank-type gas water was invented around by Ruud after he immigrated to Pittsburgh, Pennsylvania US. The Ruud Manufacturing Company, still in existence today, made many advancements in tank-type and tankless water heater design and operation. The Uniform Plumbing Code reference shower flow rate is 2. Natural gas in the US is measured in CCF cubic feet , which is converted to a standardized energy unit called the therm , which is equal to , British

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thermal units BTU. A BTU is the energy required to raise one pound of water by one degree Fahrenheit. A US gallon of water weighs 8. Energy efficiencies of water heaters in residential use can vary greatly, particularly depending on manufacturer and model. However, use of a heat pump can make electric water heaters much more energy efficient and lead to a decrease in carbon dioxide emissions, even more so if a low carbon source of electricity is used. Unfortunately, it takes a great deal of energy to heat water, as one may experience when waiting to boil a gallon of water on a stove. For this reason, tankless on-demand water heaters require a powerful energy source. A standard V, ampere rated wall electric outlet, by comparison, only sources enough power to warm a disappointingly small amount of water: Under the standard, for the first time, storage water heaters with capacities of 55 US gallons or larger now face stricter efficiency requirements than those of 50 US gallons or less. Storage water heaters with a nominal input of 75, btu or greater are not currently affected by these requirements, since energy factor is not defined for such units. This rating measures efficiency at the point of use. Depending on how electricity is generated, overall efficiency may be much lower. According to data from the Energy Information Administration, transmission and distribution losses in consumed 6. Most plumbing codes require that a discharge pipe be connected to the valve to direct the flow of discharged hot water to a drain, typically a nearby floor drain , or outside the living space. Some building codes allow the discharge pipe to terminate in the garage. Furthermore, certain local codes mandate that tank-type heaters in new and retrofit installations must be secured to an adjacent wall by a strap or anchor to prevent tipping over and breaking the water and gas pipes in the event of an earthquake. Thermal burns scalding [ edit ] Scalding injury to right hand Scalding is a serious concern with any water heater. Older people and children often receive serious scalds due to disabilities or slow reaction times. The result of mixing hot and cold water via a tempering valve is referred to as "tempered water". However, for sanitation, hot water is needed at a temperature that can cause scalding. This may be accomplished by using a supplemental heater in an appliance that requires hotter water. Most residential dishwashing machines , for example, include an internal electric heating element for increasing the water temperature above that provided by a domestic water heater. Higher temperatures may also increase etching of glassware in the dishwasher. Tank thermostats are not a reliable guide to the internal temperature of the tank. Gas-fired water tanks may have no temperature calibration shown. An electric thermostat shows the temperature at the elevation of the thermostat, but water lower in the tank can be considerably cooler. An outlet thermometer is a better indication of water temperature. This technique allows lower water temperatures to be maintained in the pipework without the associated Legionella risk. The benefit of lower pipe temperatures is that the heat loss rate is reduced and thus the energy consumption is reduced.

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## Chapter 2 : Solar thermal collector - Wikipedia

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He had heard a lot about evacuated tube collectors, but he knew I used flat plate collectors. So he asked me which type was better. There are three ways heat energy is transferred. They are radiation, conduction, and convection. Each of these transfer methods is active in all heating and cooling systems, including solar. However, the three methods may not be equal in importance for a given system. Radiation is the transfer of energy through space, with no medium helping. There had to be something between the two to conduct the energy. We now know that radiation travels through a vacuum with nothing helping. Most people understand the radiation energy from the sun on their body, or from a fireplace, but are not aware that radiation is emitted from every body that has a temperature above absolute zero. You will feel the radiation transfer between your hand and your face. Second, there is conduction. We all know about conduction when we touch a hot surface. Heat is transferred by molecules banging together in a solid surface. If you heat one end of a copper pipe and hold on to the other, you will feel the heat that transfers from the hot end to the colder end. Convective heat transfer means moving convecting the hot molecule from one place to another, where it transfers its heat to something colder. A hot air furnace moves heated air into the house. Hot water moves through pipes from the heater to the tap. So, we need to understand that radiation is the main way solar collectors gain energy, conduction is the way the heat is transferred through the metal absorber plate into the water, and convection is the way the heat is transported by the water flowing to the storage tank. One other concept we need to understand is that the amount of heat transferred by conduction and convection depends on the temperature difference between the hot and cold ends of the system. For example, if the temperature between the hot and cold ends of a copper pipe is doubled, the amount of heat transported between the two is doubled. The cold end will heat up twice as fast. Likewise in the convection wind chill example, the greater the temperature difference between the wind and our skin, the more energy is transferred. Collectors also lose heat by radiation, conduction, and convection. Just like a fire in a fireplace, a hot collector absorber plate will radiate energy back out into space. There are special electroplated black coatings that radiate less than an ordinary hot surface. Most black coatings on solar collectors are selective surfaces. Flat Plate Solar Collector Now back to the question. Which type of solar collector is better? The answer is found by comparing the performance curves of both types of collectors on the same graph. Figure 2 shows the performance curves of typical flat plate and evacuated tube collectors. That is, when there is no temperature difference and none of the energy captured is lost to the surroundings. However, the evacuated chamber surrounding the absorber plate acts as super insulation and conducts much less heat away from the absorber. ET collector efficiency does not fall off as fast at higher temperature differences. Plotted on the same graph, the two curves cross each other around the 60°F differential temperature mark. This is called the crossover point. Before the crossover point to the left on the graph flat plate collectors are more efficient. To the right of the crossover point, evacuated tube collectors are more efficient. Due to their higher price and lower durability, the economic crossover point can be moved farther to the right before evacuated tube collectors should be selected. A flat plate collector will be more efficient as long as the entering water temperature is below 60°F. An ET collector will be more efficient when the water temperature rises above 60°F. On a day where the outside temperature is 0°F, the efficiency crossover point occurs when the entering water temperature hits 60°F. Note that we are only interested in the average daytime temperature when the collectors are running, not the coldest possible temperature in that location. The average daytime temperature for a given month is a good number for this calculation. Performance curves for a flat plate and an evacuated tube collector. A better way is to do a comparison over a whole year as shown in fig. After all, we are not going to swap out collectors monthly based on which is

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better. However, in northern climates with much lower average temperatures, the crossover point may favor ET collectors. So, when it comes to choosing between evacuated tube and flat plate solar hot water collectors, the most critical factor is where the crossover occurs and how that compares with the delivery temperatures needed for a given application. Good solar engineering involves designing systems that can operate at the lowest possible temperature. Likewise, preheating forced air starting at room temperature is preferable to trying to add heat at the output temperature. Twelve month efficiency comparison between a flat plate and an evacuated tube collector. A partial list of commercial applications that are best served by flat plate panels include:

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## Chapter 3 : Solar Heating System | calendrierdelascience.com

*Using sunshine to heat or preheat your water can cut your annual hot water costs in half. An ENERGY STAR certified solar water heating system can cut your annual hot water costs in half, and is generally designed for use with an electric or gas back-up water heater.*

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Hydronic Radiant Ceiling Systems Radiant Panel ceiling systems are an energy and cost saving method of heating. Radiant heating systems provide comfort much the same way as the sun warms the earth. Radiant cooling and heating systems offer many advantages including:

- Comfortable** The heating is distributed radiantly rather than by forced air providing a "draftless" environment.
- Economical** The pump energy required in hydronic systems is much less than that required for fans in forced air systems. The amount of energy to distribute the same amount of heating in forced air systems is typically 10 times greater than that needed for pumps in a hydronic radiant system.
- Space Saving** Radiant ceiling systems do not require wall space.
- Flexible** Ceiling radiant panels offer maximum flexibility in future layout changes, such as enlarging rooms and moving partitions.
- Healthy Environment** Radiant systems can takeover the sensible heating requirements allowing the ventilation system to provide only the air required for the latent load and ventilation requirements. This reduces the size of the ductwork and air handlers while providing superior ventilation, which greatly simplifies system design, construction and commissioning, as well as reducing the chances of "sick building syndrome".

Frenger radiant ceiling panel systems were the first to be certified and tested in Europe over 40 years ago. Sterling radiant systems offer a number of advantages over other manufacturers:

- Positive Tube To Panel bond** The copper tubing is positively affixed to the panel with a hold down clip. Thermal paste is also applied between the tubing and panel to assure a permanent yet flexible bond for maximum heat transfer.
- Lightweight Extruded Aluminum** The linear panels are constructed of light weight aluminum. This lessens the weight that must be supported by the ceiling suspension system. The modular panels are available in either aluminum or steel.

**System Design Assistance** Provide us with your ceiling and floor plans and we will help you design the right radiant system for your needs. The combination of classroom and hands-on training gives participants the opportunity to learn by doing and improve their knowledge of products, applications, installation, and service.

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## Chapter 4 : Is The Most Efficient Hot Water System A Solar PV Powered Heat Pump? - Solar Quotes Blog

*This performance specification is always found on the collector thermal performance rating label of SRCC certified and rated hot water solar panels. Knowing how much solar thermal output a particular water heating system will require is an important part of sizing a solar water panel.*

Misleading claims by manufacturers. In Lord Kelvin worked out the mathematics of heat pumps and, as a result, had the Kelvinator refrigerator named after him. But “and this is an important point” not right away. He had to wait until he was dead for 7 years before that happened. In return for the scientific advances I have made, I would like a refrigerator named after me “The Williamator. Airplanes will never work. The first heat pump was built in Austria around by Peter Ritter von Rittinger 2. He developed a practical method of taking advantage of how gas heats up when compressed into a liquid and cools down when it evaporates to move heat around. This meant heat could be moved into a confined area, such as with a heat pump hot water system, or out of a confined area such as with a refrigerator. Household air conditioners are capable of either and can move heat out of a home in summer and move heat inside in winter. Heat pumps can exchange heat between water, the ground, and air. But in Australia where temperatures rarely reach freezing, almost all heat pumps use air and these are simply called air sourced heat pumps. Occasionally heat pump hot water systems are referred to as solar heat pumps because After all, in winter almost all the heat an air conditioner pumps inside your home originally came from the sun and no one ever refers to it as solar air conditioning. While CO<sub>2</sub> is a greenhouse gas, the total amount is usually less than one kilogram, which is around how much is emitted from generating one kilowatt-hour of electricity from coal, so there is no need to worry about your heat pump roasting the planet if it leaks. Also, one kilogram of CO<sub>2</sub> is not enough to be dangerous to your health unless it is in a very confined space, such as your lungs. But it can be far more energy efficient to move heat around instead. An air conditioner is a heat pump and an energy star label for one generally looks like this: Air conditioner energy star label. On the right hand side within the far reddish rectangle is the power input for heating in kilowatts of electricity. Next to that is the capacity output in kilowatts of heat. So the air conditioner can take 0. But below the 4. Unfortunately, heat pump hot water systems are not likely to be as effective as this air conditioner. For each kilowatt-hour of electricity they consume they will generally provide around 3 kilowatt-hours of heat, making them 3 times as efficient as a conventional electric hot water system. The exact efficiency will vary through the year, because the greater the difference between the air temperature and the hot water temperature, the lower the efficiency. If you look at information about heat pump hot water systems online you will often see they generally claim to be more than 3 times as efficient. Unfortunately, this may not be the case. This is a straight forward measure. If a heat pump uses 1 kilowatt-hour of electricity to provide 3 kilowatt-hours of heat it has a COP of 3. If it uses one kilowatt-hour of electricity to provide 4 kilowatts of heat it has a COP of 4. Most heat pump hot water systems state they have a COP of 3 to 4. This is because it will use energy for more than just operating the heat pump. For example, when it is very cold ice will form on the outside exchanger of a heat pump and it may need to be defrosted every few minutes. This either requires energy to power heating elements to melt the ice, or more often the unit will be designed to switch to using a standard heating element to warm water and so in cold temperatures it will function as a conventional electric hot water system. As the highest hot water consumption occurs during cold weather, their reduced efficiency at low temperatures and their habit of either spending energy to defrost or simply giving up on operating as a heat pump, can considerably increase the amount of electricity they use. This graph I stole from an Apricus solar thermal hot water brochure shows the efficiency of flat plate and evacuated tube solar thermal systems for both the total, or gross, area of the collectors and also for the smaller absorber area: Solar thermal hot water efficiency. This page will let you download a list of all the approved heat pump hot water systems and the number of STCs created when they are installed. If you want to know exactly how many STCs a system will receive, you can go to this page and enter its brand, model, and the postcode it will

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be installed in. The exact number you will receive will depend on which zone you are in. But these zones are different from the ones for rooftop solar PV. Here is a map of the hot water zones for both solar thermal hot water and heat pump hot water: The number of STCs received depend on how much electricity is likely to be saved by a system in each zone and this is affected by amount of hot water people use and by its efficiency there. These are the coldest places in Australia and you might think they would get the most STCs because hot water use there is likely to be the highest. But because heat pump hot water will often operate with lower efficiency there, zone 5 can receive fewer STCs than zone 4. The number of STCs received will be cut by one tenth at the start of and cut each year after that until they are phased out entirely by the end of Solar Power, Timers, And Heat Pump Hot Water I recently wrote about putting conventional hot water systems on timers so they will switch on during the day when they will hopefully be able to take advantage of surplus solar electricity that would otherwise go into the grid and receive a feed-in tariff. It is easier to run heat pump hot water systems off surplus solar using a timer because they usually draw only one kilowatt or less, which is around half as much as even the smallest standard heating element used by conventional electric hot water systems. This low power draw makes it much more likely rooftop solar will provide enough power to run them without needing to dip into grid electricity. Because the average temperature is higher, heat pump hot water will operate more efficiently when run during the day and will be much less likely to need to waste energy defrosting or operating as a conventional hot water system. Heat pump hot water also has the advantage of generally coming with their own built in timers. Besides setting them to turn on when a surplus of solar electricity is likely, they also allow households that are on time-of-use tariffs take advantage of low cost off-peak power. Solar Hot Water Diverters Cannot Be Used Solar hot water diverters that send surplus solar electricity to the heating elements of conventional hot water systems cannot be used with heat pump hot water. The type of current they supply is not compatible with pumps or electronics and may damage them. Threshold Power Can Be Used Devices that can send normal household AC power to devices when there is sufficient surplus solar energy to operate them can be used with heat pumps. Examples are the Fronius relay and SunMate diverter. These devices also permit users to select minimum activation times and activation delays after the surplus solar power threshold is reached to prevent clouds rapidly turning the heat pump on and off. Controlled Load Or Economy Tariffs Can Be Used Heat pump hot water systems can be used with controlled load tariffs, which are also known as economy tariffs. Note there are some systems where the manufacturers recommended they have access to electricity for more than 8 hours a day, which can make them unsuitable for most controlled load tariffs. Lukewarm Water Is Dangerous No matter what method is used to power a heat pump hot water system, it is a matter of life and death that the storage tank reach a minimum temperature of 60 degrees every three days to control dangerous microorganisms such as Legionella. The total cost is often at least 2 to 3 times as much as an equivalent conventional electric hot water system. Warranties Are Often Short Warranties for heat pump hot water systems are often horrifically short and may be as little as one year. The longest I have seen is 6 years. While they may have much longer warranties on their storage tanks, that is not the part that is likely to break down. They Can Be Noisy Some heat pump hot water systems generate a considerable amount of noise. The quietest I am aware of is the Sanden Eco Plus which operates at 37 decibels. Because they are similar in operation and power use, most heat pump hot water systems make noise comparable to room air conditioners, which can range from a mild hum to a mild cacophony 7. Potential Savings The most cost effective location in Australia to install a heat pump hot water system is likely to be Western Australia. This is because controlled load tariffs that lower the cost of using conventional hot water systems are no longer available and the cost of electricity is high. In Perth the large majority of households use natural gas hot water systems. But if there was a family that, despite the warm climate, was a very large user of hot water and had a conventional electric hot water system, they could potentially reduce the number of kilowatt-hours they use to heat water annually by 1, with a heat pump hot water system. Elsewhere in Australia the savings generally will be far less. Elsewhere in Australia where controlled loads are usually lower and feed-in tariffs sometimes higher, the benefit is likely to be even lower. Environmental Benefit

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While the economics of heat pump hot water are not yet favorable, it can provide considerable environmental benefit by either greatly reducing the amount of fossil fuel a home uses to heat water, or alternatively by freeing up rooftop solar generated electricity to be sent into the grid where it will reduce fossil fuel generation. But many households will find they will be better off economically and provide greater environmental benefit by using the money to instead install a larger rooftop solar system than they would have otherwise. Those who have already installed as large a solar system as is practical may find heat pump hot water an effective way to further reduce emissions. There are many people who will find that worthwhile even if the return on a heat pump hot water system is extremely low or even negative. A number of nations overseas are working on improving heat pumps and we will benefit from their efforts. But one drawback I can see for heat pump hot water is that the cost of operating conventional hot water systems may fall as the cost of rooftop solar continues to decline and increasing renewable generation puts downward pressure on controlled load tariffs and the off-peak rates of time-of-use tariffs. Footnotes I am working on creating the next leap forward in household energy efficiency by combining refrigerators and heat pump hot water systems. All I need to succeed is work out how to get them to mate. While we usually think of a fluid as a liquid it can also be used to describe a gas!

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## Chapter 5 : Comparing Solar Hot Water Panels

*Solar water heaters -- also called solar domestic hot water systems -- can be a cost-effective way to generate hot water for your home. They can be used in any climate, and the fuel they use -- sunshine -- is free.*

In the non-concentrating type, the collector area is  $i$ . In these types the whole solar panel absorbs light. Concentrating collectors have a bigger intercepter than absorber. Flat plate collectors[ edit ] Flat plate thermal system for water heating deployed on a flat roof Flat-plate collectors are the most common solar thermal technology. They consist of an 1 enclosure containing 2 a dark colored absorber plate with fluid circulation passageways, and 3 a transparent cover to allow transmission of solar energy into the enclosure. The sides and back of the enclosure are typically insulated to reduce heat loss to the outside air. The circulation fluid in tropical and sub-tropical climates is typically water. In climates where freezing is likely, a heat-transfer fluid similar to an automotive antifreeze solution may be used instead of water, or in a mixture with water. If a heat transfer fluid is used, a heat exchanger is typically employed to transfer heat from the solar collector fluid to a hot water storage tank. The most common absorber design consists of copper tubing attached to thermally conductive copper or aluminum fins. A dark coating is applied to the sun-facing side of the absorber assembly to increase its absorption of solar energy. A common absorber coating is flat black enamel paint. In higher performance solar collector designs, the transparent cover is tempered glass with reduced iron oxide content the green color visible when viewing a pane of window glass from the side. The glass may also have a stippling pattern an anti-reflective coating to trap more solar energy by reducing reflection. The absorber coating is typically a selective coating. Selective coatings have special optical properties to improve efficiency by reducing the emittance of infrared energy from the absorber. Some manufacturers have introduced inexpensive flat plate solar collectors that employ polycarbonate transparent covers and polypropylene absorber assemblies. Most air heat fabricators and some water heat manufacturers have a completely flooded absorber consisting of two sheets of metal which the fluid passes between. Because the heat exchange area is greater, they may be marginally more efficient than traditional absorbers. Absorber piping configurations include: Because the energy is absorbed in the boundary layer, heat conversion may be more efficient than for collectors where absorbed heat is conducted through a material before the heat is accumulated in a circulating liquid. These may be wholly polymer , or they may include metal plates in front of freeze-tolerant water channels made of silicone rubber. Polymers are flexible and therefore freeze-tolerant and can employ plain water instead of antifreeze, so that they may be plumbed directly into existing water tanks instead of needing heat exchangers that lower efficiency. By dispensing with a heat exchanger, temperatures need not be quite so high for the circulation system to be switched on, so such direct circulation panels, whether polymer or otherwise, can be more efficient, particularly at low light levels. For this reason polypropylene is not often used in glazed selectively coated solar collectors. In areas where freezing is a possibility, freeze-tolerance the capability to freeze repeatedly without cracking can be achieved by the use of flexible polymers. Silicone rubber pipes have been used for this purpose in UK since Conventional metal collectors are vulnerable to damage from freezing, so if they are water filled they must be carefully plumbed so they completely drain using gravity before freezing is expected, so that they do not crack. Many metal collectors are installed as part of a sealed heat exchanger system. Rather than having potable water flow directly through the collectors, a mixture of water and antifreeze such as propylene glycol is used. A heat exchange fluid protects against freeze damage down to a locally determined risk temperature that depends on the proportion of propylene glycol in the mixture. A pool or unglazed collector is a simple form of flat-plate collector without a transparent cover. Typically polypropylene or EPDM rubber or silicone rubber is used as an absorber. Used for pool heating it can work quite well when the desired output temperature is near the ambient temperature that is, when it is warm outside. As the ambient temperature gets cooler, these collectors become less effective. Most flat plate collectors have a life expectancy of over 25 years. Evacuated tube collectors[ edit ] Evacuated tube collector

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An array of evacuated tubes collectors on a roof Most vacuum tube collectors are used in middle Europe use heat pipes for their core instead of passing liquid directly through them. Direct flow is more popular in China. Evacuated heat pipe tubes EHPTs are composed of multiple evacuated glass tubes each containing an absorber plate fused to a heat pipe. The manifold is wrapped in insulation and covered by a protective sheet metal or plastic case. The vacuum inside of the evacuated tube collectors have been proven to last more than 25 years, the reflective coating for the design is encapsulated in the vacuum inside of the tube, which will not degrade until the vacuum is lost. This advantage is largely lost in warmer climates, except in those cases where very hot water is desirable, e. The high temperatures that can occur may require special design to prevent overheating. Glass-glass evacuated tube Some evacuated tubes glass-metal are made with one layer of glass that fuses to the heat pipe at the upper end and encloses the heat pipe and absorber in the vacuum. Others glass-glass are made with a double layer of glass fused together at one or both ends with a vacuum between the layers like a vacuum bottle or flask , with the absorber and heat pipe contained at normal atmospheric pressure. Glass-glass tubes have a highly reliable vacuum seal, but the two layers of glass reduce the light that reaches the absorber. Moisture may enter the non-evacuated area of the tube and cause absorber corrosion. Glass-metal tubes allow more light to reach the absorber, and protect the absorber and heat pipe from corrosion even if they are made from dissimilar materials see galvanic corrosion. The gaps between the tubes may allow for snow to fall through the collector, minimizing the loss of production in some snowy conditions, though the lack of radiated heat from the tubes can also prevent effective shedding of accumulated snow. Please help improve this section by adding citations to reliable sources. Unsourced material may be challenged and removed. October Learn how and when to remove this template message A longstanding argument exists between proponents of these two technologies. Some of this can be related to the physical structure of evacuated tube collectors which have a discontinuous absorbance area. An array of evacuated tubes on a roof has open space between the collector tubes, and vacuum between the two concentric glass tubes of each collector. Collector tubes cover only a fraction of a unit area on a roof. If evacuated tubes are compared with flat-plate collectors on the basis of area of roof occupied, a different conclusion might be reached than if the areas of absorber were compared. In addition, the ISO standard [10] is ambiguous in describing the way in which the efficiency of solar thermal collectors should be measured, since these could be measured either in terms of gross area or in terms of absorber area. Unfortunately, power output is not given for thermal collectors as it is for PV panels. This makes it difficult for purchasers and engineers to make informed decisions. A comparison of the energy output kW. Firstly, as  $T_m - T_a$  increases the flat plate collector loses efficiency more rapidly than the evac tube collector. This means the flat plate collector is less efficient in producing water higher than 25 degrees C above ambient i. Although many factors obstruct the extrapolation from two collectors to two different technologies, above, the basic relationships between their efficiencies remain valid[ dubious â€” discuss ]. A field trial [11] illustrating the differences discussed in the figure on the left. A flat plate collector and a similar-sized evacuated tube collector were installed adjacently on a roof, each with a pump, controller and storage tank. Several variables were logged during a day with intermittent rain and cloud. The top maroon line indicates the temperature of the evac tube collector for which cycling of the pump is much slower and even stopping for some 30 minutes during the cool parts of the day irradiation low , indicating a slow rate of heat collection. The temperature of the flat plate collector fell significantly during the day bottom purple line , but started cycling again later in the day when irradiation increased. The temperature in the water storage tank of the evac tube system dark blue graph increased by 8 degrees C during the day while that of the flat plate system light blue graph only remained constant. They are inappropriate for high temperature applications such as process steam production. Based on absorber plate area, most evacuated tube systems are more efficient per square meter than equivalent flat plate systems. This makes them suitable where roof space is limiting, for example where the number of occupants of a building is higher than the number of square metres of suitable and available roof space. In general, per installed square metre, evacuated tubes deliver marginally more energy when the ambient temperature is low e. However, even in areas without much

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sunshine and solar heat, some low cost flat plate collectors can be more cost efficient than evacuated tube collectors. Although several European companies manufacture evacuated tube collectors, the evacuated tube market is dominated by manufacturers in the East. Several Chinese companies have track records of 15–30 years. There is no unambiguous evidence that the two designs differ in long term reliability. However, evacuated tube technology is younger and especially for newer variants with sealed heat pipes still need to demonstrate competitive lifetimes. The modularity of evacuated tubes can be advantageous in terms of extensibility and maintenance, for example if the vacuum in one tube diminishes. In most climates, flat-plate collectors will generally be more cost-effective than evacuated tubes. When employed in arrays and considered instead on a per square metre basis, the efficient but costly evacuated tube collectors can have a net benefit in winter and summer. They are well-suited to cold ambient temperatures and work well in situations of consistently low sunshine, providing heat more consistently than flat plate collectors per square metre. Heating of water by a medium to low amount  $i. T_m - T_a$  is much more efficiently performed by flat plate collectors. Domestic hot water frequently falls into this medium category. Glazed or unglazed flat collectors are the preferred devices for heating swimming pool water. EHPTs work as a thermal one-way valve due to their heat pipes. This gives them an inherent maximum operating temperature that acts as a safety feature. They have less aerodynamic drag, which may allow them to be placed onto the roof without being tied down. They can collect thermal radiation from the bottom in addition to the top. Tubes can be replaced individually without stopping the entire system. There is no condensation or corrosion within the tubes. One hurdle to wider adoption of evacuated tube collectors in some markets is their inability to pass internal thermal shock tests where ISO section 9 class b is a requirement for durability certification. There is also the question of vacuum leakage. Flat panels have been around much longer and are less expensive. They may be easier to clean. Other properties, such as appearance and ease of installation are more subjective. Applications[ edit ] The main use of this technology is in residential buildings where the demand for hot water has a large impact on energy bills. This generally means a situation with a large family, or a situation in which the hot water demand is excessive due to frequent laundry washing.

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## Chapter 6 : Solar Hot Water Heater | Sizing Solar Panels & Storage Tanks

*Solar hot water panels, or collectors, are the heat gathering component of any solar hot water heater. These panels, or collectors, should always maximize as much of a site's solar resource as possible.*

See Here The performance of solar pool heaters is patently not comparable to that of their electric or gas-powered counterparts. However, where they cede in fast performance, they more than make up for in reliability, ease of use, pocket-friendly running costs, affordability, versatility, and near zero maintenance costs. In addition to minimizing carbon footprint, pool heaters are also capable of raising the pool temperature by some significant degrees to allow you enjoy a comfortable, relaxing and warm swim. The aim is to remove the time and effort away from the otherwise nerve-wreaking, energy-draining, and mundane task of combing through the Internet comparing hundreds of different units with one another to find your knight in shining armour. Aside from being powerful and effective, the solar heater also features physical dimensions of 4 feet by 20 feet, making it one of the widest or largest solar heaters on the market. The dimensions aim to maximize its exposure to the sun in an attempt at trapping the most solar energy to provide the user with the best performance, an endeavour it never fails to achieve. While being large has obvious advantages, it also presents some problems. First off, it makes the solar heater considerably bulky, not necessarily heavy, which makes it a little hard finding adequate space to set it up. The package comes with all the accessories you need to install it quickly and effectively. You get the 4 feet by 20 feet extra-large solar collector, two 6-foot long 1. Expand to see more The design eliminates the need for using couplings or connectors and therefore makes the installation process quite a breeze. Putting all these accessories together and getting them to work effectively and efficiently might sound a little daunting, especially to greenhorns setting up their first heater. However, the package comes with a detailed user manual to guide you through the installation process. Plus, the customer service is very handy for when the process becomes a little complex. Its working is a little different from the vast majority of solar heaters on the market. Instead of the conventional heat transfer, it works by pumping water through the solar heater before sucking it back out. The included oversized 2-inch headers guarantee maximum circulation for uniform and quick circulation of the water. Since it uses the concentrated power of the sun, its performance can vary all through the day. In most cases, it reaches optimal performance between 10 am and 4 pm if the season and latitude allow it. One way of ensuring optimal performance is by aiming or installing it south at a degree angle to maximize exposure to the heat of the sun. As for installation, you have the discretion of choosing the ground, the rack, or the roof, among other suitable surfaces. In spite of its bulky size, it nonetheless features a heavy-duty and long-lasting construction quality and works efficiently and smoothly provided the installation is done right. If you want to extend the swimming season and keep the pool comfortable and sufficiently toasty, all without breaking the bank, we cannot recommend the Fafco Solar Bear enough. Pros Features a heavy-duty and long-lasting UV resistant build Using it is a cinch Boasts high-performance Comes with all accessories for quick and easy installation Eco-friendly as it only relies on the energy of the sun Comes with a generous month warranty Cons Prone to minor leaks 2. It is a workhorse that invariably guarantees toasty waters, effectively allowing you to extend the swimming season by several months without incurring any additional costs or harming the environment, as its NOx emissions stand at zero percent. Another reason that makes it the preference of environmentally-conscious users is the ease of installation. Why spend thousands of dollars on an electric or gas-powered pool heater when you can get similar performance at a fraction of the price and without harming the environment? The superiority of the performance is not in doubt. Such universal compatibility does not limit your choices. With regards to performance, the machine features the convenient Max-Flow design and comes with 2-inch OD headers that together significantly enhance the circulation of water. Expand to see more Another beauty is its compatibility with the vast majority of pool pumps. The professional design of the heater eliminates the need to check whether or not the two can work in tandem before making a purchase. Neither do you have to uninstall your

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pool pump after buying the heater. And the installation process happens to be one of the easiest of all the options featuring on our list. Given the size of the solar panels, it might be a little difficult to mount the system on the roof, unless of course you have an extra pair of hands or resort to seeking professional assistance. However, after a successful installation, the universal compatibility and the 2-inch OD headers mentioned earlier provide for a quick, effective swimming pool heating experience. Depending on the prevailing weather conditions, it is capable of raising the temperature of the pool by up to 10 degrees. The reliable and superior performance effectively bring to an end the days of letting Mother Nature dictate the swimming season or have to grind your teeth together and clench your fists before plunging in, in full anticipation of chilling waters. Additional reasons include the fastidious construction quality, unyielding dependability, and cost-effectiveness. The heavy-duty UV-resistant design will provide you with several years of stress-free and flawless performance. Pros Easily and quickly raises pool temperature by up to degrees Very compatible with water pumps Very easy to maintain Sports Max-Flo design that increases circulation of water Compatible with both in-ground and above-ground swimming pools Cons Installing it on the roof requires skill Not ideal for pools larger than 15 square feet 3. Aside from its remarkable performance, the heater is similarly very cost effective, easy to use and maintain and best of all, it features superior construction capable of withstanding the rigorous task of heating large volumes of water quickly and effectively. Since it packs several technologically advanced features to the brim, it provides for easy and quick heating solution for the swimming pool. Raising the water temperature in your pool from cold to toasty does not have to be time-consuming and frustrating. The GAME takes away all the time and effort from the exercise, leaving you with a peace of mind to enjoy a relaxing and refreshing swim in toasty waters. In ideal situations, the heater easily raises the temperature of up to 10, gallons of pool water in a few days. The unique curved shape of the heater, combined with the foldability and adjustability of the legs, provides for maximum exposure to the sun. Consequently, the solar panels still get to capture the heat from the sun even its position during the day. The design, therefore, spares the headache of having to move it around the yard to increase exposure constantly. Expand to see more The heater also has the advantage of being a simple DIY installation. No point in incurring additional installation charges if you have a crack for connecting a few wires here and there. Plus, the delivery package comes with everything you need to get started and finish. There are the stainless steel clamps, hoses, Intex adapters, among other vital accessories. And with its paltry weight of just According to the manufacturer, it takes the GAME just seven days to raise the temperature of the swimming pool by 5-degree. It manages the fete by using a protective cover for trapping heat from the sun before transferring the heat to the water as it passes through. And if your pool is large, the design of the model allows for the connection of more than one unit to another, allowing for the quick heating of the water. Additional reasons that make it worth considering are the ease of installation, the durability of its construction, and of course, the remarkable performance. At this price range, it never gets better. Pros Sports a unique curved design for enhanced heat absorption Features a compact and lightweight design Installs easily and quickly Ideal for use with above-ground pools Energy-efficient Effectively harnesses the power of the sun for optimal performance Cons A little bulky 4. SmartPool SunHeater-Solar Heating System Keeping your pool warm and toasty or extending the swimming season does not have to cost you an arm and a leg, as it does with gas-powered and electric pool heaters. There are several formidable alternatives that are both easy on your pocket and the environment, one of them being the SmartPool SunHeater-Solar Heating System. Like other conventional solar collector pool heating system, the machine uses panels and tubes to raise the temperature of the pool. The heater has the advantage of being easy to install, easy to use, requiring minimal maintenance, and cost-effectiveness. The icing on the cake though, if the affordability. Proper installation on a raised surface or at an angle to ensure maximum exposure to the sun enables it to effortlessly raise the temperature of the water by up to 10 degrees in under 12 hours. For pool owners living in sunny regions, it is a better and more affordable alternative to gas-powered and electric pool heaters. To ensure effective and quick performance, it comes with several black polyethylene panels joined together to increase their surface area and therefore trap more solar energy. Considering their

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sheer volume and number, they ensure maximum exposure to the sun and therefore collect as much heat as possible during the day. Together with the two threaded-elbow adapters, the result is an effortless and quick rise in the temperature by up to 10 degrees in just 12 hours, making it possible for you to enjoy the cool yet warm water all during the day. Expand to see more Its power and performance are wholly attributable to its design and engineering. As the water passes through, the heat in the panels transfers to the water before being sucked back to the pool. The process repeats itself all through the day to provide you with warm pool water all through the day, enabling you to enjoy a relaxing swim all day long without incurring huge electricity bills. Another unique selling point is the high-quality construction. The panels are themselves constructed using industrial-grade polyethylene material that enables them to stand the test of time, in addition to enhancing their performance. The other components feature similarly heavy-duty construction necessary for withstanding the rigors that come with constant exposure to the sun. And to sweeten the deal, it comes with a generous warranty to cater for the repair or replacement of defective or malfunctioning parts and components. If that assurance does not give you the peace of mind to use it with confidence, nothing will. Lastly, it is a simple DIY installation, like most other heaters on our list. With a paltry weight of 10 pounds, it is the lightest solar heater on our list and possibly the entire industry. However, its measurements come at inches by 1. If you have sufficient space by the pool on top of the roof, the measurements should not present much of a problem though. And you have everything you need to make all the connections. The delivery package has the end caps, stainless steel hose clamps, Teflon tape, and hoses if you want to connect more than one collector. The machine is an epitome of all these features and qualities and so much more. They only way to reclaim your beautiful swimming spot and inject a little fun into the weekend gathering would be to get a practical, functional, high-performance, and affordable option. Unlike gas and electric pool heaters, the solar heater packs a lot of potential and effortlessly raises the pool temperature within a short time without harming the environment. To find out why it strikes a chord with the vast majority of private and commercial pool owners out there, continuing reading our in-depth review of the product. While most options come with one bulky sheet of solar collector, the XtremepowerUS comes with two each measuring 20 feet by 28 feet, bringing the aggregate to an impressive 40 inches total. The large surface area ensures maximum exposure to sunshine and their sensitivity to light is solely responsible for the exceptional performance of the heater. Place them at the right angle, degrees facing South for most states, and watch the pool temperature rise quickly from frigid to warm in just a couple of minutes. Expand to see more Installing and getting it to work optimally has never been easier. The simple design makes installation a straightforward and quick DIY procedure. The quick connect design essentially takes the effort and time away from the process, making it possible for the user to set up the machine in a fraction of the time it takes with gas-powered and electric models. Irrespective of where you install them, there are a few guidelines you need to keep in mind. They work optimally with oval pools measuring 24 feet in length by 12 feet in width. Round pools should not exceed 18 feet to achieve the same level of performance and efficiency. If your pool is bigger, it would be prudent to invest in an additional option to experience any significant change in water temperature. The XtremepowerUS is a tried, tested and proven high-performance heater that raises the temperature of a gallon pool by up to degrees in just a few days.

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## Chapter 7 : Commercial Solar Water Heaters | A. O. Smith

*Solar hot water diverters that send surplus solar electricity to the heating elements of conventional hot water systems cannot be used with heat pump hot water. The type of current they supply is not compatible with pumps or electronics and may damage them.*

Solar Space Heat for home or shop Commercial Solar Heating Project Invalid Input Solar Heating System Solar Heating System have greatly evolved in the last 20 years both in performance and price decrease as the world demand for solar heating systems continues to grow. Evacuated tubes that can reach temperatures of F are controlled with state of the are Solar differential controls. At Northern Lights our Solar Heating Systems work seamlessly by integrating with the best components on the market to provide you with highest returns on your investment. All our system are expandable to 2nd heating zones to form larger solar heating systems. Our solar water heaters can be combined with space heating or pool heaters to maximize your investment. All our system come with Smart Phone integration so you can see your savings in real time. Today solar water heating have drastically evolved due to the high performance available through solar vacuum tubes. There are an estimated ,, solar water heating systems worldwide with Asian leading the way and Europe in 2nd. Our solar water heating system use an active loop technology that indirectly heats the hot water through a closed loop and an internal heat exchanger located in the bottom of a specially designed solar water tank. Sophisticated solar differential controllers are able to maximize the systems performance delivering on average over 2 MW of FREE heat energy to your domestic water system. Our system can be used as either a single tank solar water heater Supplemental , or a two tank Pre-Heat solar water heater. This is possible because all our solar storage tanks contain a 4. All our solar water heating system are able to expand to a second heating loop. Our Solar Home Heating Systems use a large gallon state of the art solar hot water tank that has two internal heat exchangers. The bottom heat exchanger attaches to the solar loop to supply solar heat energy to the tank. Our solar Home Heating System come complete with both the solar loop and the heating loop. We can integrate into a forced air furnace, in floor heating loops, radiators and even geothermal loops can take advantage of the solar energy. These systems are susceptible to constants roof leaks and stains and only work if the air temperature is warmer than the pool. Any slight amount of wind quickly removes any heat created as they act as large roof top radiator. Our solar pool heaters use a state of the art closed loop system that operates a small pump consuming less than 50 watts of pumping energy. The heart of our system are solar vacuum tubes that can provide heat to the pool in any outside temperature and have zero effect at any wind speed. In fact our solar pool heaters can heat a pool at or below freezing conditions in full cloud cover! The closed loop system transfers the solar heat energy indirectly through a stainless steel or titanium solar pool heat exchanger. This ensure that chlorine does not have any effect on the solar equipment and can provide up to 20 years of maintenance free operation. State of the art digital differential controllers maximize the systems performance and also allow for WiFi connection to monitor and record the systems performance in real time. Our package systems can integrate with any pool both indoors and outdoors and can be used year round without freezing. Because of solar vacuum tubes this it is possible to heat your hot tub year round including the winter with solar. The solar hot tub heater is a closed loop that integrates directly into your hot tub heating system via a high flow stainless steel or titanium heat exchanger. During the day the solar energy generated is transferred to the hot tub via this heat exchanger. In the evenings your existing heat source may be needed in to keep up in colder winter season. All our solar heating package come ready for a second zone that can be used to heat a domestic hot water, pool, or space heating applications. When integrating with domestic hot water and a solar hot tub, you have the advantage of storing the heat energy in the solar storage tank. This allows the customer to buffer the heat energy when the hot tub does not need it and draw upon it when needed. Vacuum tubes can produce much higher heat levels than other types of collectors and business such as hotels, restaurants, car washes, agricultural and food and beverage industry are prime candidates for taking advantage of the

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opportunities of commercial solar heating. Grant and low interest financing are available in most states in the USA for commercial solar heating projects. FREE Project engineering is available with all our commercial heating packages.

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## Chapter 8 : Solar Thermal Hot Water Systems and Individual Components | Stiebel Eltron USA

*Typical solar water heating systems used in temperate climates consist of a hot water storage tank, control unit, pump station and either flat plate or evacuated tube collectors.*

It takes 9, watts of electricity to heat the water for your home. Harness the power of the sun to heat your water

### How Solar Hot Water Works

Traditional solar hot water systems use solar collectors to absorb energy from the sun. Heated fluid circulates through a solar storage tank, where it transfers its heat to the water in your hot water tank. The solar fluid never touches this water. It needs to become heat and turning sunlight into heat is no problem. Solar water heating panels, sometimes called domestic hot water DHW collectors, are made of glass, copper, and insulation. They are designed to heat relatively small amounts of water 80 to gallons in a home quickly to high temperatures suitable for bathing, laundry and washing dishes. Personal benefits of a solar hot water system include: Monthly savings on your energy bills. By using sunshine to heat or preheat your water, you can cut your water heating bill in half. Our systems use an gallon storage tank to maximize the amount of heat captured from the sun. Fast return on investment. A domestic hot water system pays for itself in about 5 years on average. What other home improvement pays for itself and keeps paying you for 20, 30 even 40 years? You own your energy instead of renting it from the power company. Sunlight is free and limitless, plus has no harmful emissions. When you use the sun to heat your water, you are using free energy and not giving your money to the power company. Reduces your carbon footprint. Installing a solar water heater can prevent 4, pounds of carbon dioxide from entering the atmosphere annually. That is the equivalent of not driving your car for four months every year! Increased value of your home. A study by the Appraisal Institute has determined that people are willing to pay more for homes with solar hot water systems. We are excited to announce a new way to heat your water with solar!

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## Chapter 9 : Solar Hot Water - NC Solar Now

*The system can be used with hot water at various temperatures; insulation blankets with a heat reflecting foil backing are utilized to maintain heating efficiency. The panels are fabricated from either 18 gauge aluminum sheet or 24 gauge steel sheet to which a heating coil is.*

Because every installation is different, we have a full line of SOLkits, mounting hardware, and the individual components necessary for solar thermal installations. We are committed to making and supplying the best solar thermal components available. As a leader in the field we have no intention of standing still. The cost to make hot water is the largest utility expense for a household. It makes sense to save as much as possible on hot water, which is exactly what solar thermal can do. Solar thermal has been used to capture the power of the sun and turn it into hot water for decades before solar photovoltaic PV became a possibility. It reduces carbon footprint and increases the property value of a home. State rebates and incentives, as well as local utility incentives, exist in many parts of the country. A pump moves the hot fluid to a domestic water tank where the heat is transferred to the water through a heat exchanger. The now cool heat transfer fluid circulates back to the collector to gather more heat. Stiebel Eltron has been designing and manufacturing solar thermal components for 40 years. They are designed to work both individually and system-wide to bring you the best in performance and reliability. Explore Live Solar Thermal Installations You can interact with two live Stiebel Eltron solar thermal installations in real-time to learn more about how our systems function. Choose a system below to get started. The diagrams show three common solar thermal installations. Many components of a solar thermal system are universal to all systems. Solar Thermal Collectors Absorbs energy from the sun, converting it into heat. Heat Transfer Fluid A propylene glycol food- and pharmaceutical-grade fluid that holds and transfers heat from the collectors to the tank. The heat transfer fluid is freeze-proof for cold nights. Pump Station Moves the heat transfer fluid around the system. DHW Storage Tank The internal heat exchanger transfers the heat from the heat transfer fluid to the domestic hot water the tank holds. Controller An electronic device that controls the operation of the pump and the safety of the system. Backup Options A backup system is used to add additional heat to the household hot water if necessary. This situation can happen, for instance, on a very cloudy day if the solar system can not make enough hot water to satisfy the demand or make it hot enough. SOLkits come in 1, 2, or 3 panel sizes in up-roof configuration, and 2 or 3 panel sizes across the roof. Selection of the correct kit depends on family size, domestic hot water needs, and space heating needs if required. Our expert service representatives are available by phone or email for assistance and recommendations. Kits come complete with recommended pump station, controller, and tank. A rack kit, and the line set for a particular installation, completes the package, supplying every component needed. Our components are designed for maximum compatibility, ease of installation, and reliability. The SOL 27 Premium features a highly selective absorber coating, low-iron, tempered solar glazing, and very effective insulation around the absorber plate. The internal fluid tubes are copper and the absorber plate is aluminum. Manufacturing in the US for our collectors and racking systems also means we can custom-anodize collector frames and racks to meet specific architectural color requirements. They are three to five times more effective at capturing solar power than photovoltaic PV systems. Their latest-technology copper absorber plates are sealed inside single-walled, proprietary glass tubes with an uncompromising vacuum seal. Ideal for conditions where the outside temperatures are low and the demands for thermal energy are high, they are particularly well suited for combination systems where hot water, space heating, and air conditioning are required. They come in both 80 gallon l and gallon l sizes and can serve as a dedicated high-capacity solar storage tank in both residential and commercial installations. Stiebel Eltron tanks and heat exchangers are made of heavy gauge steel. In addition, vessel exteriors receive a light porcelain coating. Two inches of urethane foam insulation ensures that hot water stays hot, and standby heat loss is minimized. Stiebel Eltron SBB tanks are equipped with large sacrificial anodes with wear indicator and an extra-large clean-out port for

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ease of maintenance. SB and E storage tanks are equipped with a 3 kW electric heating element to back up the solar production. This heating element is sheathed in a steel cylinder inside the tank, and can be removed and replaced without needing to depressurize and drain the tank. Auxiliary ports allow for additional installation applications, including boiler backup, split heat pumps, and hydronic applications. Stiebel Eltron also sells German-made single and dual coil storage tanks without the electric backups. The controller is equipped with an illuminated system-monitoring display. Adjustment and control of the solar system can be easily carried out through the user-friendly pictograph display. Other Stiebel Eltron controllers are available for larger residential and commercial systems, including complex commercial systems. Pump station piping is high grade brass. Pump stations come preassembled with a steel wall mounting bracket and feature 2 drain valves, brass check valves to prevent thermo-siphoning, integrated flow meter, and include fittings for tank mount as well as NPT adapters. The pump station can be completely isolated from the system, so no draining is necessary during servicing. Dashboards are designed for both owners and installers, and include a diagram view for virtual inspection of the system. Installers can manage and control systems remotely and set optional email alarms for notification of performance issues. Remote access reduces on-site cost for service contracts.

**Mounting Systems** Stiebel Eltron mounting systems are made in the U. Racks are available in three different configurations: The Flush Mount Kit is used for installations where the roof structure itself is at the proper angle to mount the collectors. The simple, strong u-channel design of our racks can withstand high wind and heavy snow. Stiebel Eltron mounting systems can be assembled using only two different socket sizes. Additional mounting components, such as hardware, in addition to flush mount and fixed angle racks, are available.