

Water heaters are the second largest energy load in a typical Florida home and they average about 15% to 20% of the annual energy consumed. Homes with large families can be more than that, sometimes 30% to 35% of the energy consumed. Energy consumption from water heating is a very straight forward concept and revolves primarily around how much hot water is used in the home and when it is used. These two factors drive what type of water heater is best suited for the home and how much energy and money can be saved with it. There are many types of water heaters with varying efficiencies but the only one that uses an energy source that is free to heat the water is a solar water heater. All others use an energy source that costs money, no matter how efficient they are.

Solar water heating has been around since the late 1800's so it's not a new concept by any stretch. In fact the basic principles are still the same. A **solar collector**, which is basically an insulated box of metal pipes, is installed in a sunny place. As the sun heats up the metal pipes, water is sent through the collector to capture the heat and store it in the water heater tank. Solar water heaters typically supply 70% to 90% of the annual hot water requirements to a home from the sun, so they can reduce the cost of heating water by that same amount. This fact makes them the most efficient water heating systems available. There is 40 plus years of data proving that these systems will perform this way if designed and installed properly. One of the key aspects of proper design is to ensure plenty of storage capability to capture the hot water and store it for use by the home at a later time.

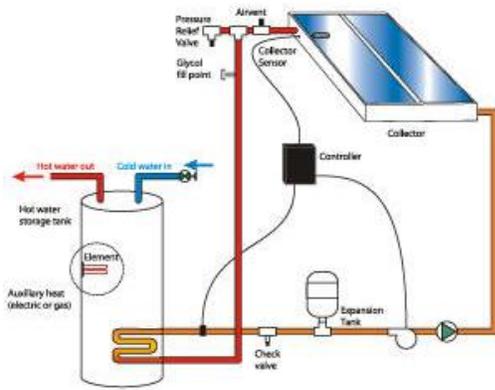
There are many types of solar water heating systems. Some are designed for very cold climates and others for climates that never freeze. They all have their pros and cons but it is important to install a system properly designed for the climate zone. The two most common systems installed in Northeast Florida are:

- ***Active flat plate collector closed loop drainback systems***
- ***Passive open loop integrated collector storage (ICS) systems***

Both of these systems are generic names but specific models of these systems are manufactured locally by Alternative Energy Technologies in Green Cove Springs and Thermal Conversion Technologies in Jacksonville. Here's how these systems work (*refer to the terminologies section to understand the terms more clearly*).

Active flat plate collector closed loop drainback systems: These are the most predominant systems in our area and are very effective for our climate zone. They use a flat plate collector to heat the water and have a water heater tank and a small drainback tank for the collector water to be stored. When the sun begins to heat the collector, a temperature sensor will turn on a pump that circulates water from the drainback tank, through the collector and into a heat exchanger inside the hot water tank. The heat exchanger heats up the water in the tank and then flows back through the collector to heat up. When the sun goes away or the collector cools down for any reason, the pump will turn off and the water in the collector will drain into the drainback tank to prevent any issues with freezing in the collector. The hot water tank is a specially designed with a heat exchanger and either 80 gallons or 120 gallons in size and coupled to one or more collectors. The tanks have heaters in them so that if the sun can't produce enough hot water, the heaters come on to heat the water. As stated earlier, the sun produces most of the hot water and the heaters come on very infrequently.

Since the freeze protection is designed around the drainback system, the collectors must be installed in a place that allows the water to drain out and back into the drainback tank. As a closed loop system, the water in the collector never enters the home. It's only function is to get hot and exchange that heat to the water in the tank that will be used in the home.



Active closed loop system



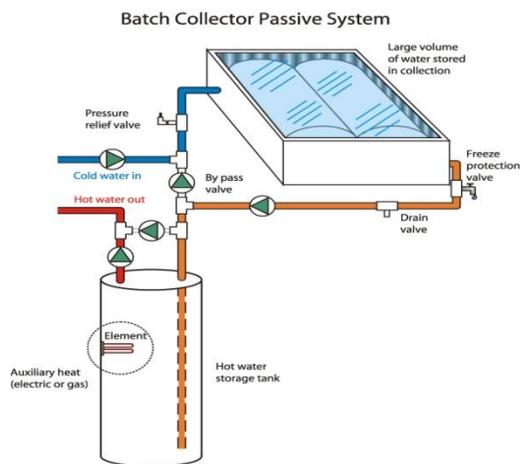
Flat plate collector



Water & drainback tanks

Passive open loop integrated collector storage systems: These systems use a collector that has larger pipes connected in series inside the box. The cold water inlet normally installed on the water heater is connected to the collector. The outlet of the collector is connected to the cold water inlet on the water heater. When the sun heats up the collector the water inside gets hot. As hot water is used in the home and drawn from the hot water tank, the hot water inside the collector flows into the tank so that hot water is coming in instead of cold water. Basically, it acts like a pre-heater for the hot water tank so that the heating elements in the tank do not come on nearly as much. There is no heat exchanger so any standard water heater can be used.

The collector is basically a big insulated metal pipe sponge that slowly heats up when the sun is out and slowly cools down when it is not. Since they are passive systems and use the water pressure to move the water through the collector, they can be mounted almost anywhere. They are very effective in the warmer months and not as efficient during the colder months but over an entire year will reduce the energy requirements for heating water significantly. They are not as efficient as active closed loop flat plate collector systems but are also not as costly. They are not prone to freezing since the volume of water and the heat they store prevents that in our climate, but during the short cold snaps we receive in Northeast Florida, they will cool off dramatically. Also, these are open loop systems so the water used in the home flows through the collector. Depending on the quality of the water, these collectors can begin to scale up over time and may need to be flushed with a vinegar mix a few times over the systems life to break up the mineral deposits that form on the pipe walls.



Passive open loop ICS system



Roof mounted ICS or "Batch" collector

There are multiple variations of these two systems and there are many, many other types of solar water heating systems that can work very well in Northeast Florida. The key is that the system was designed and installed properly to ensure longevity and energy savings.

Caution: *There is an active flat plate collector OPEN loop system design that is used extensively in south Florida. This system is very efficient and less expensive but is VERY prone to freezing in Northeast Florida. It is not recommended that this system be installed in this area unless the homeowner CLEARLY understands how to operate and maintain the system.*

Terminologies:

Collector: Is the piece of equipment that “collects” the sun’s heat for heating the water. There are many types and styles of collectors but the basic functionality is the same for all of them. Some common types are:

- *Flat plate collector:* These collectors tend to be very thin (comparatively), heat up/cool down quickly and are not designed to hold any significant volume of water. They are used in active systems so once they reach the required temperature, a pump turns on to flow water through the collector to capture the heat. Once the collector cools down, the pump will turn off. They are very efficient but also very prone to freezing so must be designed properly in cooler climates where freezes occur. They are normally 32 square feet in size and can be installed in series if more heating is required.
- *Batch collector or ICS:* These collectors are larger and hold some volume of water, typically 40 to 60 gallons, but can be most any size. Predominantly used in passive systems and very mild climates, they heat up and cool down very slowly due to the stored energy in the water inside the collector. They will freeze but usually much less prone to freezing unless exposed to extended periods below 32 degrees.
- *Evacuated tube collector:* Used in cold climates since they are very freeze resistant. The metal pipes which heat up the water are inside a clear tube that has a vacuum drawn on it. The vacuum tube helps to insulate the pipes and prevents them from freezing and also makes them very efficient. These are excellent collectors but also very expensive and rarely used in mild climates like Jacksonville.

Active and passive Systems: Active systems use a pump to circulate the water through the collector while passive systems do not use a pump. They use the water pressure in the system or natural convection flow.

Closed and open loop systems: Closed loop means that the water that flows through the collector is separated from the water used in the home. Closed loop systems use a heat exchanger to transfer the heat to the water to be used in the home. Closed loop systems are also referred to as “indirect” systems.

Open loop means the water used in the home flows through the collector and is heated directly without any other types of heat exchangers. Open loop systems are also referred to as “direct” systems.

Pitch and bearing: The pitch refers to the angle of the collector with reference to the horizontal plane. In Northeast Florida a good angle is about a 30 degree tilt so that the collector’s angle is somewhat perpendicular to the sun throughout the year. The sun will move higher in the sky in summer and lower in winter and 30 degrees is a good mid-point.

The bearing refers to which direction the collector is pointing. In other words: south, southwest, etc. In bearing terms, 0 degrees is due north and 180 degrees is due south.

Energy Factor: A value that denotes the amount of energy input that is converted to usable hot water. Standard electric tank water heaters have energy factors of .91 to .94. This means 91% to 94% of the energy they consume is converted to usable hot water. Solar water heaters have energy factors between 2.5 and 4, since much of the energy to heat the water comes from the sun and not heating elements.

FSEC ID #: The Florida Solar Energy Center is an extension of the University of Central Florida and one of Florida's leading academic experts in solar systems. FSEC tests solar systems and has data on them. The FSEC ID number refers to the system identification so that any data on that system can be looked up. You can view data at www.fsec.ucf.edu

Section 1: Type of System

This section provides the information necessary to determine what type of solar water heating system was installed, how large it was, its rated efficiency and what its FSEC ID number is.

Section 2: Installation

- *Average daily direct sunlight on collector(s):* Depending on site conditions, the collector may only have a few places that it can be installed. How much average daily sunlight it will see in this location is important to understand the performance of the system.
- *Collector(s) pitch (angle):* This is the angle at which the collector was installed.
- *Collector(s) bearing (compass heading):* This is the direction the collector is facing (south, southwest etc.). You want a collector facing somewhere between southeast to southwest as much as possible. Due west facing collectors will work also if there is an open sky and they receive a lot of direct evening sun. However, during the winter, west facing collector's average daily direct sunlight is diminished.
- *Anti-freeze sensor installed on drainback systems:* This is another temperature sensor installed with the pump temperature sensor to ensure the pump is off during freezing conditions. It's basically a backup sensor in to prevent the pump from running during freezing conditions.
- *Air vent installed and insulated to prevent vacuum in collector:* This vent prevents a vacuum from forming inside the collector.
- *Hot water return lines and cold water supply lines insulated:* Insulating the water pipes aids in efficiency and also can prevent freeze damage.
- *Collector(s), support structures and piping properly mounted and secured:* Many collectors are installed on the roof of the home and need to be properly secured for wind uplift and other measures. Ensuring all parts of the system have been properly secured prevents damage and aids in system longevity.
- *Pressure relief valve operation verified:* A pressure relief valve is installed to ensure too much pressure doesn't build up in the system as the water heats up and expands. Verifying the valve works properly helps to ensure it will work when needed.
- *Mixing valve (tempering valve) installed on passive ICS systems:* Passive ICS systems don't have an active temperature control system and at times, the water inside the tank can get very hot. A mixing valve (aka: tempering valve), which mixes cold and hot water, is installed at the outlet of the water heater to prevent scalding hot water from being sent to the fixtures in the home.
- *All roof penetrations sealed and/or flashed properly:* One of the most common problems that occur from a solar system installation is roof leaks from the new penetrations. Ensuring these penetrations were flashed and sealed properly is critical to preventing any future problems with leaks in those areas.

Section 3: Notes

This section is for any additional notes concerning the installation process or product description. The installer may provide additional information about any issues encountered while installing the new product that may have prevented a best-practice from being followed.

Section 4: Homeowner Orientation

This section is a reminder for the contractor to review the checklist with the homeowner and discuss all aspects of the solar water heating system, how to operate the system and any maintenance issues that are required.