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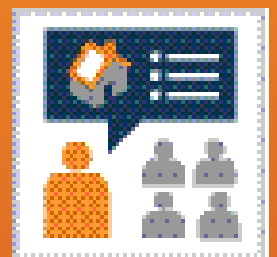
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SunMaxx INFORMATION GUIDE

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Solar Domestic Hot Water



SOLAR DOMESTIC HOT WATER

Domestic hot water is the water that you use everyday around the home for taking a shower, washing your hands, and washing laundry and dishes. The average American uses 20 gallons of hot water per day. Therefore, the average four family home uses about 80 Gallons total, and a six family home around 120 gallons. And we are all familiar with the traditional energy sources, such as fossil fuels and electricity, that have been traditionally used to heat hot water.

However, with rising and unpredictable energy prices and the effect that some of these fuels are having on our environment, today's consumers are looking elsewhere for alternative energy solutions. Not only is there a desire to lower their hot water heating costs, but they are also interested in doing whatever they can to help in the global effort to reduce their own carbon footprint on the planet.

Solar thermal energy is quickly being realized as the most viable alternative to accomplish both goals. A solar thermal system uses the sun's heat energy provide 75% or more of your domestic water heating needs; while at the same time, reducing your dependence on oil, natural gas or electricity for water heating and cutting your energy bills dramatically. The fact is, the average American household spends more than 20% of their annual total energy bills on domestic hot water alone.

SunMaxx Solar is the industry leader in providing turnkey solar thermal system solutions for the heating of domestic hot water. Our prepackaged solar hot water kits feature all of the major components needed to design and install a new solar hot water system, or retrofit your existing system.

Typically, a solar hot water system will include the following major components:

- Solar collectors (evacuated tubes or flat plates)
- Solar storage tank or heat exchanger
- Differential temperature controller
- Circulator pump(s)
- Expansion tank/vessel
- Key plumbing components

SunMaxx also carries a line of thermosyphon kits, which are designed to be a simple on-demand solution for domestic hot water, and require no pumps or controllers to operate.

In this guide, you will learn the basics (and specifics) of solar domestic hot water systems, and information on how to select the right SunMaxx components for your specific application.



Determining Your Hot Water Usage

For a typical household, the average hot water usage per person is 20 gallons. This is a good starting number to begin calculating what kind of load is currently required by your existing system. Using this figure, you can estimate the amount of hot water used for a house that has three occupants is roughly 60 gallons per day.

By knowing the amount of hot water you require, you can begin to determine the size domestic solar hot water system you will need. Typically, SunMaxx recommends that you size your solar hot water system to provide roughly 70% of the annual water heating load of your home.

The easiest way to size your SunMaxx solar hot water system is by determining the heating load in BTU's. You can determine the heating load with the following information:

- Gallons of hot water consumed per day
- Cold water temperature coming into the house
- Desired hot water temperature

It takes 8.34 BTUs to raise the temperature of one gallon of water 1 °F. So, if we assume the following:

- 3 residents: 60 g/day
- Cold water temperature: 50 °F
- Desired water temperature: 130 °F

BTU needed: $(8.34 \times 60) \times 80 = 40,000$ BTU/day

You should size your SunMaxx solar hot water system to meet close to 100% of your need on a bright summer day.

Solar Hot Water Buying Process

Using the following step-by-step process, you will be able to choose the right solar collectors, components or pre-packaged solar hot water kit to meet your needs. You can then refer to the pages following, which give a more extensive break down of the different steps in the process.

1. **Select the Right SunMaxx Solar Collector** - Flat plate solar collectors and evacuated tube solar collectors are two main types of solar collectors available. And determining which one is best suited for your solar hot water system is as simple as looking at a map and determining your climate designation. Flat plate solar collectors are designed for use in warmer climates where freezing temperatures are not a major concern. This typically means the southeast, southwest, and most areas along the west coast of the United States.

Evacuated tube solar collectors are designed to provide incredible performance in colder freezing climates where flat plate solar collectors would begin to lose efficiency and may become damaged by freezing. While evacuated tube solar collectors are more expensive than flat plates, in colder climates they have a higher return on investment and a shorter payback period.

2. **Choose a Storage Tank or Heat Exchanger** - Your domestic solar hot water system can be designed and installed in a number of different ways. If you plan to keep your existing hot water storage tank/heater, you can use a solar hot water storage tank as a pre-heat tank in series with your current tank. Or you can use a brazed plate heat exchanger to pre-heat your potable water before it enters the existing hot water tank.

If, however, there is no existing hot water tank/heater, or you plan to completely replace it, you can use just a solar hot water storage tank, which has internal heat exchangers for the solar heating and a place for a backup electric heating element. This compensates for the lack of solar heating at night or extended periods of cloudy weather.

Whichever option you choose, you should choose a storage tank that will hold enough water for your family to use in a normal day. Typically, the average person uses 20 gallons of hot water per day. You can underestimate the size of the storage tank, because as hot water is used it will be replaced with cold water which will then be heated within the tank, maintaining the proper level of hot water on hand when it is needed.

3. **Select Your Prepackaged Domestic Solar Hot Water Kit** - To make purchasing a solar hot water system even easier, SunMaxx offers a number of prepackaged domestic solar hot water kits, sized for households from 2-6 people.

There are two main types of pre-packaged domestic solar hot water kits:

- **Pre-packaged kits with solar hot water storage tanks**
 - Includes models built with SunMaxx evacuated tube solar collectors
 - Includes models built with SunMaxx flat plate solar collectors



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Solar Hot Water Buying Process, cont.

- Pre-packaged kits with solar hot water heat exchangers
 - Includes models built with SunMaxx evacuated tube solar collectors
 - Includes models built with SunMaxx flat plate solar collectors

Please see the last page of this brochure for available prepackaged domestic solar hot water kits from SunMaxx.

Both evacuated tube solar collectors and flat plate solar collectors are extremely affordable, and highly-efficient solar collectors. However, there are distinct difference, and advantages of these solar collectors when compared to each other.

You can use the map at the lower right to see where SunMaxx recommends that customers use flat plate collectors vs evacuated tube collectors.

Evacuated Tubes vs Flat Plates

Below, explore the differences between evacuated tube and flat plate solar collectors to help you make a more informed decision on which solar collector is the right choice for you.

Efficiency

Both evacuated tube and flat plate solar collectors are extremely efficient. However, flat plate solar collectors have an overall higher efficiency. But, for customers who live in colder, northern climates, evacuated tube solar collectors provide more reliable, efficient performance in colder temperatures (down to -60 °F) making them the clear choice in these locations.

Price

Both types of solar collectors are affordable. Flat plate solar collectors, because of their simplistic design and manufacturing have a lower initial price. But, again, in colder climates, the extended performance of evacuated tube solar collectors makes them significantly more cost-effective in the long run.

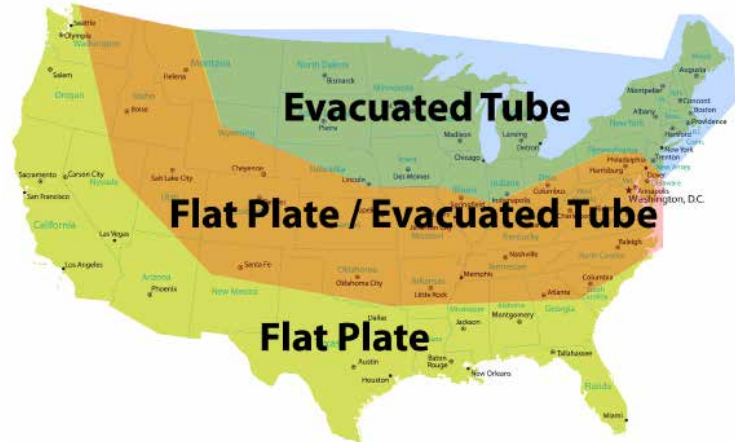
Durability / Reliability

While flat plate solar collectors are extremely reliable and durable, should a problem occur with one flat plate collector, the entire system must be shut down, and the entire collector(s) must be replaced. Evacuated tube solar collectors, however, are modular by nature, and should a single tube (or multiple tubes) break for any reason, the system will continue to operate, and may be kept functioning while the tubes are replaced.

Choosing the solar collector that will make your new SunMaxx solar hot water system efficient, cost-effective and affordable is the key to your investment. It will ensure long-term growth in your energy savings, especially as the cost of traditional heating fuels continues to rise. Whether you should use a solar hot water storage tank or a brazed plate heat exchanger depends on a few factors. This is also an important factor in choosing your solar hot water system because a solar hot water storage tank will cost hundreds of dollars more than a heat exchanger. However, in many applications, it is more efficient and cost-effective to purchase a solar hot water storage tank because your return on investment tends to be higher and your payback period tends to be shorter.

Solar Hot Water Storage Tanks

Solar hot water storage tanks are an affordable way to provide to hot water storage and solar heating capacity to your solar hot water system in one component, with minimal system alteration and plumbing work.



Evacuated Tubes vs Flat Plates, cont.

Solar Storage Tank or Heat Exchanger

SunMaxx solar hot water storage tank features:

- Outer finish: stainless steel or painted steel
- Tank material: stainless steel
- Internal copper coil heat exchangers
 - 1 in 40/50 gallon tanks
 - 2 in 80 gallon tanks
- Increased efficiency and R-value

Pros & Cons:

- Designed to provide solar heating and hot water storage in one component
- Built in heat exchangers
- Designed to be used with SunMaxx solar hot water systems

Used for system types:

- Where the solar storage tank will be a pre-heat tank for the existing hot water tank/heater
- New construction/installation where no hot water tank heater exists
- Where the existing hot water tank/heater will be completely removed and replaced

Solar Storage Tanks			
Model	Capacity	Outer Finish	Heat Exchangers
StorMaxxPtec-50-2HX	50G	Stainless	2
StorMaxxPtec-80-2HX	80G	Painted	2
StorMaxxPtec-105-2HX	105G	Stainless	2
StorMaxxPtec-130-2HX	130G	Painted	2

Solar Hot Water Heat Exchangers

Brazed plate solar hot water heat exchangers are an even more affordable to utilize SunMaxx solar collectors and systems in your current domestic hot water system. The key advantage is that these heat exchangers utilize your existing hot water storage tank/heater, eliminating the need to purchase a pricey solar hot water storage tank.

Brazed plate heat exchanger features:

- Copper and steel construction
- Easy, quick plug 'n' play installation
- Available in 10, 20 and 30 plate models

Pros & Cons:

- Use your existing hot water tank/heater in your solar hot water system
- Lower cost investment than a solar hot water storage tank
- Easily integrates into any domestic solar hot water system

Used for System Types:

- Where the existing hot water tank/heater will be used to pre-heat potable water before it enters the tank

Model	# of Plates	BTU/hr
XMaxx-BP-10	10	90K
XMaxx-BP-20	20	100 - 175K
XMaxx-BP-30	30	200 - 275K



SOLAR DOMESTIC HOT WATER

Prepackaged Solar Hot Water Systems

SunMaxx Solar manufactures a variety of prepackaged solar hot water systems designed to meet the needs of a variety of system sizes, locations and budgets.

Pressurized glycol systems

- Systems with solar storage tanks or brazed plate heat exchangers
- Systems with evacuated tube or flat plate solar collectors

Model	Daily Capacity (G)	Solar Collectors	Tank / Heat Exchanger
with Solar Storage Tanks			
3570	40 - 50	(1) ThermoPower-VHP20	40G Tank
1704	60 - 70	(2) ThermoPower-VHP20	40G Tank
4005	80 - 120	(2) ThermoPower-VHP20	80G Tank
17885	50	(1) TitanPower Plus-SU2	40G Tank
17886	80	(2) TitanPower Plus-SU2	80G Tank
with Brazed Plate Heat Exchangers			
17881	40 - 50	(1) ThermoPower-VHP20	10 Plate HE
17882	80 - 120	(2) ThermoPower-VHP20	10 Plate HE
17883	40 - 50	(1) TitanPower Plus-SU2	10 Plate HE
17884	80 - 120	(2) TitanPower Plus-SU2	10 Plate HE

Drainback systems

- Systems with storage tanks or retrofit kits (no storage tank)
- Systems with evacuated tube or flat plate solar collectors

Model	Daily Capacity (G)	Solar Collectors	Drainback Tank
with Solar Storage Tanks			
DBS-4050-1	40 - 50	(1) ThermoPower-VHP20	10G
DBS-80120-1	80 - 120	(2) ThermoPower-VHP20	10G
DBS-4050-2	40 - 50	(1) SunMaxx-FP	10G
DBS-80120-2	80 - 120	(2) SunMaxx-FP	10G
without Solar Storage Tanks			
DBR-4050-1	40 - 50	(1) ThermoPower-VHP20	10G/HE
DBR-80120-1	80 - 120	(2) ThermoPower-VHP20	10G/HE
DBR-4050-2	40 - 50	(1) TitanPower Plus-SU2	10G/HE
DBR-80120-2	80 - 120	(2) TitanPower Plus-SU2	10G/HE

Thermosyphon Solar Hot Water Heaters

- Thermal storage & solar collector in one complete unit
- Can be used in active or passive systems
- Built with SunMaxx evacuated tubes
- Ideal for any climate

Model	Storage (G)	# of Tubes	People Served
ThermoPower-VTS20	40	20	5 - 7
ThermoPower-VTS30	80	30	8 - 10+

Additionally, SunMaxx thermosyphon solar hot water heaters are ideal as on-demand passive (or active) domestic solar hot water systems.



Typical System Types

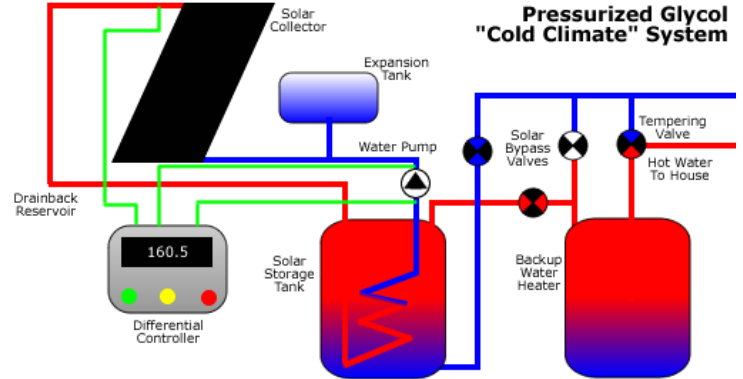
Pressurized Glycol (Cold Climate) System

The pressurized glycol system is the most reliable configuration for solar water heaters, but the initial cost in collectors and components, and the costs of maintenance and repair are significantly higher than any other system setup configuration.

This system is appropriate if damage from freezing is not an issue. Changing your fluid (a water/glycol solution) regularly is recommended for the protection of your investment, but will modestly increase your maintenance time and costs.

Advantages:

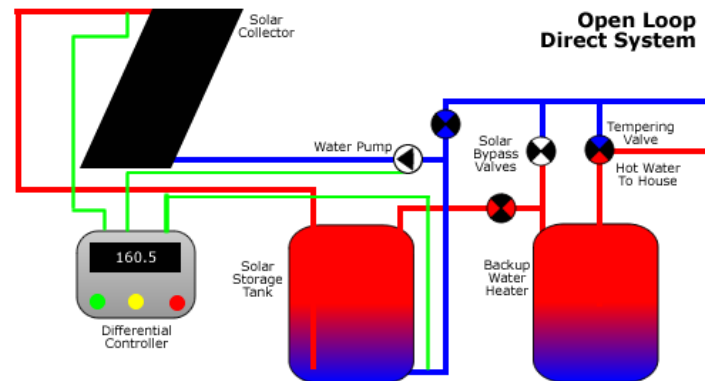
- Will not freeze, except in extreme temperatures
- Uses a pressurized loop that circulates a food-grade glycol
- Indirectly transfers heat from the glycol solution to your potable water
- Requires the glycol solution to be changed every few years (at least)



Open-Loop Direct

The simplest of all direct systems is the thermosyphon water heater. These systems operate on a very simple principle – water is circulated by natural convection and gravity – rising and falling in response to solar heat, just as air does. In their simplest form, thermosyphon systems are not suitable for cold weather climates because water remains in the collector at all times, creating a problem with freezing conditions. However, a valve can be added to drain the collectors when freezing temperatures occur.

A direct pump system is often used as flexibility in system layout and design becomes necessary. With this forced circulation, the tank does not need to be placed above, or even near, the solar collectors. In this system, the pump moves water through the collectors only when there is enough solar radiation to provide useful heat. When the pump shuts off the collectors are drained of water (assuming the drain valve has been installed).



Important Note: Direct systems, whether pumped or thermosyphoned, cannot be used in areas where water is hard or acidic. Scale deposits would quickly clog the inside of the absorber tubing, and the corrosion could render the system inoperable.



SOLAR DOMESTIC HOT WATER

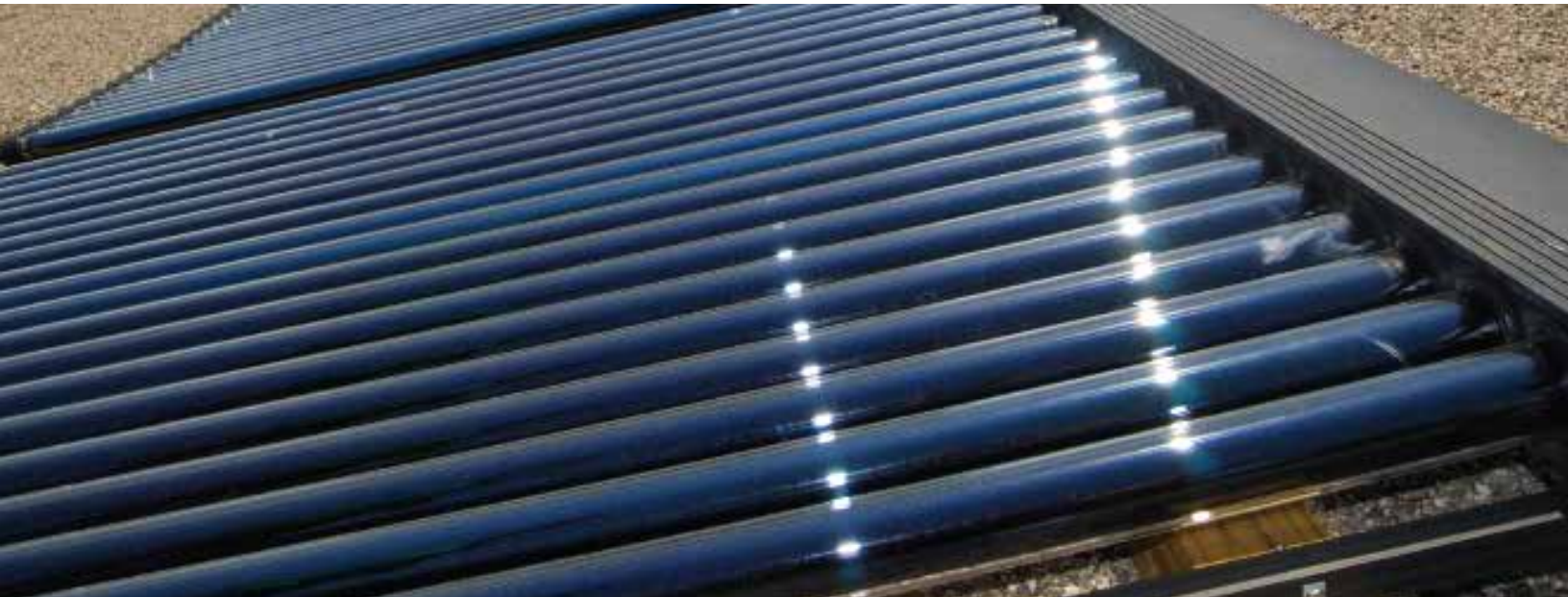
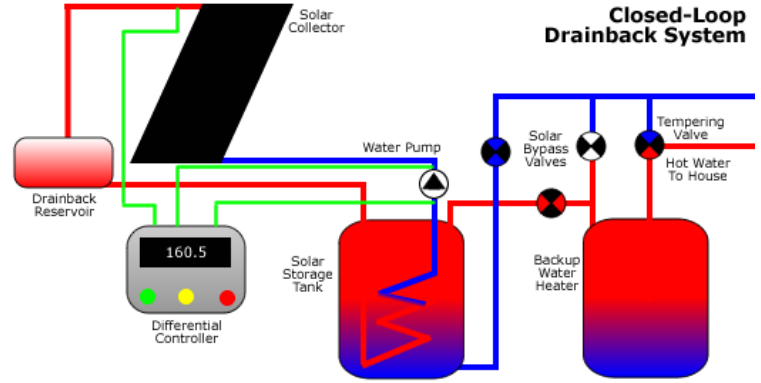
Closed-Loop Drainback

First developed in the 1980's, the closed-loop drainback systems have proven themselves to be reliable and highly efficient. They are essentially a non-pressurized closed-loop system that uses water as a heat transfer fluid (not a glycol mix). A small drainback reservoir is added to the collector loop, and the system is filled pure water to the top of the reservoir. Because the collectors are located above the reservoir, they remain dry when the system's pump(s) is off.

How they work – when the collectors are hotter than the water in the storage tank, the system activates automatically to heat the water. Then, when the water in the storage tank is hotter than the collectors, or reaches a pre-determined cut-off temperature, the system shuts down the pump and the water drains back to the reservoir.

Problems Addressed:

- Freeze protection gravity based
- The pump is shut down when the water temperature is correct, draining all excess water from the collectors
- Fewer components than other systems, reducing the risk of problems, and lowering any repair or replacement costs



Typical System Components

Solar hot water systems require a number of key components to operate efficiently and as cost-effectively as possible. These components work together seamlessly, and assist in incorporating your new solar hot water system with your existing hot water system, home heating system or pool/spa heater to reduce your energy bills without any hassles and huge overhead costs.

Following is a list, with descriptions, of the major components of a solar thermal hot water heating system.

Solar Collectors

Whether you use evacuated tube solar collectors or flat plate solar collectors, these are the heart and soul of your solar hot water system. By capturing the UV radiation from the sun, converting it to heat and transferring it to your potable water or via a heat transfer fluid (HTF), SunMaxx solar collectors make it possible to generate your hot water and heating needs for a fraction of the cost of your current traditional fuel powered heating system.

Solar Hot Water Storage Tank

A solar hot water storage tank is specifically designed to operate in concert with today's SunMaxx solar collectors and solar hot water systems. These tanks feature thick insulation, stainless steel construction, easy plug-n-play connections and internal copper coil heat exchangers, making it extremely easy to design and install a closed-loop solar hot water system. Tanks can be coupled with an electric backup heating element to be a standalone hot water heater that can replace the current hot water boiler at a location, or plumbed in series with the existing water heater to provide a pre-heat tank that is always full of hot water to meet the demands of large households.

Solar Hot Water Heat Exchangers

There are a variety of solar hot water heat exchangers available today, and most are designed to fit the specific needs of a solar thermal hot water systems. The main types of solar hot water heat exchangers are:

- **Copper Coil** - these are typically found within a solar hot water storage tank, allowing you to create a closed-loop solar hot water system with a new, solar specific hot water storage tank
- **Brazed Plate** - these heat exchangers feature a number of copper plates with a small space between them, allowing your HTF and potable water to pass through, separate from each other while providing adequate heat transfer to create an efficient and cost-effective closed loop system for domestic hot water or radiant heating applications

- **Shell & Tube** - These heat exchangers are specifically designed for pool & spa heating as well as marine solar hot water applications. Typically they are made from stainless steel, which is not susceptible to corrosion from contact with chlorinated water like a copper heat exchanger would be.
- **Air-to-Water** - these heat exchangers operate essentially the same as a car radiator does, allowing hot water to pass through the exchanger and heating the surrounding through a series of radiator fins as it does. These heat exchangers are ideal for use in solar hot water systems, in forced hot air central heating systems, and as a heat dump for releasing excess heat from your solar hot water system in the summer months when it is not needed.

Differential Temperature Controller

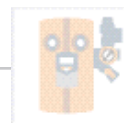
These are designed to provide automatic operation of your SunMaxx solar hot water system, which means a more hassle-free system with less maintenance and less attention. By measuring the temperature of the water in the solar collector header (manifold) and within the storage tank, the controller will determine when your solar hot water system should operate to heat water. This will provide significant energy savings over a system that is operated manually, or allowed to run continuously with no checks in place. The differential temperature controller is the brain of your solar hot water system. Whether you have a small residential system or a large commercial array, this is a component that must be included in your installation.

Solar Hot Water Circulator Pump

The circulator pump operates as the heart of your solar hot water system. The pump is controlled by the controller, and is told when to cycle water or HTF through the system to provide heating, to turn off when heating is not needed, or when there is not enough heat being generated by the solar collectors. Solar hot water circulator pumps are available in AC models, DC models and PV/battery controlled models. Each of these types of circulator pumps have their advantages and disadvantages - you should consult your dealer or installer regarding which type of pump is the most appropriate for your application and budget.

Expansion Tank

An expansion tank is a necessary component in a closed-loop system. As water is heated, it expands. The expansion tank allows the expanded water a place within the system to escape to until the temperature has lowered and the water or HTF volume has returned to normal levels.



Drainback Tank

A drainback tank is used in a drainback system, where water or HTF is drained from the solar collectors when the system is not in use. This serves as a freeze protection method for protecting the system in cold climates and weather, much like glycol does in a pressurized system. Drainback systems are one of the most common solar hot water system installation types used today.

Plumbing Hardware & Additional Components

There are several other components that are used in solar hot water systems. These components should not be overlooked in their importance to performance of the overall solar hot water system. These components include:

- Tempering valves
- Check valves
- 3-Way valves
- Automatic air bleeders
- Temperature and pressure gauges
- Temperature and pressure relief valves
- Copper and PEX piping
- Quick connectors, PEX-to-copper connectors, compression fittings and more

Working with Glycol - Pressurized Systems

You can use the information below to assist in determining the correct amount of glycol to use in your domestic hot water system, if you are choosing to install a pressurized glycol system for cold-weather protection.

For safety, always use propylene (food-grade) glycol, not ethylene glycol. You will also need to maintain a pH level of 8-10.

Freezing Point for Glycol-water Solutions

Glycol Solution (% by mass)	Temperature	
	°F	°C
00	32	0
10	26	-3
20	18	-8
30	7	14
40	-8	-22
50	-29	-34
60	-55	-48

*Due to slush creation, you should avoid using these solutions at temperatures close to their freezing point.

Recommended % of Volume for Glycol Solutions

Temperature (°F)	% for Freeze Protection	% for Burst Protection
20	18	12
10	29	20
0	36	24
-10	42	28
-20	46	30
-30	50	33
-40	54	35
-50	57	35
-60	60	35

*Neither Silicon Solar, nor the manufacturer of the glycol, guarantee that freezing damage will not occur at the temperatures listed in these tables.



Solar Hot Water FAQs

Is solar hot water a viable alternative to my current gas or electric hot water heater?

A SunMaxx solar hot water system should not be seen as an alternative, but rather a supplement. You should strive to size your SunMaxx solar hot water system to meet between 60 - 70% of your total annual hot water needs. A properly sized system should produce nearly 100% of your daily hot water needs on a sunny summer day.

How long will it take for my system to pay for itself?

A SunMaxx solar hot water system is a major investment, like any heating system or major home appliance. However, unlike most major appliances that continuously cost money year after year for operation and maintenance, a SunMaxx solar hot water system will save you enough money in fuel bills to have completely paid for itself in as little as 2-3 years.

Can a SunMaxx solar hot water system be used in cold weather climates?

Yes. Any SunMaxx solar collector can be used in cold conditions, down to -60°F. However, performance is greatly reduced in these extreme temperatures. Good heat output can still be achieved in mild sub-zero conditions. The use of a pressurized glycol or drainback system is recommended in cold climates to prevent freezing damage.

Will water still be heated on a cloudy day?

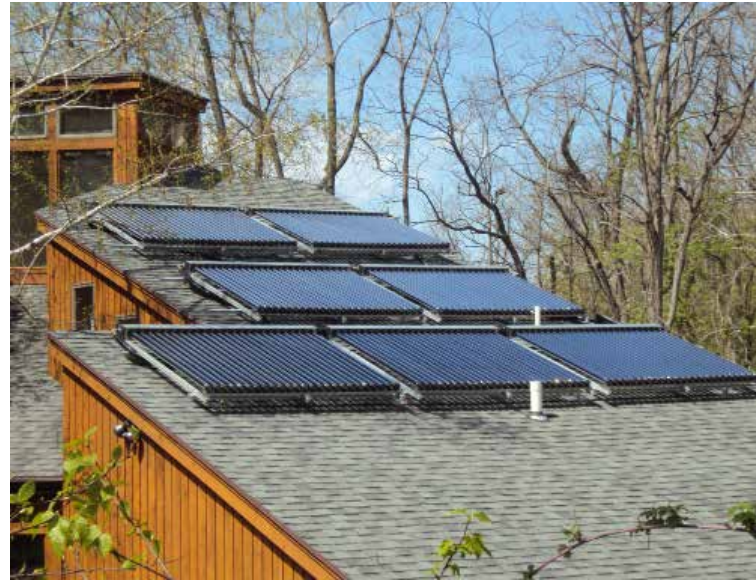
Yes. SunMaxx solar collectors operate on UV radiation, not direct sunlight. Though performance is greatly increased in direct sunlight, significant efficiency can be achieved in mildly overcast conditions.

Can I use a SunMaxx solar hot water system with my current hot water heater?

Yes. The idea is to tie your SunMaxx solar hot water system into your current hot water heater, using the solar heater as your main source of heating and the traditional heater as a supplement when there is not enough solar heating.

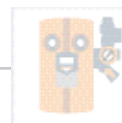
What else can SunMaxx solar collectors be used for?

By combining a number of SunMaxx solar collectors together in series and/or parallel, a SunMaxx solar hot water system can be size large enough to be used for radiant/space heating and pool/spa heating.



Additional Resources

If you need any additional information regarding any of the products referenced in this guide, or regarding using a SunMaxx solar hot water system for radiant heating or pool/spa heating applications, please call us at 1.877.786.6299. Or you can visit us online at www.sunmaxxsolar.com.





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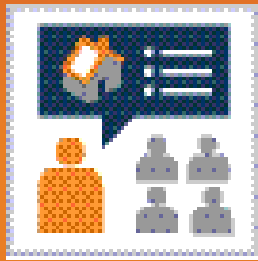
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Complete solar thermal training
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SunMaxx Solar, Inc.
56 Broome Corp. Pkwy
Binghamton NY 13748
1.877.786.6299
1.800.786.0329 fax
www.sunmaxxsolar.com

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