# CHAPTER 8

# Combined Central Heating and Solar Hot Water

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# 8. COMBINED CENTRAL HEATING AND SOLAR HOT WATER

## 8.1 Introduction

People in southern Australia or New Zealand often ask the question: Can a solar water heater be used to heat a house? (Heating air within a house, office, etc. is called **space heating**). The short answer is 'Yes, it can be done', but first let us examine a few facts before we analyse the question much further.

- House heating is generally required because the sun is not shining – at night time, or on rainy or overcast days. On sunny days there is often enough heat coming in through the north windows that additional heating is not required. To try and use the sun to heat the house when the sun is not shining presents a problem.
- It is possible to store heated water from sunny winter days and use it when the sun is not shining, but the storage needs to be large (thousands of litres) for houses in Victoria, Tasmania and New Zealand.
- Remember that a normal solar hot water service needs to be boosted in winter time because the sun does not heat the water sufficiently, so there will certainly be no spare heat to heat a house. There is not enough heat for just the domestic hot water needs. There are two aspects that need to be considered:
    - The water temperatures in flat plate collectors will not be very high in winter in some areas – perhaps 40ºC or 45ºC.
    - If there is not enough heat captured in a normal solar hot water system for domestic hot water (DHW) then to provide additional hot water for house heating will require additional collectors.
- In order to collect enough heat from solar collectors, a much greater area of collectors would be required than on a normal solar water heater, which has perhaps $4m^2$ or $6m^2$ of collector area. What will be done with all that hot water in summer? Research is being done on systems that use solar hot water for cooling, but these are as yet uncommon and are beyond the scope of this book.
- Hydronic (hot water) central heating systems work on a temperature drop of 11ºC across the heaters, from perhaps 75ºC to 64ºC or 80ºC to 69ºC. The water having lost 11ºC through the heaters is then returned to the boiler where it is reheated. Water at 45ºC from solar collectors cannot be used in such a system. It isn't hot enough.
- In winter time in southern Australia and New Zealand flat plate collectors do not heat water to temperatures much above 45ºC. A hydronic heating system even with oversized panel radiators would require water temperatures of at least 70ºC, and usually higher. It is possible to heat through a concrete slab floor using water at low temperatures of 45ºC, but this can be a less efficient method of heating.

## 8.2 Requirements for solar central heating

Now to return to the short answer: 'Yes, it can be done.' Here is what needs to be done to use solar hot water for winter house heating, unless solar is used as a preheater to a primary heating source such as oil, diesel or wood pellets.

- A large area of collectors is required.
- A large insulated hot water storage is required. If the temperature of the solar heated water is low then a larger volume of water is required to store the 'heat energy' than if the water was at a higher temperature.
- The problem of overheating the domestic hot water in summer can be overcome by standing the collectors at a very steep angle of perhaps 60º or 70º from the horizontal, or by connecting to a swimming pool that acts as a heat dump. Future options might include solar-assisted air-conditioning systems, though domestic systems are not yet commercially available.
- Find some sort of heaters to get heat out of the water and into the air in the house. Using incredibly large panel radiators is one possibility, but they would be very big. Heating a concrete floor requires water at temperatures no higher than 45ºC so from that viewpoint it would be a better option. Floor heating, however, is not very efficient.
- The house being heated would need to be very energy efficient – well insulated (floor, walls and ceiling) and probably with double glazed windows.

All of this suggests that it is not particularly practical and the engineering calculations are beyond the scope of this book. The cost would be high because:

- the area of solar hot water collectors would be high
- the insulated hot water storage would need to be large (particularly if the water temperatures are comparatively low)
- the heaters required to get the heat out of the water and into the house would be expensive
- any hydronic heating system is an expensive installation.

Research work carried out in the 1980s demonstrated that a **passive** solar design house is far more cost effective than installing an **active** heating system.

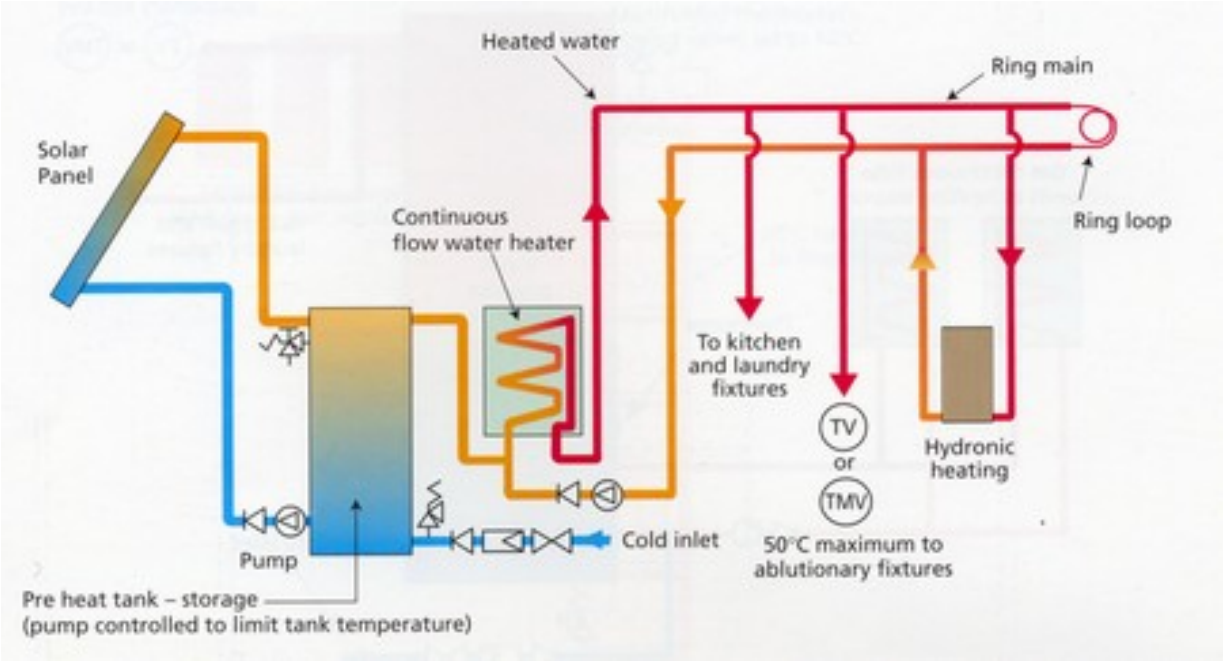


Diagram: Courtesy Plumbing Industry Commission/Standards Australia *Heated Water Systems Handbook HB263 – 2004*

This diagram shows that when the central heating is operating, water flows through the ring main and the heaters and through the *continuous flow water heater* (boiler). If some hot water is drawn off from one of the taps it is supplied from the water stored in the *pre-heat tank*. It passes through the c*ontinuous flow water heater* boiler where it will be heated to about 75ºC or 80ºC if required. You can see with a system like this that the solar makes no contribution to house heating at all.

**Figure 8.1 – Central heating system including solar**

Some suppliers of hot water systems sell combined solar and central heating systems. A gas booster heats the water if there is inadequate solar heating. Some advertising infers that the solar energy is used to heat the house, but this is generally misleading. With 4 $m^2$ or 6$m^2$ of flat plate collectors, even if no domestic hot water was used, it would be most unlikely that the sun would contribute anything towards house heating.

Evacuated tubes do heat water to higher temperatures in winter than flat plate collectors, but the volumes of hot water are low compared with summer time. As with flat plate collectors, a large area of tubes and a large insulated hot water store would be required to be effective.

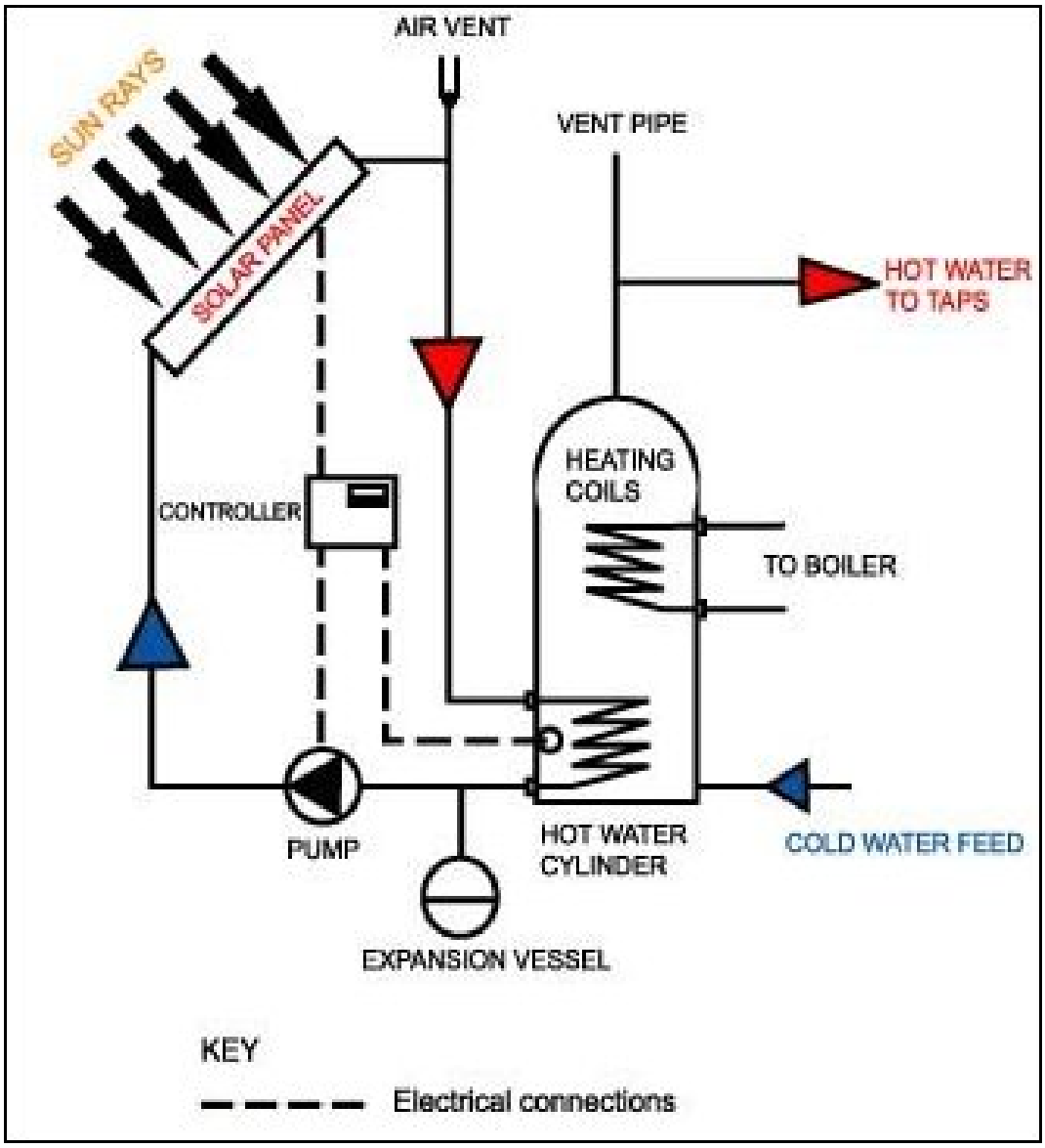


Diagram: from www.ecolocal.org.uk/solarHeating/default

*Note: The information provided is of a general nature and should not be used as a foolproof guide to carrying out solar water heating installations. EcoLocal takes no responsibility for any actions you may take in relation to the information given in this pack. You must make sure that you familiarise yourself with manufacturer's instructions, water company regulations, planning permission if required, or any other laws or regulations in place at the time of installation and that any person carrying out an installation does so at their own risk.*

In this system it can be seen that if the hot water for the central heating left where it says *Hot water to taps* and returns where it says *Cold water feed*, the system could run on solar provided the *solar collectors* heated the water to a high enough temperature.

**Figure 8.2 – Central heating system with solar input**

## 8.3 Floor heating

Floor heating of concrete floors is commonly achieved in one of two ways:

- using electrical cables buried in the concrete floor. When an electric current is passed through the cables they give off heat, heating the floor.
- passing hot water through low density polythene pipe, which is also buried in the concrete. The temperature of the water flowing through the pipe must not exceed 40ºC to 45ºC. Higher temperatures are likely to

cause damage to the concrete floor and cause deterioration in the polythene pipes.

Floor heating is clearly one way of utilising the low grade heat produced by solar water collectors in winter. Floor heating, however, is not very efficient because:

- even with insulation underneath the concrete floor slab, heat is lost to the ground. Not many concrete floors have insulation underneath them, so heat lost to the ground is significant.
- people usually do not require house heating for 24 hours of the day, but concrete floor heating puts out heat over the day whether the heat is required or not. Heat that is given off but is not required is wasted heat.

Floor heating can be very effective (in heating the house), but with significant heat energy wasted it is not efficient.

The concrete floor could be a good place to store the heat energy rather than in a large hot water storage tank, but with more than one day without sunshine the solar floor heating system would do little heating unless it was boosted by a boiler of some type.

## Key points

Solar energy can be used to provide some space heating, but if the system does not already meet all winter domestic hot water needs, extra collectors will be required. This will result in extra heat being available in summer, which may have limited use, though could be used in the future for solar cooling systems.

Concrete slab heating may be suitable, but extra slab insulation would be beneficial in a new home installation.

System configuration should allow for maximum solar contribution.

Passive solar heating can be more cost effective than active systems.

## Section 8 questions

1. What is the difference between an *active* and a *passive* solar house heating system?

2. What is required to produce an active solar hot water house heating system?

3. In winter in southern Australia what is the likely hot water temperature produced by flat plate solar collectors?

4. Is increasing the number of flat plate solar collectors going to increase the water temperature of water in a hot water storage tank to the 75ºC or 80ºC required for a normal hydronic heating system?

5. A flat plate solar water heating system operating in a southern Australia *winter* raises water temperature from 15ºC to 35ºC. It is going to capture far more heat than one raising water temperature from 40ºC to 60ºC. Why?

6. What are the disadvantages or difficulties of using water at low temperatures for space heating?