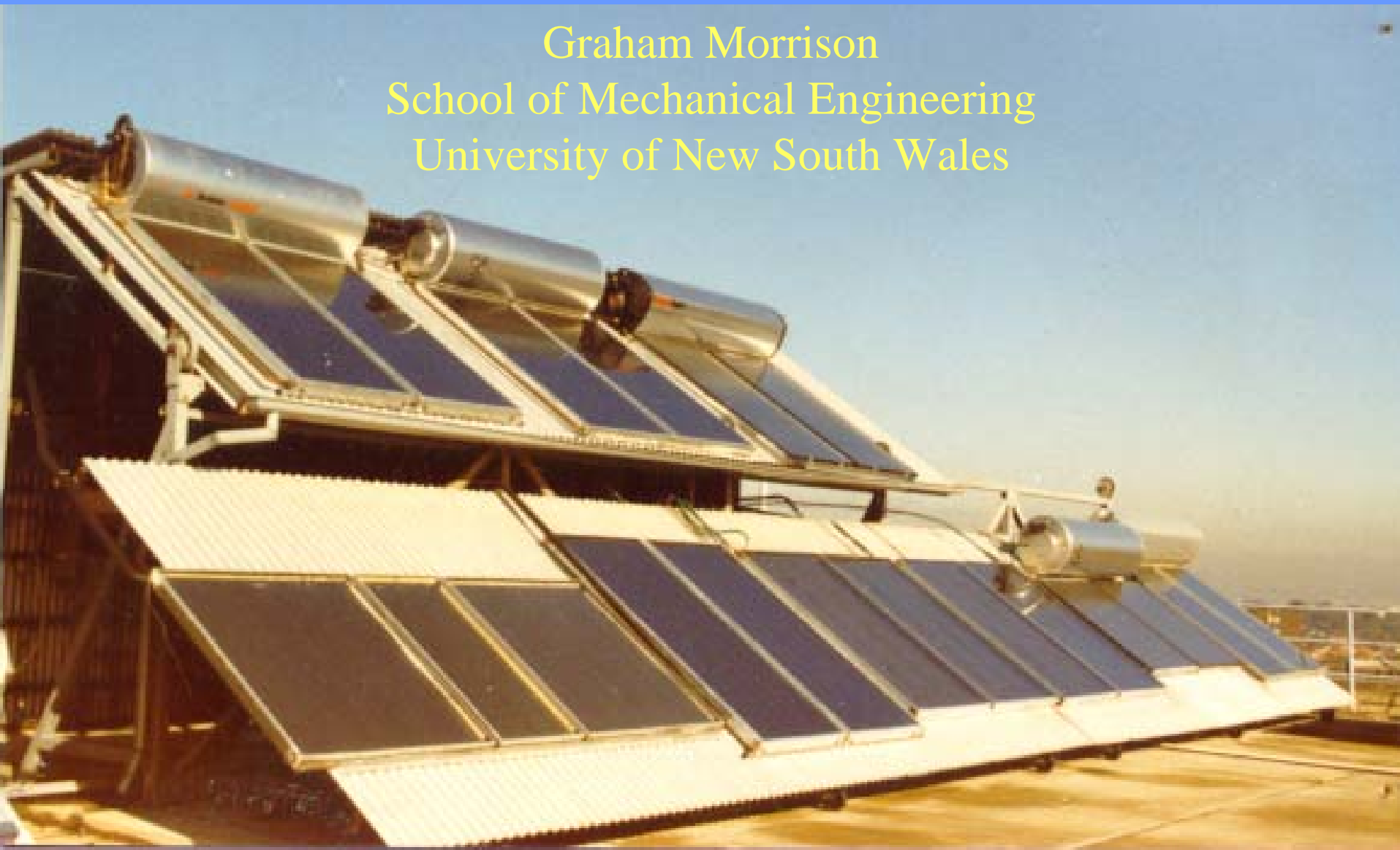


SOLAR WATER HEATING IN AUSTRALIA

Graham Morrison
School of Mechanical Engineering
University of New South Wales



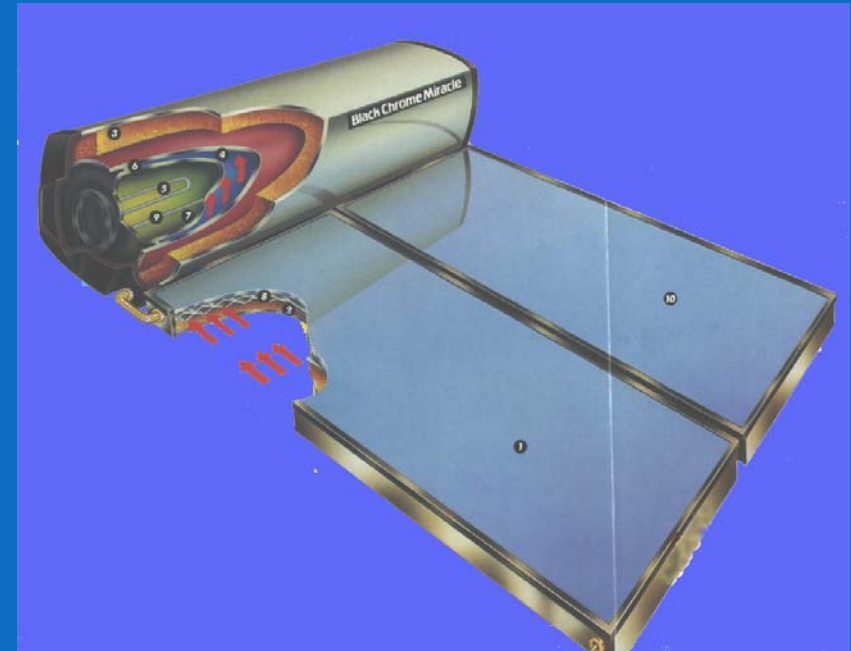
SUMMARY

- The production of packaged solar water heaters is a significant industry in Australia. Major water heater manufacturers now see solar and heat pump water heaters as significant product lines.
- Domestic and commercial solar hot water collector production in 2004 was around 160,000 m². The cumulative area installed up to 2004 is of the order of 1.2 million m² and the annual conventional energy displaced by the cumulative installation is greater than 1000 GWh/year.
- The performance of domestic and commercial solar water heaters are now published on the web by The Office of the Renewable Energy Regulator and The Sustainable Energy Authority of Victoria. The impact of this public information has had a significant effect on product development.
- Adoption of software modelling by manufacturers has resulted in expansion of the range of products and significant performance improvements.



THERMOSYPHON SOLAR WATER HEATERS

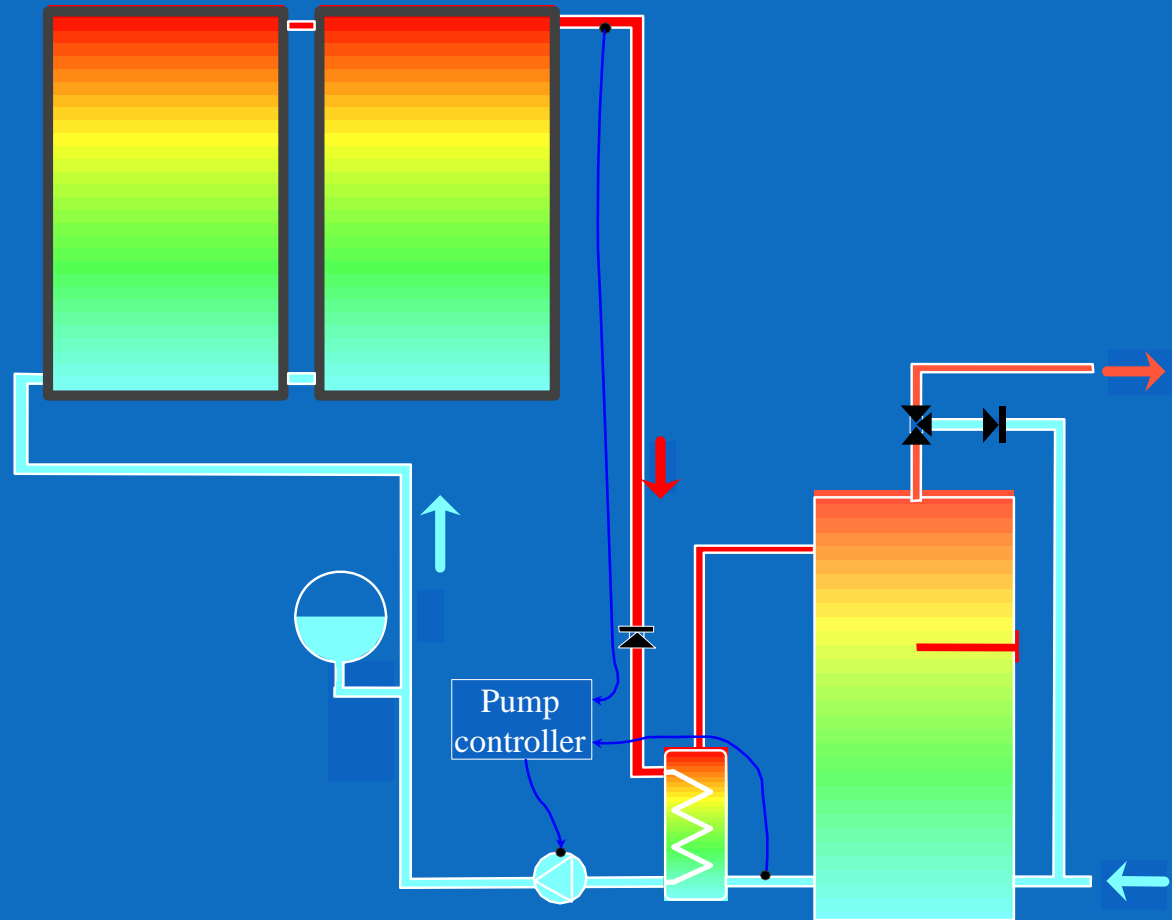
Thermosyphon systems are still the major product type



PUMPED SYSTEMS

Proportion of pumped system is growing quickly.

Many types of collector loop heat exchangers are used; side-arm, mantle and other low cost designs



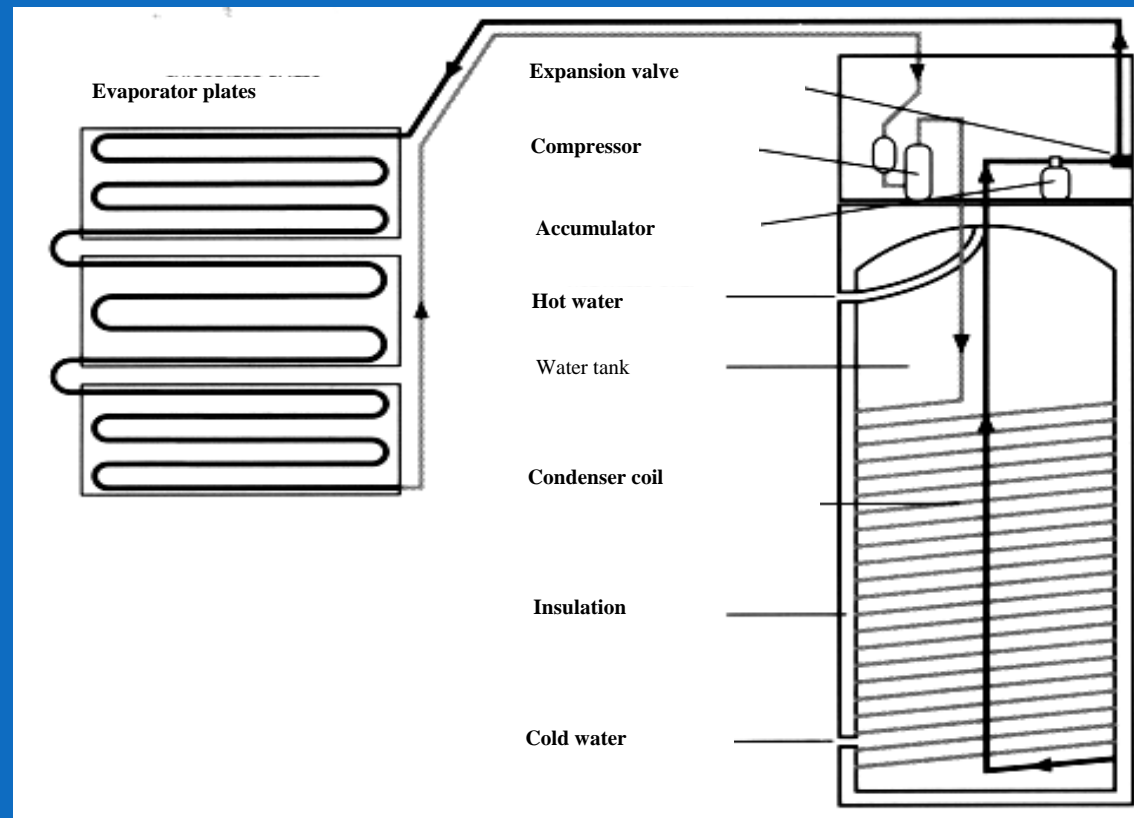
SOLAR BOOSTED HEAT PUMPS

Heat pump with evaporator exposed to direct solar radiation, operates as both a direct solar collector and as an air source heat pump.



SOLAR BOOSTED HEAT PUMPS

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



PRODUCT DEVELOPMENTS

- High efficiency flat plate solar collectors
- Evacuated tubular collectors ?
- Low flow rate system design
- Intelligent controllers for boosting and solar loop
- Solar preheating with gas storage boosting and instantaneous gas boosting
- Low cost integral plastic solar water heaters
- Heat pump water heaters; mainly air source
- Software



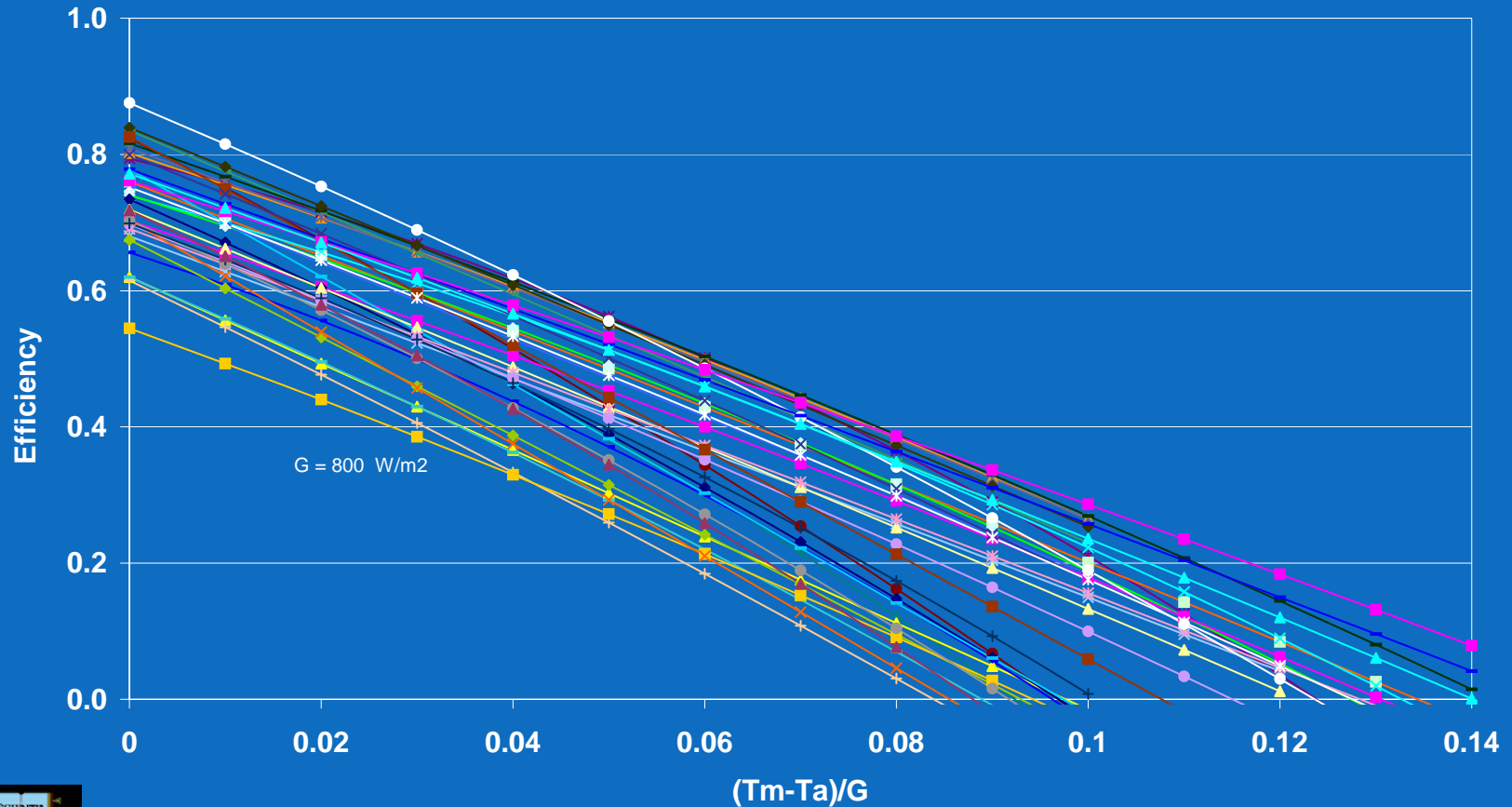
SOLAR COLLECTOR EFFICIENCY IMPROVEMENTS

- 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



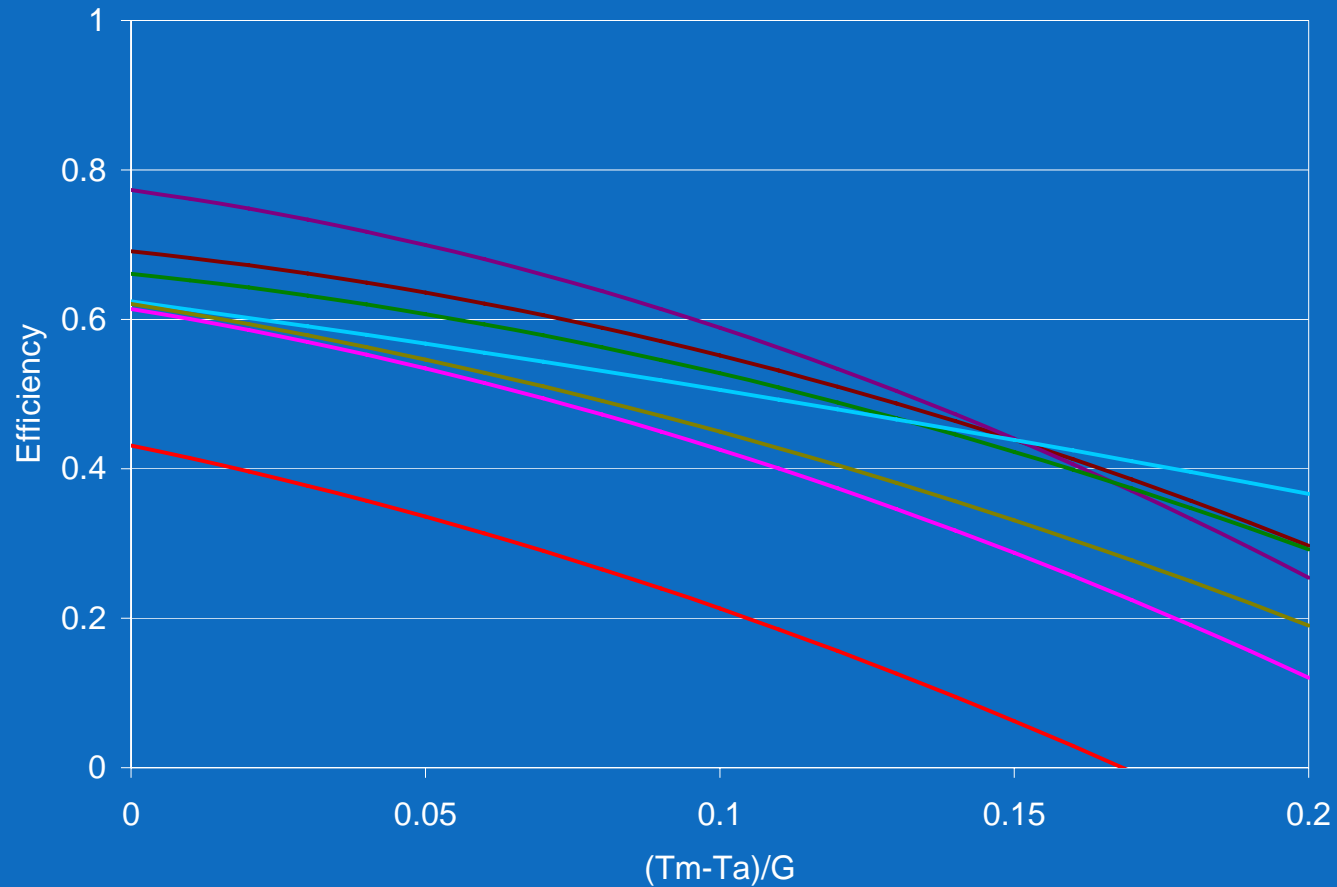
SOLAR COLLECTOR EFFICIENCY

Flat plate collectors



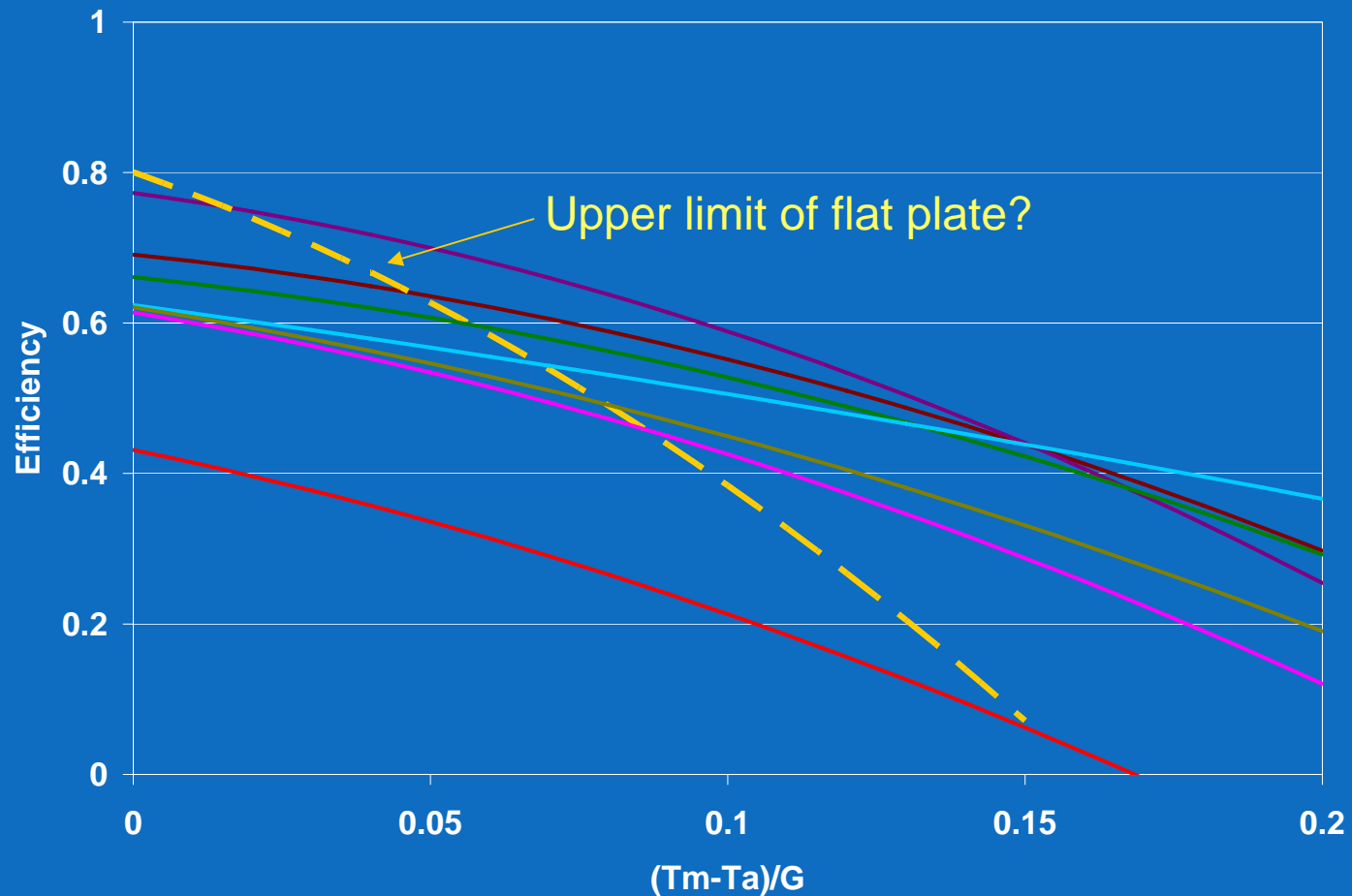
SOLAR COLLECTOR EFFICIENCY

Evacuated tubes



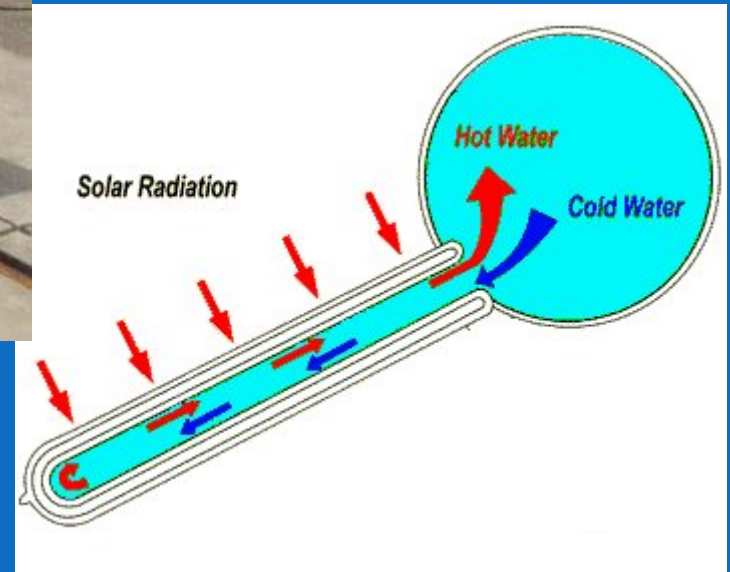
SOLAR COLLECTOR EFFICIENCY

Evacuated tubes / flat plate



EVACUATED TUBES

Water-in-glass



WATER-IN-GLASS DESIGN

- Single-ended evacuated tubes with direct connection to a horizontal tank
- Collector inclination: 45°
- Tube aspect ratio (length/diameter): 2200/34 to 3500/45
- Inter-tube spacing: typically 2 diameters

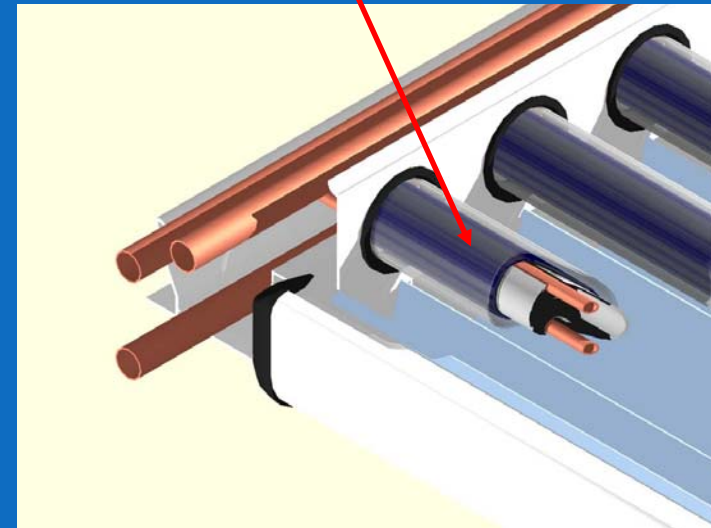


EVACUATED TUBE ARRAYS

optimised optics, pressurised fluid, self draining



Fluid in pressurised
pipes inserted into
evacuated tubes



EVACUATED TUBES WITH AIR CIRCULATION IN COLLECTOR LOOP



Evacuated tubular array with air circulation in collector loop to eliminate stagnation and freezing problems.



INTELLEGENANT CONTROLLERS

Controller with A/D and 10 amp relays allows

- Variable pump speed
- Variable auxiliary boost volume
- Variable thermostat setting in response to demand and solar availability
- User setting of electric boost to match usage patterns or controller learning of demand patterns



STATIONARY REFLECTORS FOR BOOSTING WINTER PERFORMANCE



WINTER BIASED PERFORMANCE USING MIRRORS



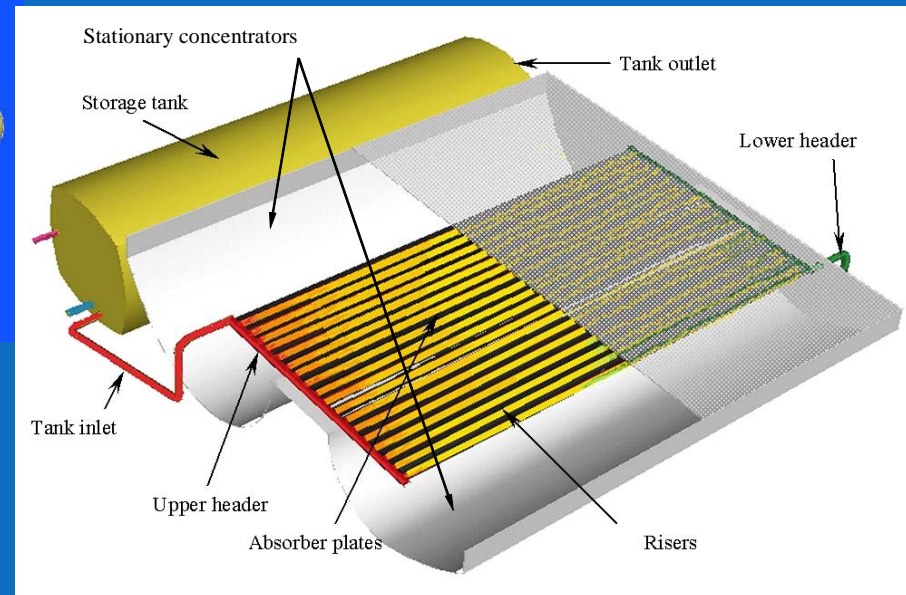
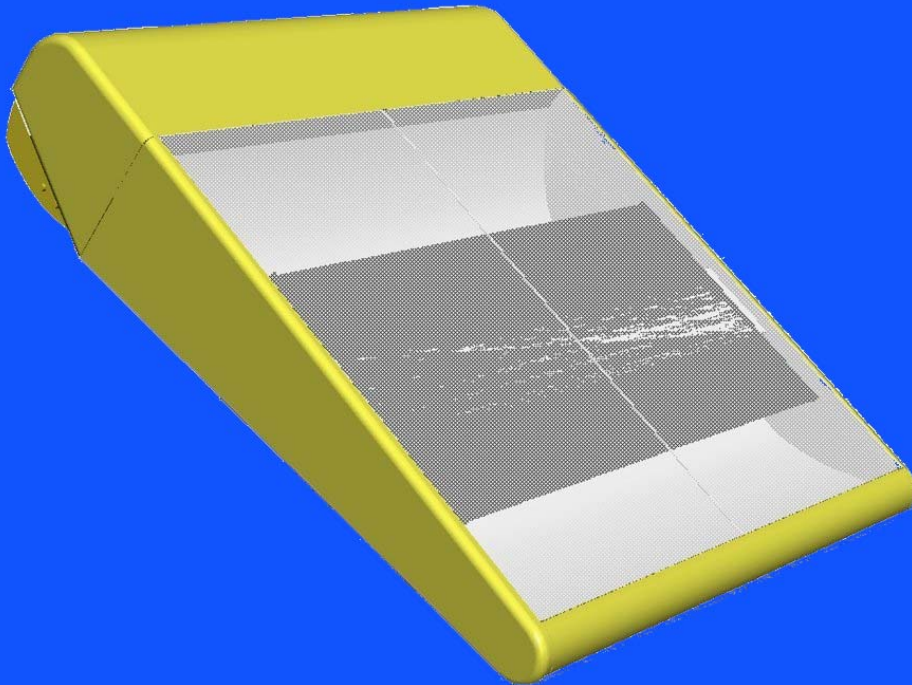
Mirror booster to give winter biased peak performance for low slope installation.



Evacuated tubes with winter biased concentrator.



PACKAGED SYSTEM WITH WINTER BIASED PERFORMANCE



PLASTIC INTEGRAL SOLAR WATER HEATERS



Insulated-tank integral system



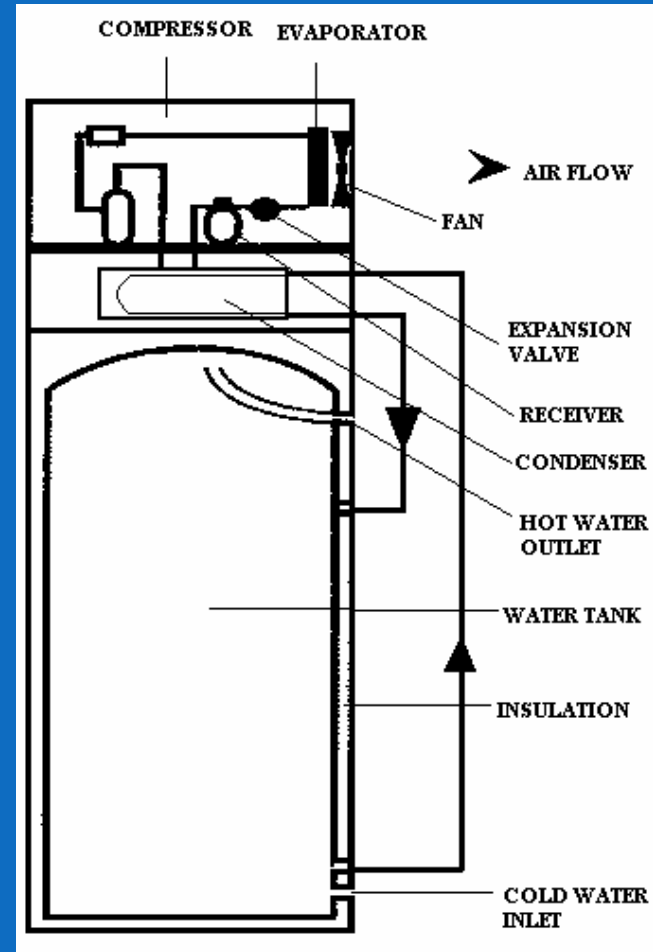
Fully integrated collector/ tank



AIR SOURCE HEAT PUMPS



AIR SOURCE HEAT PUMP INTEGRAL TO TANK



PRODUCT DEVELOPMENT DRIVERS

- Renewable Energy Certificate market
- Marketing advantage from having products with highest REC rating
- Requirement of 60% annual energy savings in Melbourne and compulsory solar water heater in new houses.
- Easiest option to achieve integrated household rating in Sydney



SOFTWARE DESIGN TOOLS

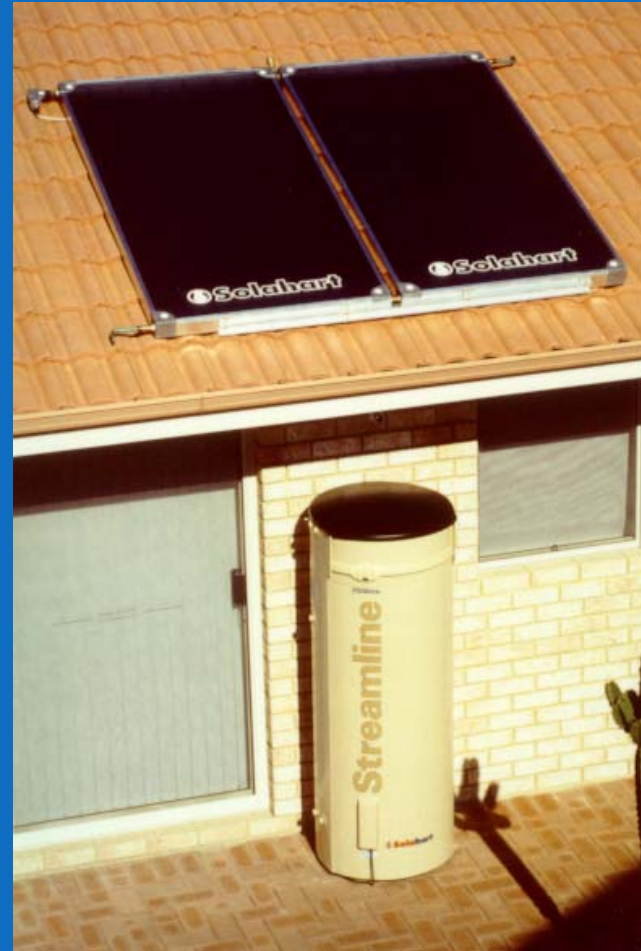
- Faster product development
- Wide range of product configurations can be considered (>4000 models registered)
- Performance optimization for high rating
- Performance optimization for cost/REC rating leading to cheaper products
eg maximum profit from basic low cost solar collectors or plastic integrated systems but poor pollution impact



LOW FLOW RATE SYSTEM DESIGN

Component matching has a significant effect on performance

Both pumped and thermosyphon system performance maximised by “Low Flow” design to improving thermal stratification in the storage tank.



MARKET DIRECTION

- Compulsory installation in new houses or requirement to meet overall household energy use target has shifted large part of market from individual purchasers to bulk purchases by developers.
- Easy installation of packaged air-source heat pump systems.
- Low cost evacuated tube systems?

