

Solar Water Heater Innovations

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The production of packaged solar water heaters has developed into a significant industry in Australia. Domestic and commercial solar hot water collector production in 2004 is likely to exceed 160,000 m² and the annual conventional energy displaced by the cumulative installation is greater than 1000 GWh/year. The cumulative area installed up to 2003 is of the order of 1.2M m². Local sales of solar water heaters showed a significant dip in the early 1990's but have recently expanded significantly partially as a result of the renewable energy credit program.

Detailed performance analysis of every solar water heater is now published by The Office of the Renewable Energy Regulator. The impact of this public information has had a significant effect on competition between manufacturers and the requirement that all products in the Renewable Energy Credit program meet AS2712 design requirements has had a significant impact on the quality of solar water heater products. As a result there has been a substantial increase in the range and quality of products now available.

This paper reviews design concepts for domestic solar water heaters and summarises new product developments for passive and active solar water heating including

- High efficiency flat plate solar collectors
- Evacuated tubular collectors
- Seasonally biased collectors
- Low cost plastic integral solar pre-heaters
- Low flow rate system design
- Solar preheating with gas boosting
- Heat pump water heaters, solar boosted and air source
- Freeze protection (required in most parts of Australia)
- Photovoltaic water heaters



SOLAR WATER HEATER INNOVATIONS

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Solar Thermal Energy The University of New South Wales

CONVENTIONAL SOLAR WATER HEATER DESIGNS

- **Thermosyphon**

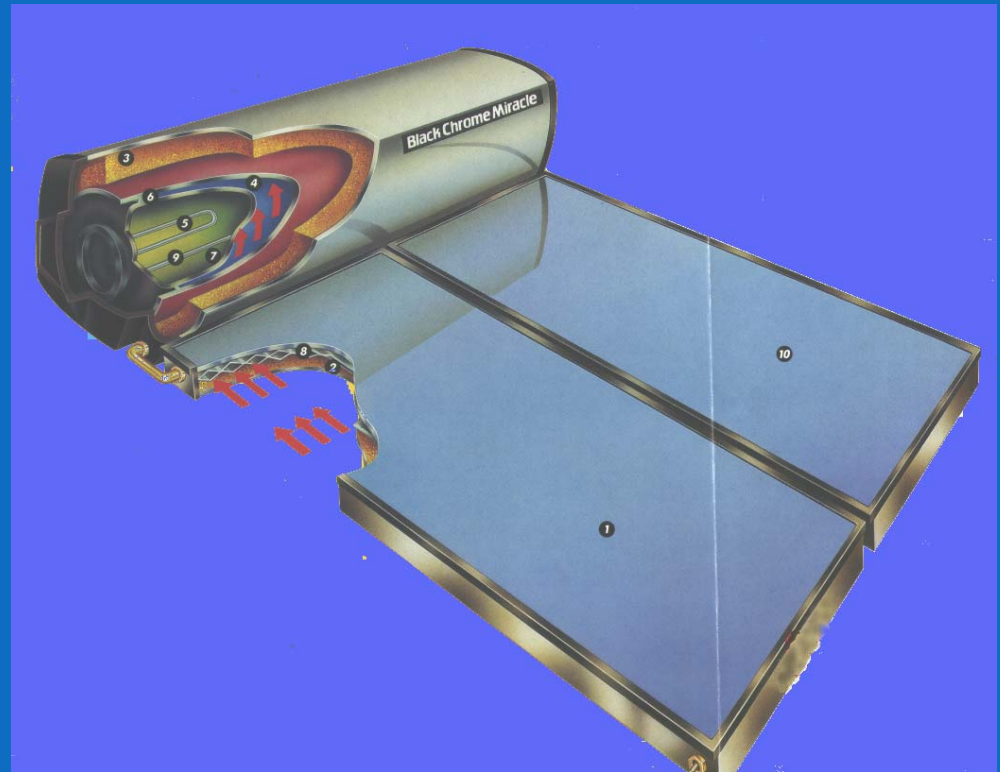
Flat-plate collectors with direct connection to a horizontal tank



CONVENTIONAL SOLAR WATER HEATER DESIGNS

- **Thermosyphon**

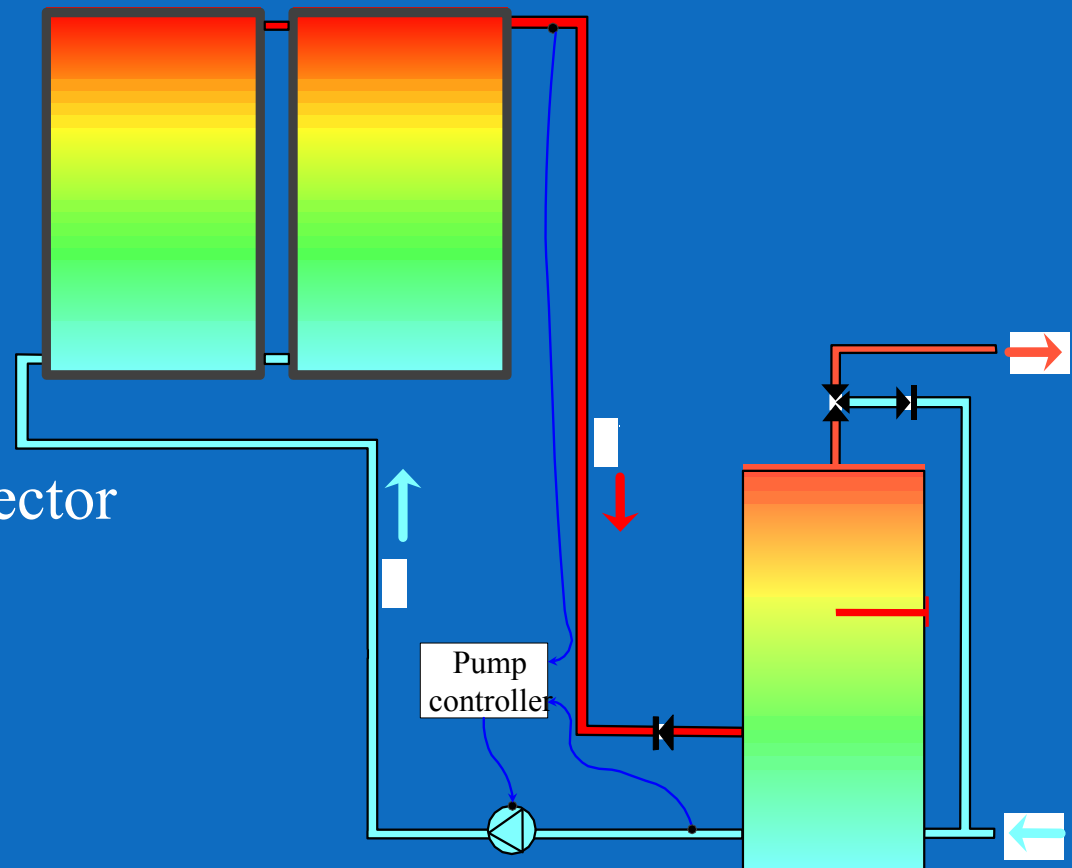
Flat-plate collectors with connection to a horizontal tank through a heat exchanger for freeze protection



CONVENTIONAL SOLAR WATER HEATER DESIGNS

- Pumped circulation

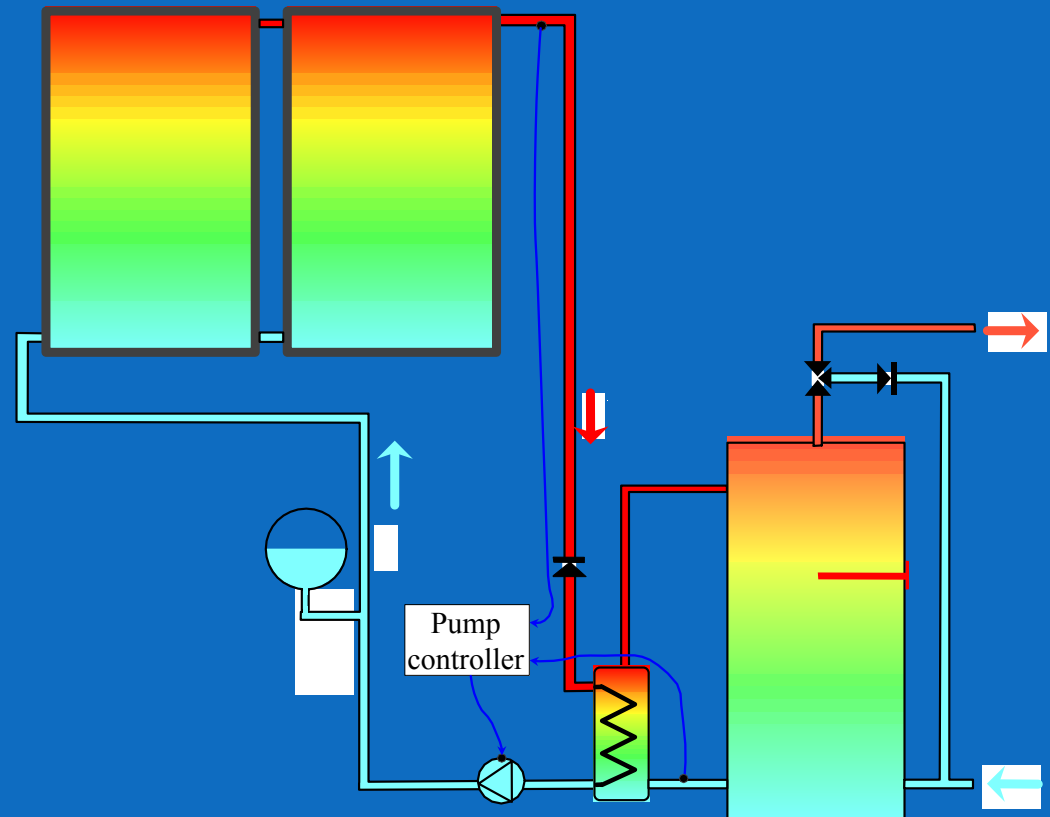
Frees placement of collector and tank



PUMPED CIRCULATION SOLAR WATER HEATERS

Pumped circulation

With freeze protection



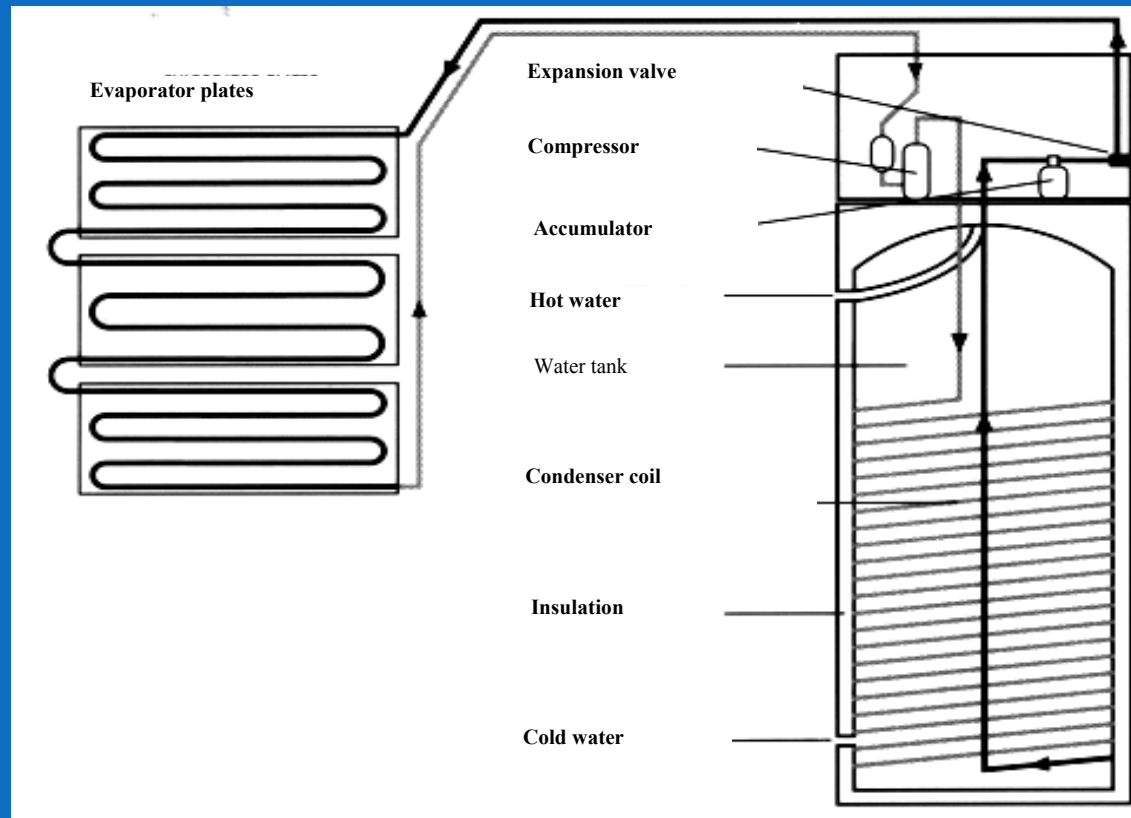
SOLAR BOOSTED HEAT PUMPS

Small refrigerant compressor used to move heat from low temperature solar collector (heat pump evaporator) to high temperature water tank.



SOLAR BOOSTED HEAT PUMPS

Heat pump circuit uses low cost unglazed solar collector (evaporator) and a double walled heat exchanger (condenser) in the water tank



INNOVATIONS IN SOLAR WATER HEATER DESIGN

- High efficiency flat plate solar collectors
- Evacuated tubular collectors
- Seasonally biased collectors
- Low flow rate system design
- Intelligent control of electric boosting
- Solar preheating with gas boosting
- Low cost integral plastic solar water heaters
- Heat pump water heaters; solar boosted and air source
- Freeze protection (required in most parts of Australia)
- Photovoltaic water heaters



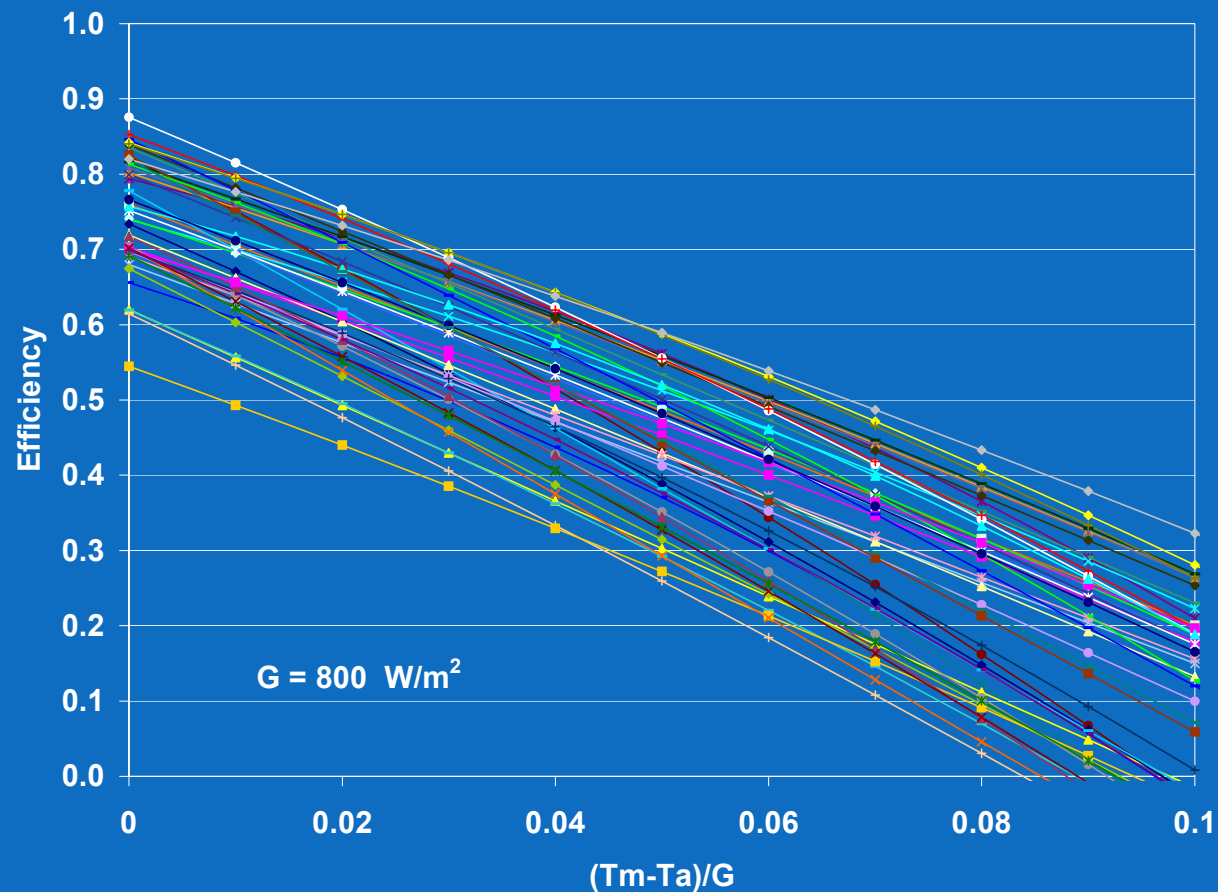
SOLAR COLLECTOR EFFICIENCY IMPROVEMENTS

- Improved selective surfaces (sputtering of wide absorber sheets)
- Laser welding of absorber and risers
- Anti-reflection coatings of glass
- Optimisation of flat plate cover spacing, insulation and casing design

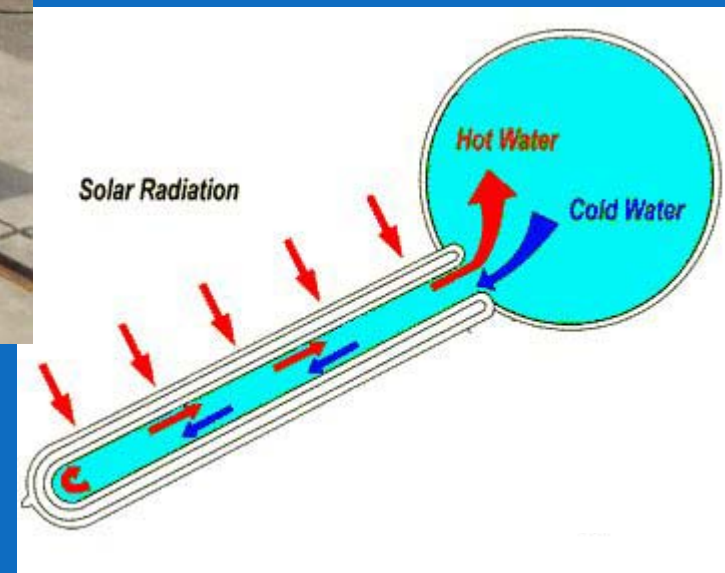


SOLAR COLLECTOR EFFICIENCY

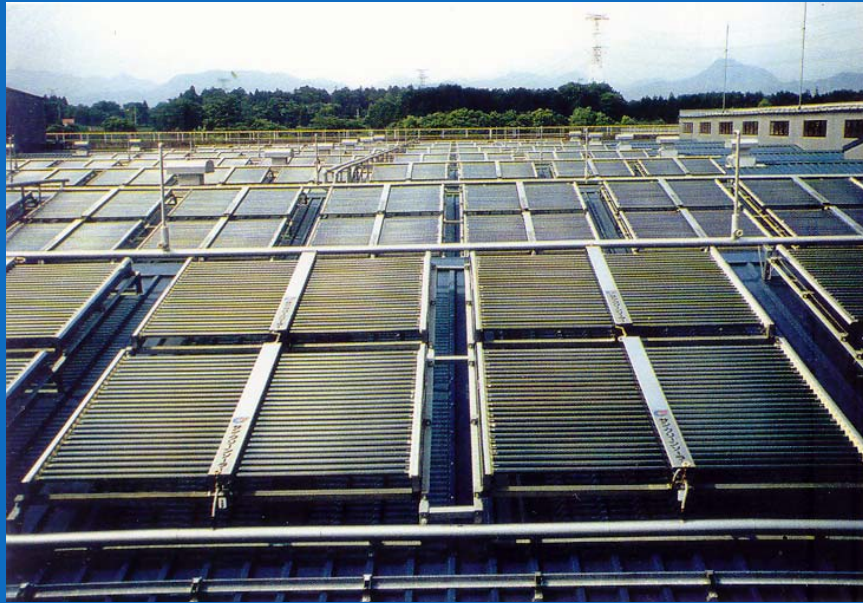
current products



EVACUATED TUBE SOLAR ABSORBERS (China)



LARGE SCALE USE OF EVACUATED TUBE SOLAR COLLECTORS (China)



Large arrays of evacuated tubes for commercial heat systems



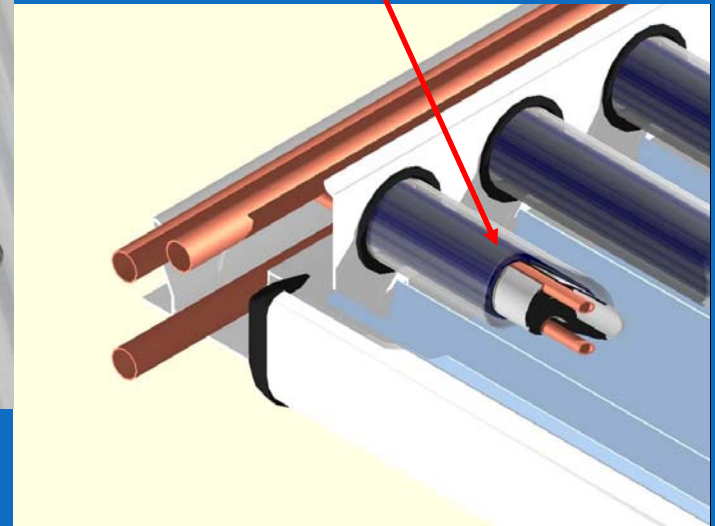
Full utilization of high rise building roof for evacuated tube solar water heaters



U-TUBE HEAT REMOVAL IN EVACUATED TUBES



Fluid in pressurised
pipes inserted into
evacuated tubes



EVACUATED TUBE WATER HEATER WITH AIR CIRCULATION



Prototype evacuated tubular collector solar water heater, using air circulation to eliminate stagnation and freezing problems.

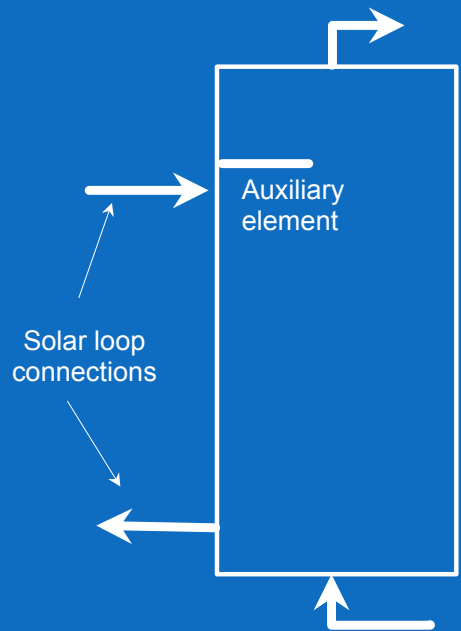


DYNAMIC SWITCHING OF ELECTRIC BOOSTING

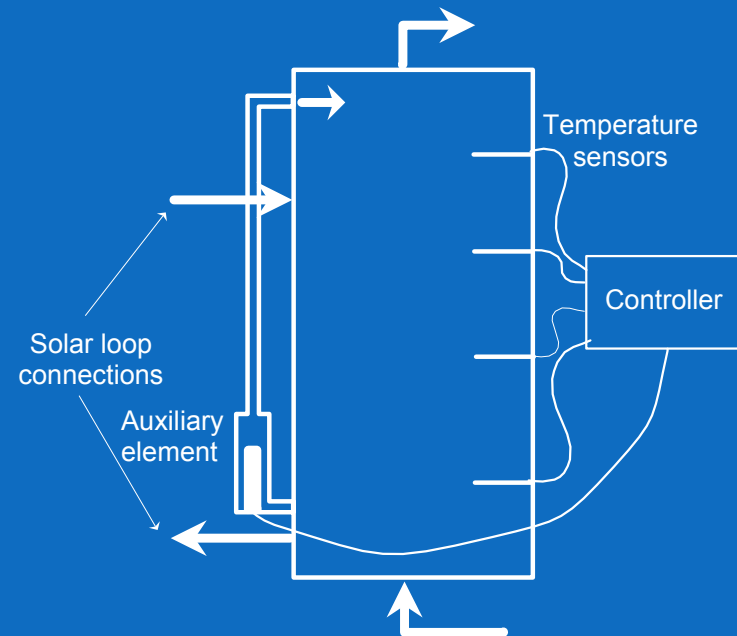
- Variable auxiliary boost volume
- Electric booster thermostat setting reduced during periods of good solar input and at night
- User setting of electric boost to match usage patterns



VARIABLE BOOST VOLUME



Fixed volume auxiliary boosting



Variable auxiliary volume



LOW FLOW RATE SYSTEM DESIGN

Component matching has a significant effect on performance

Major factor in both pumped and thermosyphon systems is the concept of “Low Flow” design to maximise thermal stratification in the storage tank.



STATIONARY REFLECTORS FOR BOOSTING WINTER PERFORMANCE



Solar Thermal Energy The University of New South Wales

WINTER BIASED PERFORMANCE USING MIRRORS



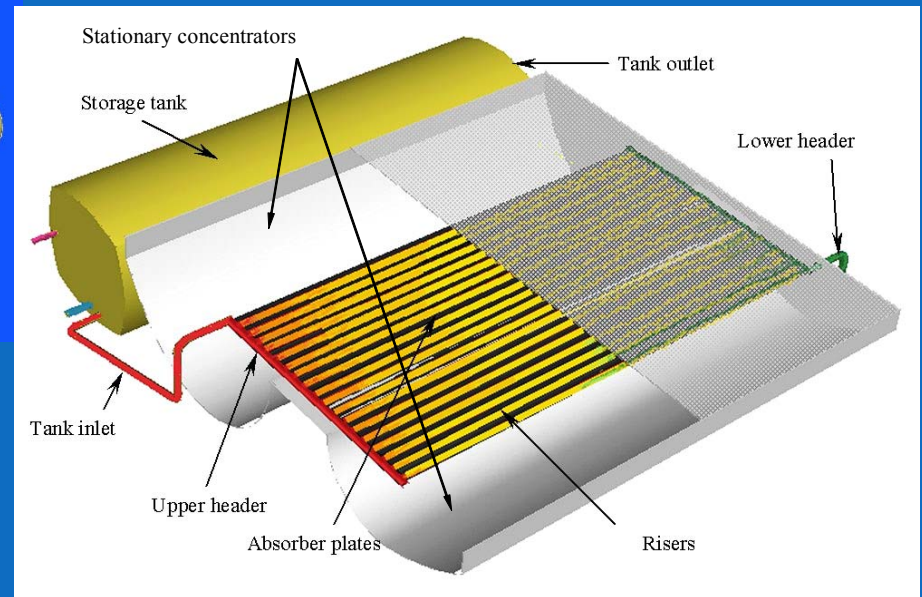
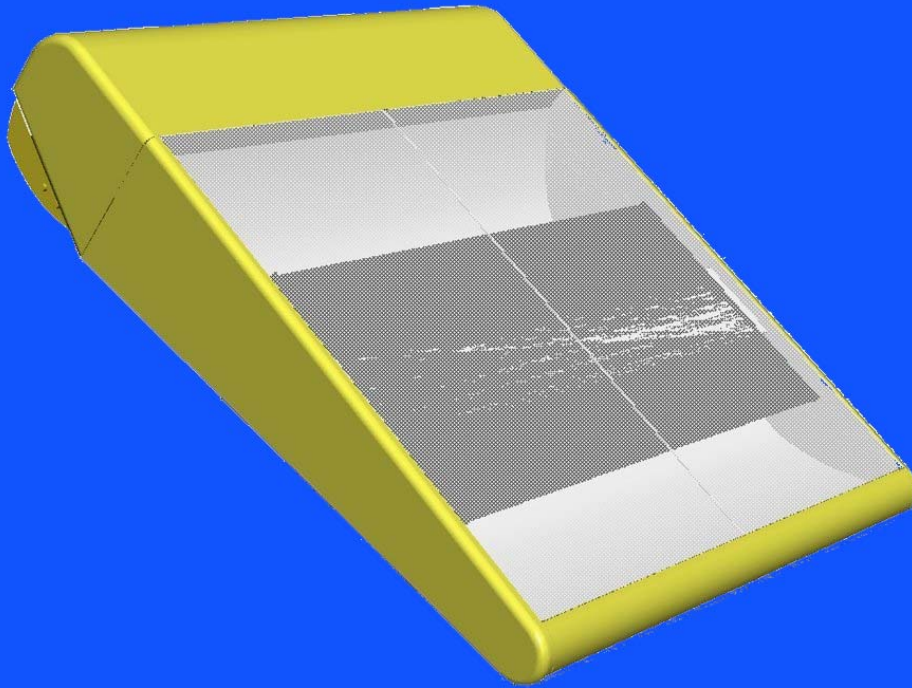
Mirror booster to give winter biased peak performance for low slope installation.



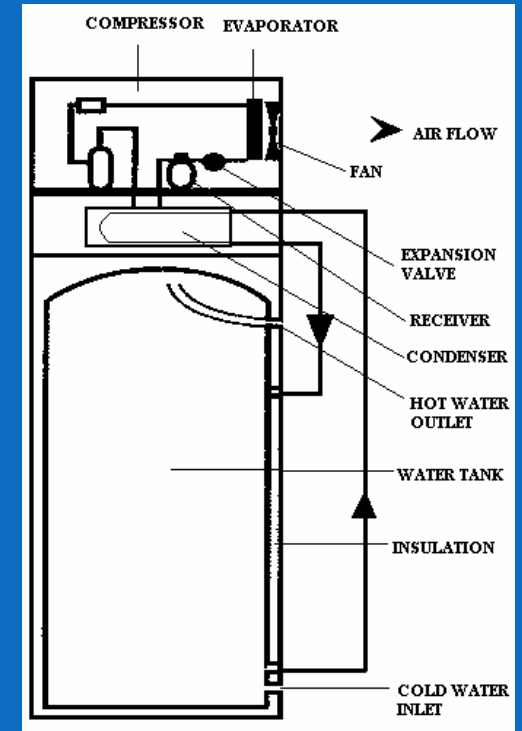
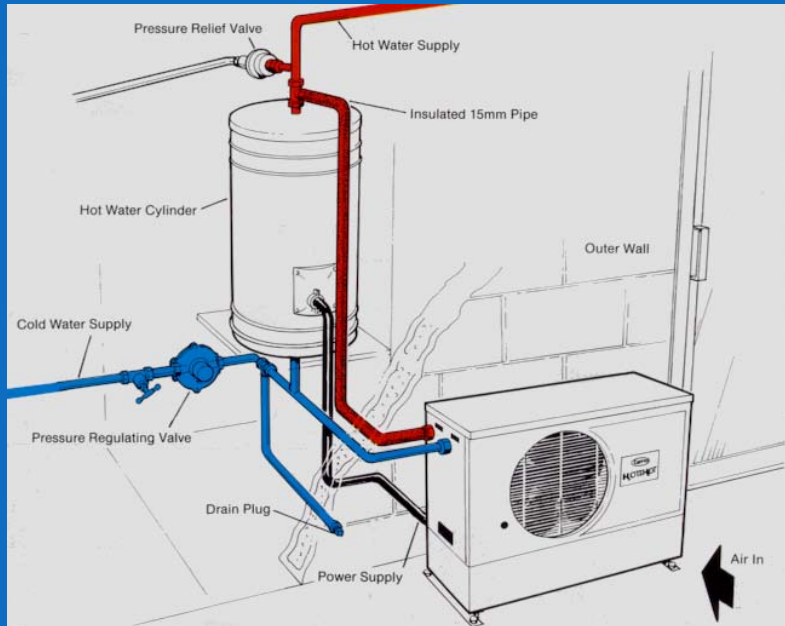
Prototype solar water with stationary mirrors to give winter biased peak performance.



PACKAGED SYSTEM WITH WINTER BIASED PERFORMANCE



AIR SOURCE HEAT PUMP WATER HEATERS



FREEZE PROTECTION OPTIONS

Collector loop heat
exchanger

Tapered riser tubes

Dump valve



PLASTIC INTEGRAL SOLAR WATER HEATERS



Insulated-tank integral system



Fully integrated collector/ tank



PHOTOVOLTAIC WATER HEATER

no plumbing to the roof, no freeze problems
no bank balance!

