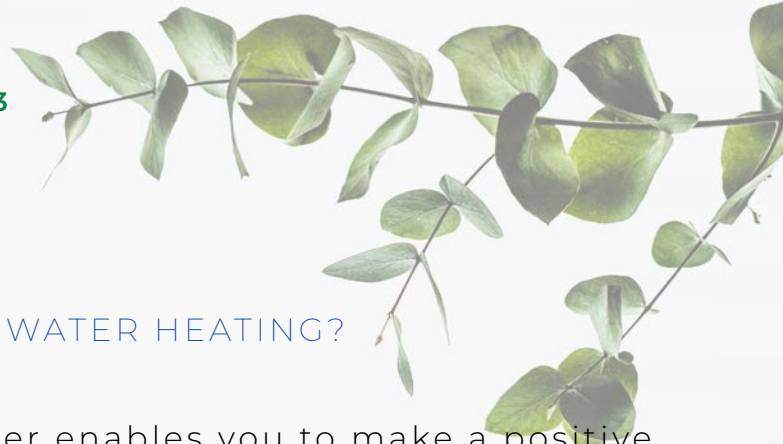




# FACTS ON SOLAR SYSTEMS

MAY 2023

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## WHAT ARE THE BENEFITS OF SOLAR WATER HEATING?

The installation of a solar water heater enables you to make a positive contribution to our global environment, while also saving you money in the long run.

This simple act can save 40% - 50% of your electricity usage, which means that our local power utility will burn less coal or gas to generate electricity. Reduced burning of fossil fuels will cut the amount of greenhouse gases released into the atmosphere, especially carbon dioxide (CO<sub>2</sub>). Solar water heaters are therefore one of the best long-term investments you can make - both financially and for the environment. Moreover, solar energy is not affected by our current shortage of electricity.

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## WHAT ELSE DO I GAIN?

Besides making a positive contribution to the environment, you gain:

- A hedge against spiraling energy costs.
- Free hot water for life.
- More independence from erratic power supply.
- An investment in your children's future.
- The release of much needed energy to industry.
- An increase in the resale value of your property.





## HOW MUCH WILL I SAVE BY USING A SOLAR HOT WATER SYSTEM TO HEAT WATER?

A good quality, correctly installed system should be able to save at least 40% of an average household's electricity bill.

## WHAT IS THE TYPICAL PAYBACK PERIOD FOR A SOLAR WATER HEATER?

Based on current electricity prices paybacks are typically 5 years or less, depending on geographical area, water consumption patterns, number of people in the household, type of system chosen and energy cost.

## WHAT IS SOLAR WATER HEATING?

Solar water heating is a system for heating water using energy from the sun. Solar energy is collected by a solar collector (either a panel or a set of evacuated tubes) which is then connected by means of pipes to a hot water storage device such as a hot water cylinder. A correctly designed solar water heater system is an extremely simple and reliable concept. Today several million homes and businesses all over the world use solar water heating, which supplies 40% – 70% of all the energy your home or business needs for water heating.





## HOW DOES A SOLAR HOT WATER SYSTEM (SHW) WORK? WHAT DO I NEED?

You'll need a storage tank with solar ports, a solar collector (panel or tubes) and a minimum of 4-6

hours of daily direct sunlight. The XSTREAM range of storage tanks is a standard solar unit – the extra fittings required are standard built-in.

You'll find “split-systems”, “thermo-siphon systems” and “pumped systems” and a variety of temperature controllers as additional options.

We believe a thermo-siphon system (where the tank is installed at a point above the panel) is the best option as it does not contain any working parts and it works on a basic law of nature: heat rises. The heated water will rise and remain inside the storage tank while the colder water at the bottom of the tank will circulate through the panel to be heated again.



## HOW DO I CHOOSE THE RIGHT SIZE WATER HEATING SYSTEM FOR MY HOUSEHOLD/BUSINESS?

First you need to work out your hot water needs. A unit that is too small will not provide enough hot water, so slightly over-sizing your



hot water cylinder is recommended. However, if it is too big it will be uneconomical. An accepted way to size a system is to allocate 50 litres of water per person in your household and then to add an extra 50 litres for appliances that draw a large amount of hot water from the geyser. By over-sizing a system slightly you can maximize the hot water achieved by solar gain.

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## HOW HOT CAN THE WATER GET?

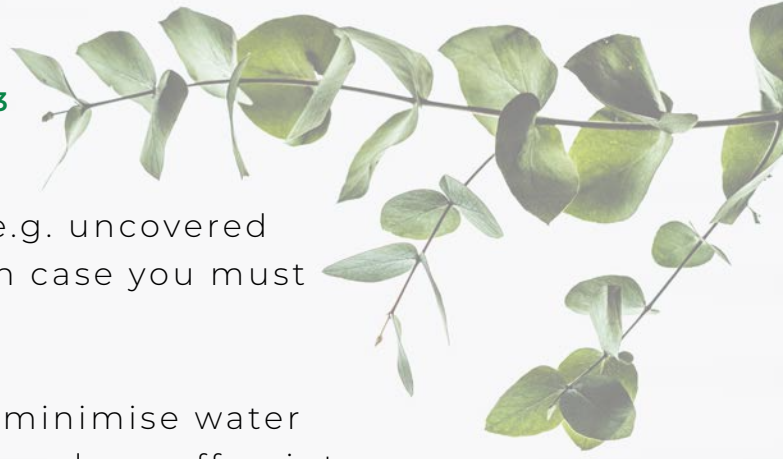
The ideal temperature of your hot water storage tank is between 55° C and 60° C. Most solar systems heat the water to between 55° C – 65° C, but some can heat much higher than that. You need to be aware of over-performing systems so that you are not scalded by the hot water. Unless otherwise required the water temperature at the point of use should be at least 38° C for domestic fixtures such as baths, basins and showers and at least 45° C (in order to melt fats) for sinks. The temperature is not meant to exceed 55° C at any point of use. Typically a mechanical temperature mixing valve must be installed.

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## WHAT FACTORS NEED TO BE CONSIDERED WHEN DECIDING ON A SPECIFIC SHW SYSTEM?

The storage tank must be properly insulated to minimize heat loss. It should provide electrical back up (element & thermostat fitted) and must have minimum maintenance. The regular replacements of anodes are not only costly, but if not properly maintained, may also cause the guarantee of the supplier to become null and void. Therefore rather use non-ferrous products with no need for anode replacements.

Installation options are also important. Ideally a tank should be



designed to be installed anywhere (e.g. uncovered on the roof of the building – in which case you must insist on IPX4 rating).

Position the installation carefully to minimise water wastage and heat loss to the hot water draw-off point.

The solar collector should be properly insulated and the casing material of high quality non-corrosive material – aluminium is a good option for panels. It should provide fixing points to the roof to enable a secure fit.

The ratio between the absorption area and the volume of water to be heated should be in balance. This is very important. A good ratio is 55-75 litre per m<sup>2</sup> panel or 10-12 litre per tube.

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## WHICH COMPONENTS DO I NEED?

A Solar Hot Water system consists of a solar collector, a storage tank (geyser) and a system of pipes for water circulation between the solar collector and the tank.

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## WHAT ARE THE DIFFERENT TYPES OF SOLAR COLLECTORS?

Two types of Solar Collectors are available: one based on flat plate collectors and the other based on evacuated tube collectors. Flat plate collector (FPC) systems are made of metal, while Evacuated tube collector (ETC) systems are made of glass. This means FPC systems are more robust than ETC systems.

Both these systems are available with and without heat exchangers. They can also work with and without pumps. Systems without pumps are known as thermo-siphon systems and those with pumps are known



as forced circulation systems.



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## WHAT IS A SOLAR PANEL (FLAT PLATE COLLECTOR) AND HOW DOES IT WORK?

A solar panel is very efficient at turning light into heat. It has a special coating called an Absorber Surface Coating that is spluttered or fused at a very high temperature with the metal sheet inside the solar collector; it is this surface that makes the collector so effective.

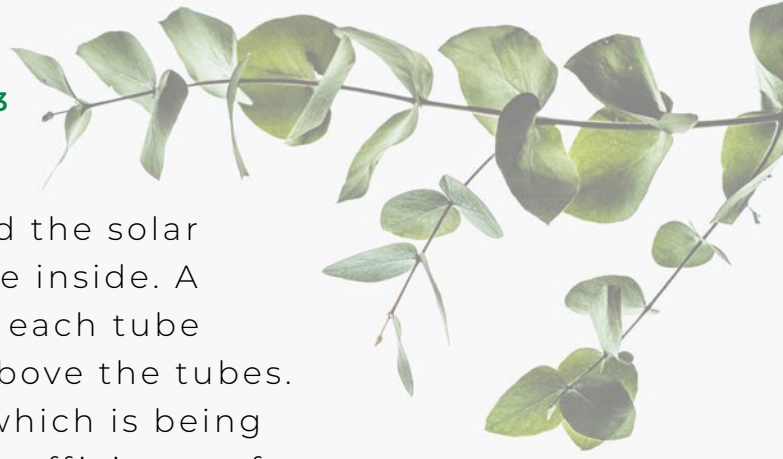
Its efficiency depends on the aperture area or absorber surface which is the part of the collector that collects light and turns it into heat. The bigger the panel, the more heat it collects.

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## HOW DOES EVACUATED TUBE TECHNOLOGY WORK?

Evacuated Tube Technology works on the same principle as a thermo flask. The tube is designed to capture as much sunlight as possible. It then maintains/stores the collected heat. It consists of two layers of borosilicate glass with a vacuum layer between them. Sunlight is





transmitted through the vacuum and the solar energy is transferred to the heat pipe inside. A small amount of evaporative fluid in each tube transfers this heat to the manifold above the tubes. This in turn heats the geyser water which is being circulated through the manifold. The efficiency of this system means that more than 90% of the sun's energy which hits the collector is transferred to the water.

## HOW DO EVACUATED TUBES COMPARE TO FLAT PLATE COLLECTORS?

### **With regards to efficiency:**

On a hot, clear day there is very little difference in performance between conventional flat plate panels and evacuated tubes. However, on cooler days, evacuated tubes have a clear advantage:

The vacuum greatly reduces conductive and convective heat losses. As a result wind and cold temperatures have less effect on the efficiency of the evacuated tube.

- Due to the cylindrical shape of the tubes, they passively “track” the sun during the day by presenting themselves perpendicular to the sun throughout the day. Flat plate collectors generally only experience perpendicular exposure around midday.
- Averaged over a whole year, the output of an evacuated tube collector is between 20 to 30% greater than that of a flat plate collector.
- Due to their modular nature, they are easier to install.
- They are less susceptible to being blown off your roof in high winds.
- They can be serviced without shutting down the system.
- If a tube breaks the whole panel is not lost. A broken tube is easily replaced.





## WHICH SOLAR COLLECTOR DOES XSTREAM RECOMMEND FOR USE WITH THEIR STORAGE TANKS?

This is a topic of ongoing debate and pretty much a personal choice. We do not claim that the following comparative list is comprehensive or conclusive - we have simply analysed the various advantages of each as follows:

**Tubes:** fitted with heat pipe (suitable for high pressure systems and good for all areas - including freezing areas).



### ADVANTAGES

- Well insulated.
- Replace only broken part (per tube).
- Doesn't spill any liquid should it break.
- Normally supplied with easy to install (lightweight) frame.
- Easy installation – smaller, lighter parts form the complete unit.
- Effective even in overcast weather

### DISADVANTAGES

- Very breakable, need special care.
- Can be too effective, correct sizing is very important (10-12 litre storage tank per tube).
- Higher costs not necessarily in ratio to output performance.



**Flat Panels:** fitted with copper tubing (suitable for high pressure systems and good for most areas – not suitable for freezing areas).



### ADVANTAGES

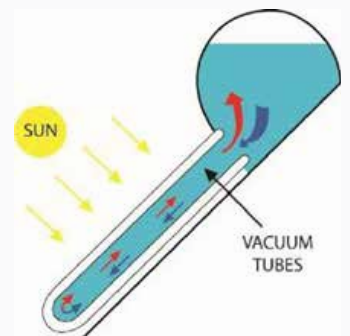
- Locally produced.
- Very long history, good track record.
- Repairable.
- Simple installation, fittings supplied.
- Have some sort of saturation point which prevents overheating.

### DISADVANTAGES

- Inclusive of some bad quality – look for reputable companies.
- Bigger panels are heavy.
- Poor insulation can lead to heat loss.
- Not very effective in overcast weather.

## HOW DO LOW PRESSURE TUBES WORK

Basically they work on a convection principle – the tubes are connected directly to the storage tank and through convection transfer the heat that builds up inside the tube to the storage tank and then the hottest (lightest) molecules rise to the top. You can work on 10-12 litres of water inside the storage tank per tube, depending on the tube size (diameter) and length.





## WHAT TYPE OF GLAZING IS USED FOR THE PANELS? IS IT PROTECTED?

It is important to ensure that your solar absorption panel is hail resistant.

## I USE A HIGH-PRESSURE SYSTEM. WHAT PRESSURE CAN THE PANELS TAKE?

Ensure the panels can withstand at least the main water supply pressure in your area. In the case of an indirect system, which uses anti-freeze, the panels are not connected to the water supply line. In these cases, low-pressure panels can be considered.

## WHAT SHOULD I LOOK FOR IN A STORAGE TANK (GEYSER) FOR A SHW SYSTEM?

The storage tank must be properly insulated to minimize heat loss. It should provide electrical back-up (element & thermostat fitted) and must have minimum maintenance.

Installation options are also important. Ideally a tank should be designed to be installed anywhere (e.g. uncovered on the roof of a building).

The XSTREAM range of SABS-approved, corrosion-free solar/electrical geysers are ideal storage tanks for any SHW system, no matter how small or large the hot water requirements of your household or business may be. They are locally manufactured, low-maintenance, lightweight and easy to install, and suitable for all water and climate conditions.





## CAN I CONNECT MY EXISTING HOT WATER CYLINDER TO A SOLAR COLLECTOR?

Yes, but it will have to be adapted for solar use. There are certain adaptors on the market to convert a standard tank. It is important to note that these special fittings are quite expensive. Solar water heaters (SWH) need special fittings in order to create a “solar flow” which allows the heated fluid to circulate from the solar collector to the top of your geyser and then back again from the bottom of the geyser to the solar collector. Each time the water circulates it becomes warmer.

If your existing electrical geyser is an XSTREAM geyser, it is already standard solar adaptable. You can simply connect it to a panel/or set of tubes of your choice.



## WHAT IS THE BEST LOCATION POINT FOR A SHW INSTALLATION?

A good average angle (roof pitch) is about 35° - 40°. In South Africa the solar collector itself should face plus or minus 20° from true north. Should it not be possible to obtain the “perfect” position, additional panels/tubes could be considered to increase the absorption area to compensate for the less efficient position.







## WHAT IS THE BEST WAY OF INSTALLING A SHW SYSTEM?

Remember this law of nature: “heat rises”.

Therefore, the best way of installing a SHW system is to have the storage tank/geyser above the panel to allow thermosiphoning to take place. No working parts are necessary for this and once the panel is colder than the heated stored water the system shuts off automatically (e.g. at night time).

The XSTREAM range of SHW systems are SABS approved for exterior installations.

If however, you want to install the SHW at a point lower than the solar collector, a circulation pump will be required.

## WHAT IS THE MAXIMUM DISTANCE THAT THE SOLAR COLLECTOR CAN BE INSTALLED FROM THE STORAGE TANK?

Actually, there is no maximum distance. However, more heat loss will occur in the pipes between the panel/tubes and the hot water cylinder the longer the pipes are. A solution is to install another solar collector to minimize heat loss.



## HOW LONG DOES IT TAKE TO REHEAT THE WATER IN THE STORAGE TANK?



If the solar collector is correctly sized and installed correctly the reheating time will be 4 to 6 hours in direct sunlight on an average sunny day. Winter reheating times will be longer.



## WILL WATER BE HEATED ON A CLOUDY/RAINY DAY?

Yes. Although the heat output of the solar collector is reduced on overcast days, it will still be able to provide heating on a cloudy day.

If it is heavily clouded or raining, gas- or electric boosting may be required to maintain water at the required temperature. This boosting system will be automated so one does not have to worry about running out of water on a rainy day.

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## WHAT HAPPENS IN WINTER WHEN THERE ISN'T ENOUGH SUNLIGHT TO HEAT THE WATER?

Solar water tanks are better insulated than ordinary electrical geysers and can keep water hot for a longer period of time. This ensures that there is always a tank full of hot water (and a backup of hot water) in the early evenings/mornings – provided the tank size is correct. Customers need to ensure that suppliers/installers appropriately insulate all the pipes exposed to the elements to prevent freezing and heat loss.





## WILL MY WATER BE HOT ENOUGH?

Yes! Solar heated water is often hotter than the thermostat setting on your water heater. A back-up electric heating element is fitted in your storage tank and will automatically heat water to the tank's thermostat setting.

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## HOW WILL THE SOLAR HEATED HOT WATER REMAIN INSIDE THE STORAGE TANK? WILL IT NOT REVERSE SIPHON TO THE SOLAR PANEL DURING NIGHT TIME?

The hottest water molecule is also the lightest molecule and will remain at the highest point inside the storage tank - therefore it will not cool off overnight by reverse thermo-siphoning - that is if the storage tank is positioned at a point above the solar collector, 200mm plus like in the case of a thermo-syphoned system. Should a pumped system (or forced circulation system) be used and the pump should run overnight (e.g. if the timer switch should malfunction) then the system will cool off, as the solar collector now becomes a heat radiator.

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## I MAKE USE OF BOREHOLE WATER – WILL THE PANELS/TUBES LAST?

If you have opted for the Xstream storage tank, the tank will be able to handle any water condition. The manifold of the tube collector and heat risers of the flat panel will be equal to the normal breakdown process common to copper over time.



## WHAT SIZE GEYSER IN RELATION TO WHAT SIZE SOLAR PANEL DO I REQUIRE?

On average one person will use approximately 50 litre of hot water per day. Therefore a household of 4 people will need at least a 200 litre system and a 3 m<sup>2</sup> solar panel.

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## CAN A SOLAR PANEL BE USED TO CHARGE BATTERIES?

No, this is not a photovoltaic system. Heat is generated through absorption only (thermal heat). A photovoltaic system (where a chemical process converts the radiation to electricity) is a totally different application.

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## CAN I REGULATE THE WATER TEMPERATURE?

Yes, by using a special mixing valve. It is however advisable to rather get the system to the correct balance (correct size of geyser, correct size of panels and proper installation) than to use valves etc. as these are working parts that need special care and maintenance – it is better to have a maintenance-free system.

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## CAN I HEAT THE WATER FROM A PHOTOVOLTIC PANEL/INVERT?

Yes. You will need a special DC-element with a suitable controller.





Feel free to contact us for any other questions about our hot water cylinders or solar water heating in general

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