

Introduction to Solar Domestic Hot Water Systems SDHW-1

Presented by...

SOLAR SOURCE[®]

The Solar Experts





Learning Objectives

1. Present basic types of SDHW systems and their applications.
2. The Direct System.
3. The Integrated Collector System.
4. The Indirect System.
5. The “High Tech System” (Heat-Pipe Evacuated-Tube)
6. Why Solar Thermo Hot Water is a prerequisite to installing a Photovoltaic System.

The image features a bright sun in the upper left corner, casting a glow over a clear blue sky. Below the sky, the top edge of a solar panel array is visible, showing the grid-like structure of the cells. The overall scene is clean and modern, representing solar energy technology.

Solar Domestic Hot Water Systems

General Discussion

Heating water for residential use is one of the most economical solar energy applications available. Most people are unaware that heating water is nearly as large a part of your energy bill as air conditioning & heating are. While payback of the initial cost varies with system, climate, and use; a payback period of 4 to 7 years is typical with most systems continuing to provide savings for 20 or more years.

Systems today are not terribly complex, new materials and design changes have steadily improved their performance efficiencies over the last 20 years.



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“How it Works”

1. Energy Collection: UV rays are collected and converted into heat

The solar collector, which is mounted on a roof or on the ground - with an angled bracket - is responsible for collecting UV rays and converting them into heat. As the sunlight strikes the collector it is converted into heat and conducted into the transfer medium inside the collector (water, air, anti-freeze, or gas).



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“How it Works”

2. Energy Transfer: Circulating fluids like water or propylene glycol transfer the heat from the manifold into a heat exchange tank where the water is heated.

In the heat exchanger tank the circulating fluid (or heating fluid) is circulated through an internal coil heat exchanger where its heat is given off to the water inside the tank. The fluid then continues to circulate back up to the collector where it is heated again.

With the DIRECT SYSTEM the potable water is directly circulated to the collector, not the best choice for locations subject to freezing conditions.



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“How it Works”

3. Energy Storage: The heated water is stored

The heated water in the heat exchanger tank is heated and stored. When there is a demand for hot water the solar heated water flows into the existing heating tank where it requires little or no additional heating. When hot water is drawn from the top of the heat exchanger tank, cold water make-up enters the bottom of the tank to be heated by solar energy. This allows for the storage of twice the volume of hot water than the existing setup with one hot water heater.

DIRECT SYSTEMS only generally use a single tank which functions as the heat exchanger for hot water from the solar collector.

The image features a bright sun in the upper left corner, casting a starburst effect against a clear blue sky. Below the sun, the top edge of a solar panel array is visible, showing the grid-like structure of the photovoltaic cells.

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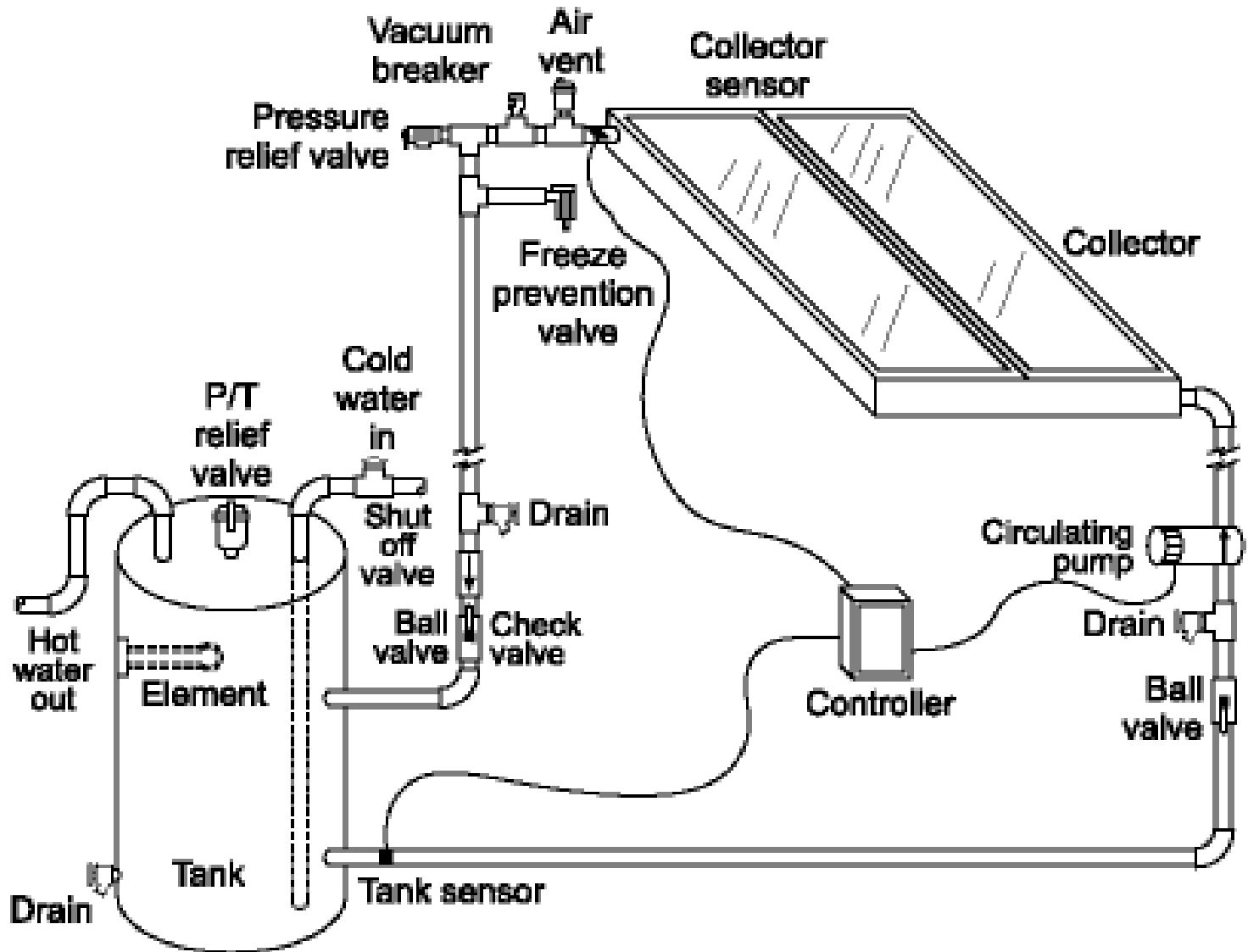
The Direct System

The Direct System explained

The Direct Solar Hot Water system is the most common system used today. The collector panel is essentially an insulated box with a glass top mounted on the roof. Household water is circulated directly through the copper tubing inside the collector by a small circulation pump. The tubes & additional copper fins transfer the heat collected from the solar radiation directly to the water. The heated water is then stored in a special solar designed hot water tank that replaces the conventional hot water tank.

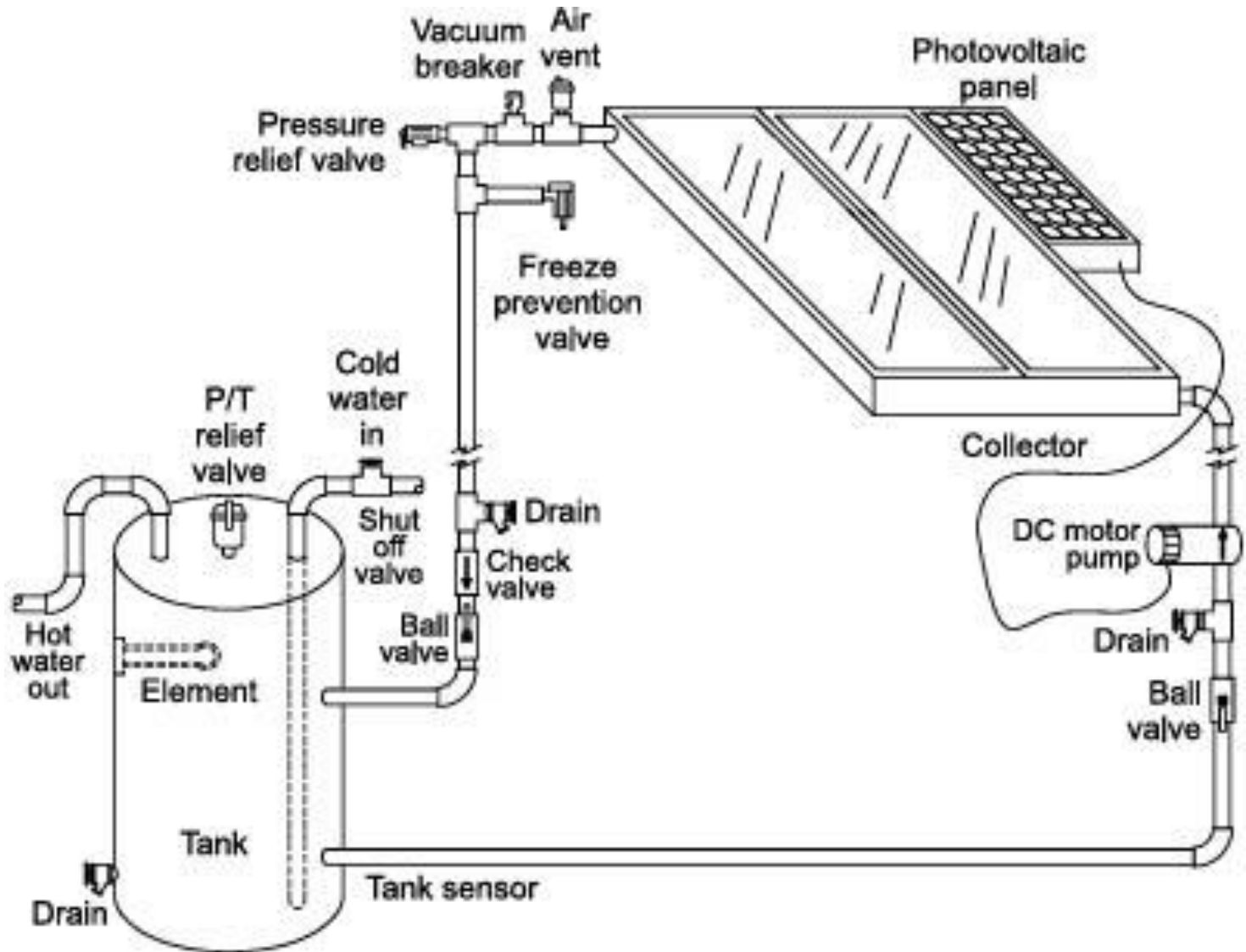
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The Direct System diagram



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PV powered Direct System diagram





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PV powered Direct System diagram

Photovoltaic powered Solar Domestic Hot Water systems are truly the “greenest”, no grid energy is used in the production of Solar Hot Water.

The simplest type just powers the DC circulation pump directly from the PV panel mounted near the Collector. Whenever there is enough electricity being generated by the small PV panel, the pump operates to circulate water through the collector.

The second type uses a DC low power differential controller to control the DC circulating pump exactly the same way as the previous discussed direct system which uses a small (1/10hp) 120VAC pump.



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“Tank-in-the-Collector”

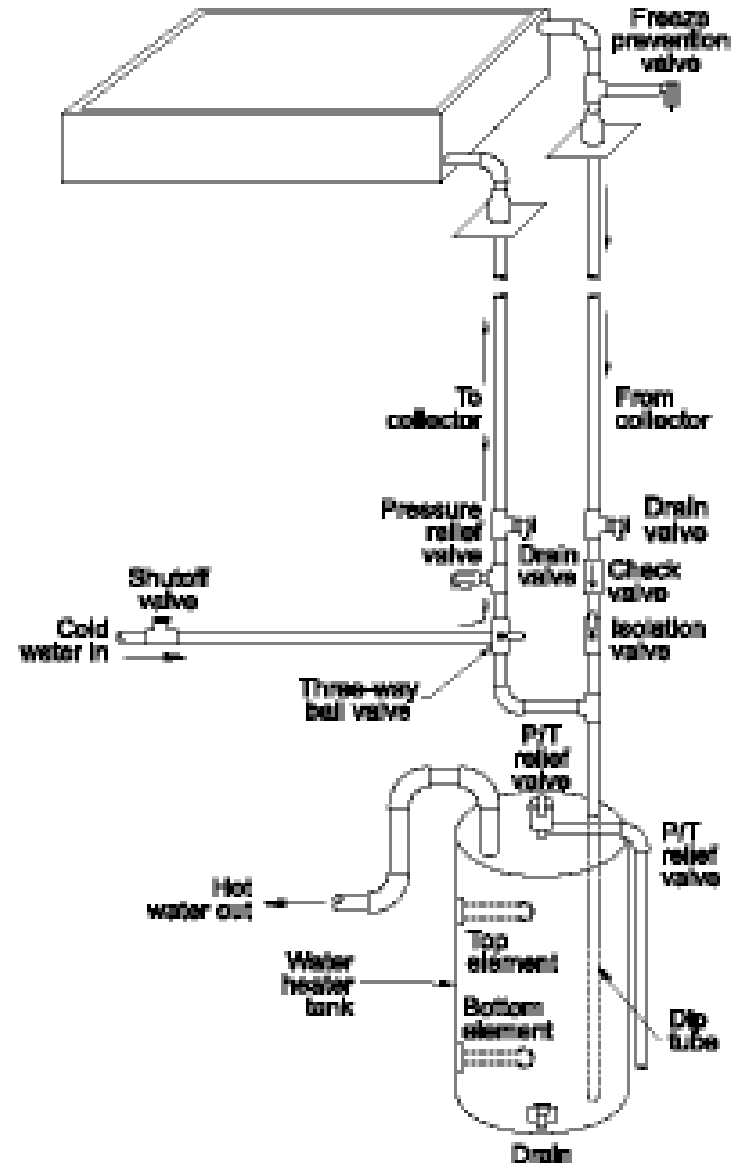
The ICS System

The **I**ntegral **C**ollector **S**torage units serve as a pre-heater to your existing electric or gas hot water system. The collector and water storage tank are contained in the collector mounted on the roof. Water is heated in this tank or large tube style collector and replaces the water drawn from your conventional water system as needed. This system is commonly referred to as a “Progressive Tube System”

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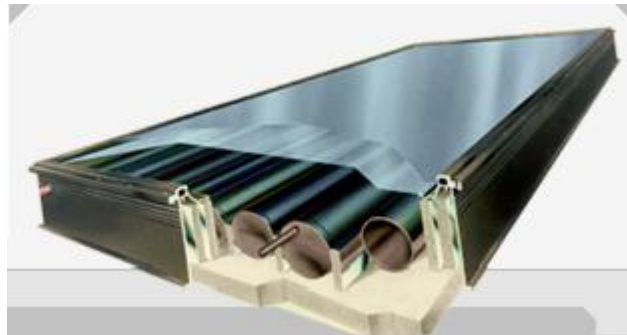
The **ICS** System diagram

ICS stands for:
Integral
Collector
Storage - The hot water is produced & stored in the collector.



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TCT Solar – Progressive Tube ICS System



<http://www.tctsolar.com/index.htm>



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Heat Exchanger Type system

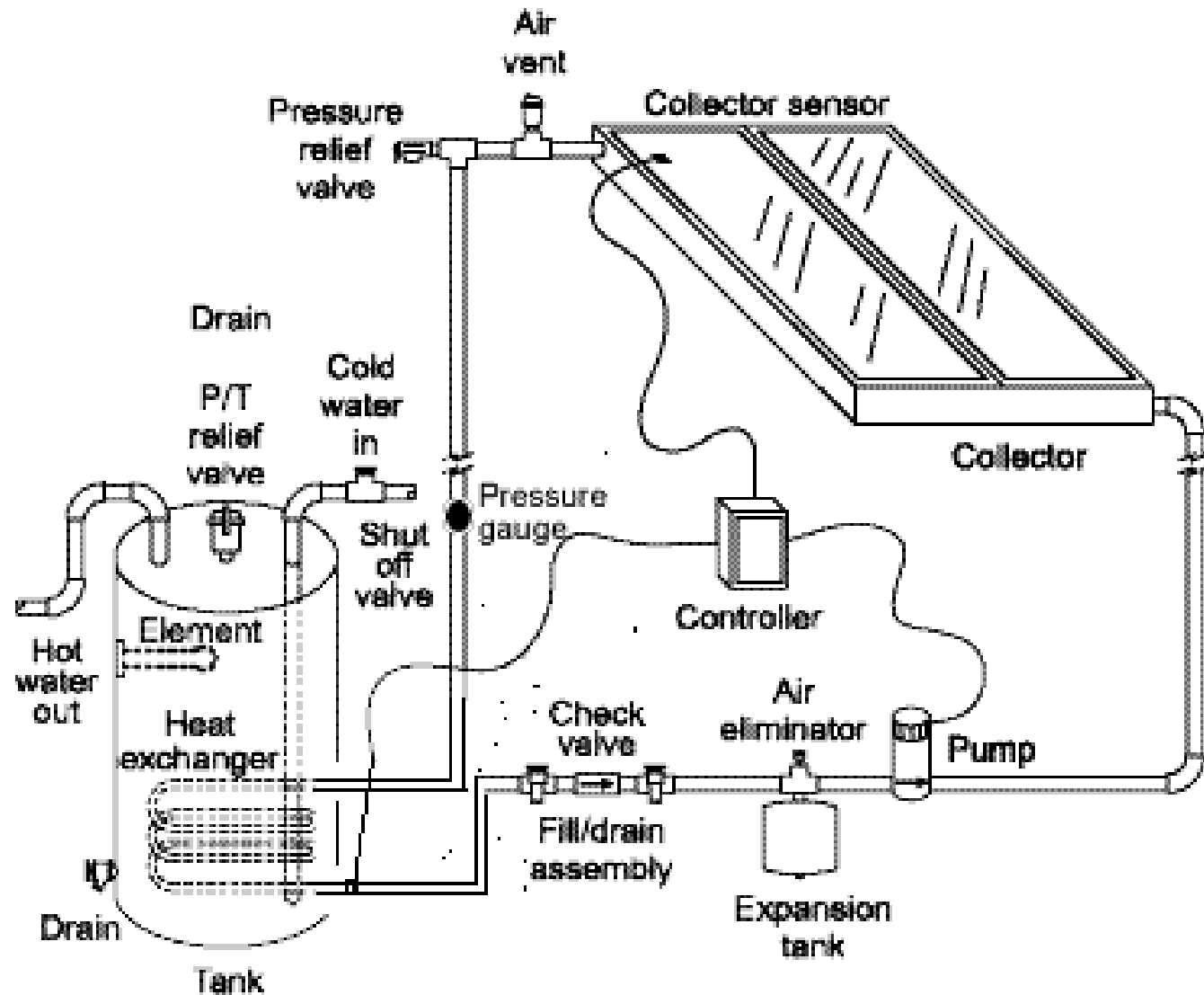
The Indirect System

The Indirect System is most often installed in climates subject to hard freezing for extended periods. Its design it is similar to a direct system except that a food grade antifreeze solution is heated in the collector in a closed loop system. The heated antifreeze is passed through a heat exchanger to transfer its heat into the conventional hot water tank.

If toxic anti-freeze is used the heat exchanger **MUST** be of the double-wall type.

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The Indirect System diagram



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High-tech system

Heat-Pipe Evacuated-Tube

Heat-Pipe collectors use a copper pipe closed at both ends which contains a liquid that vaporizes in a vacuum when heated. The hot vapor rises to a heat exchanger located in a manifold at the top of the tubes, transferring the heat to the solar fluid, either water or anti-freeze, to be circulated through the Solar Hot Water system. This type of system can be identified by the roof peak to eave orientation of the collector tubes.



The image features a bright sun in the upper left corner, casting a lens flare effect against a clear blue sky. Below the sun, the top edge of a solar panel array is visible, showing the characteristic grid pattern of photovoltaic cells. The solar panels are dark blue or black with white lines forming a grid. The overall scene is brightly lit, suggesting a sunny day.

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High-tech system

The **evacuated tube** solar collector works by absorbing solar energy in the form of UV rays and converting it into thermal energy. An evacuated tube solar collector contains a number of evacuated tubes. Each evacuated tube is responsible for absorbing the sun's radiation that reaches it independently. An evacuated tube is made up of 2 layers of strong borosilicate glass that are joined together.

There is a vacuum in between the 2 layers of glass. This layer of vacuum allows the tube to retain its heat once it is gathered. The UV rays are absorbed by an absorbing film which lies in between the 2 layers of glass on the inside layer. This special absorbing film absorbs more than 92% of the UV rays that incident the tube and rejects less than 8% back to the atmosphere.

The image features a bright sun in the upper left corner, casting a glow over a blue sky. Below the sky, a portion of a solar panel array is visible, showing a grid of cells. The main content of the image is a text box with a light blue background and a black border, containing the title and two paragraphs of text.

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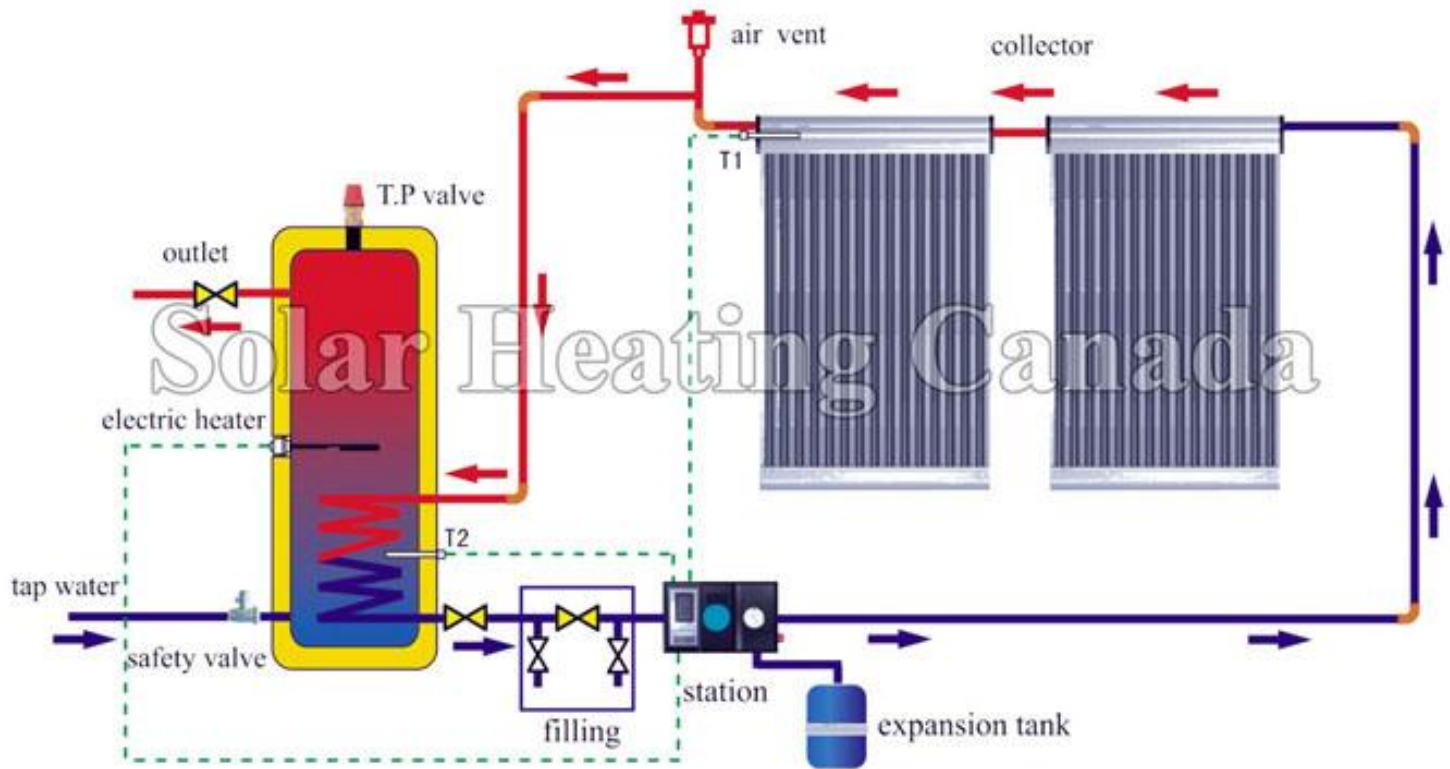
High-tech system

The heat is transferred by conduction to a copper fin inside the inner layer of glass. A **heat pipe** that is inserted into the fin absorbs this heat and transfers it to the copper header at the top of the collector. The heat pipe is a thin copper tube which contains a small amount of acetone. Once the heat pipe is subject to a small amount of heat the acetone vaporizes and turns into a vapor. It then rises to the top of the heat pipe where it reaches a condenser.

Once the heat is removed from the condenser by a heating transfer fluid such as water or a mixture of water and glycol, the acetone reverts to a liquid and returns to the bottom of the heat pipe where it repeats its cycle.

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Evacuated Tube Collector



This type of System is the most expensive but suits itself well for freezing climates. Even in the north SDHW is working.
<http://www.solarheatingcanada.com/>

SunMaxx Evacuated Tube Collector





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Thermo-siphon System

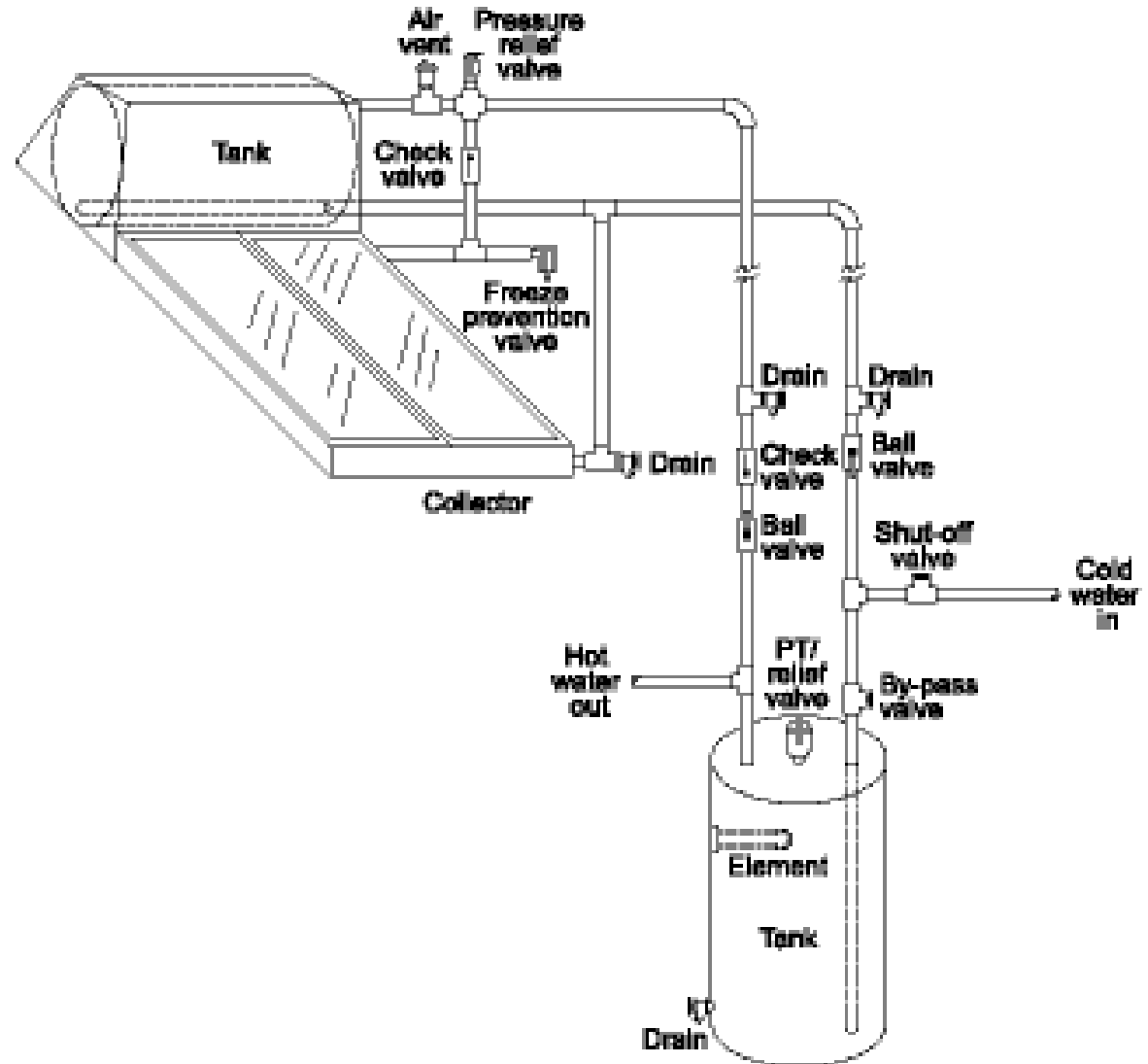
As the sun shines on the collector, the water inside the collector flow-tubes is heated. As it heats, this water expands slightly and becomes lighter than the cold water in the solar storage tank mounted above the collector. Gravity then pulls heavier, cold water down from the tank and into the collector inlet. The cold water pushes the heated water through the collector outlet and into the top of the tank, thus heating the water in the tank.

A thermo-siphon system requires neither pump nor controller. Cold water from the city water line flows directly to the tank on the roof. Solar heated water flows from the rooftop tank to the auxiliary tank installed at ground level whenever water is used within the residence.

This system features a thermally operated valve that protects the collector from freezing. It also includes isolation valves, which allow the solar system to be manually drained in case of freezing conditions, or to be bypassed completely.

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Thermo-siphon System



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Conclusions

Solar-thermal water heating systems are becoming more and more cost effective due to recent rises in energy prices.

Depending on the levels of sunshine where you live, and how much hot water you use, the system will generally pay for itself within 15 years, and often less than 10. In addition, houses with eco-friendly features tend to stand out in the market and sell more quickly. You should notice an immediate fall in your fuel bills, particularly in summer. Costs may be offset even further by government grants which help people install solar water heating. People with the right DIY skills can save money by installing their own solar-thermal water heating, as it involves general plumbing and wiring tasks, although you do have to work safely on the roof as well. If you are looking for a way to reduce your carbon footprint and save money in the long term, solar thermal water heating could be perfect for your needs!

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Solar Energy Its Future is Now!

Thank you...



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