1. This article describes the development of a home-built solar water heating system for an older house (1930s) in the South Island of New Zealand.

2. The design was chiefly based upon Gary Reysa's design as described on his website "Build It Solar".

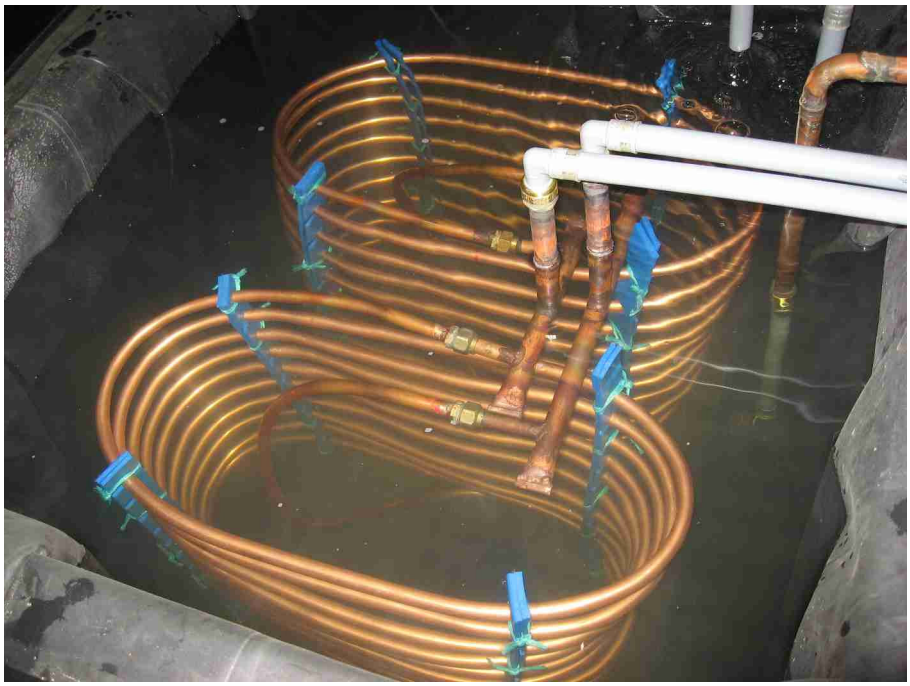
3. Various modifications to Gary's design were introduced to suit local conditions. The major difference adopted here was the use of pop-rivets to fix the aluminium fins to the copper pipes in the panels, and the absence of a plywood backing sheet for the panels. This method was used by Lindsey Roke in his system (also available on Build It Solar). The main reason for doing this was to make the panel as lightweight as possible so that it could be manipulated by one man on a roof!

4. The aluminium fins were made from “possum aluminium” sheets. These are produced to prevent possums climbing up power poles in NZ. The sheets are 0.42mm thick, and come pre-painted on both sides. Aluminium is 1/5 of the price of copper, and only half the conductivity – so the size of the panel area was increased a bit to compensate!

5. A crude press was made from old railway line to form the shape in the aluminium sheets in one squeeze. By placing a sheet of newspaper on the aluminium in the press the paint was undamaged – so there’s no risk of galvanic interaction between the copper pipe and the aluminium. To improve thermal contact between the aluminium and the copper a lithium based truck axle grease was used to coat the grooves in the aluminium before being pop-riveted in place.

6. One of the major requirements in the design was that it must be possible to incorporate the system into the existing house without the need for replacement or modifications to the existing hot water cylinder.

7. This was achieved by using saved solar heat to pre-heat the cold water feed to the existing hot water cylinder. The cold water is pre-heated by passing through copper coils in a highly insulated second tank of water which is heated directly by the solar panels.



8. The system uses two 2400x1200mm panels mounted at 26° to the vertical, mounted as the north facing side of a new roof built on top of an old concrete water tank beside the house.

8.1. The near-vertical angle was chosen to optimise winter collection and because vertical windows collect roughly the same solar energy per day throughout the year. Although in summer the sun is high and striking the panel at an angle, the days are longer, and there is more reflected and diffuse radiation;

8.2. This means that a steeply mounted panel will provide a roughly constant energy input per day throughout the year and should help avoid over-heating in summer

8.3. The heat storage tank is built inside the old concrete water tank which now acts as a shed.

9. Because Gary has reported that the insulation of his tank was perhaps not sufficient the tank was heavily insulated at great expense with 100mm of phenolic (ie urethane) foam all round (that stuff's REALLY expensive in NZ).

10. The height of the steep panels meant that it was necessary to use the larger Swiftech MCP355 pump.

11. The height also caused an interesting problem – as soon as the panels filled and water started to fall back into the tank, siphoning started and sucked all the water out of the panels!!

12. This was overcome by:

    12.1. Leaving an open vent in the pipework at the highest point of each panel, and;

    12.2. Inserting a throttle into each downpipe – this consisted of a thick washer of engineering plastic with a 5mm diameter hole in the centre. Two 5mm diameter holes have an area slightly larger than the output port of the pump, so the restriction is enough, but not too much! The washers were easily placed inside the brass couplings at the upper ends of the 20mm butylene downpipes.

13. The system is controlled by two Maxim DS18B20 temperature sensors which feed digital temperature data to a 16F628 microchip which makes the decisions about turning on or off. The whole controller is powered off at night via a modified solar garden-light which provides enough power during the day to hold the controlling relay in the 'ON' state.

14. An important feature at this site is frost protection, so the controller is always very conscious of the information provided by the 'top-of-panel' sensor before it switches on!

15. The controller has an LCD screen with menus which allow adjustment of panel-minimum temperature, tank-maximum temperature, and time intervals between temperature measurements (about 5 minutes or so seems to work).

16. It's great having free hot water!