Solar water heating in Australia

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May 2013
Solar water heating in Australia

First documented solar water heater  1941
Morse / Bates  North Qld

Commercial applications from early
1950’s
S W Hart  (Solahart)
Beasley
Small
and others
CSIRO Solar Energy Research
1954 - 1988

- Thermosyphon solar water heater design and field trials in all Australian climates.

- Development of selective surface coatings for flat plate collector absorbers and commercial transfer of collector technology.

- Quality and performance standards for flat plate collectors and solar water heating systems.

- First large commercial demonstration 1976, Queanbeyan Coca Cola bottling plant.
Early research on solar water heating in Australia

Pioneers from 1950’s
Wall Read  CSIRO
Bill Charters Univ of Melb
Jack Duffie  Univ of Wisconsin
Roger Morse CSIRO

Not shown
Bob Dunkle
Terry Hollands
Don Close
Roger Morse

First documented solar water heater 1941
Leader CSIRO Energy Research division
After leaving the CSIRO Roger developed domestic evacuated tube products

CSIRO evacuated tube commercial solar water heating prototype

Air circulation evacuated tube solar water heater. Morse (post CSIRO) 1980’s
Bill Charters

Solar boosted heat pump solar water heater

Commercialised by Siddons Solar Systems and Quantum Energy
In 1983 Solahart developed a unique closed loop thermosyphon system suitable for cold climates and bad water areas.

This resulted in significant international sales and a “Solahart” becoming the international bench mark for quality.
Figure 37: Distribution by type of solar thermal collector for the total installed glazed (FPC + ETC) water collector capacity in operation by the end of 2010
The all glass evacuated tube is often referred to as the “Sydney Univ tube” as a result of the selective surface developed at the University of Sydney. Evacuated tube selective surface research started by Brian Windows & Geoffrey Harding then David McKenzie & Dick Collins then David Mills & Q-C Zhang
# SELECTIVE SURFACES

<table>
<thead>
<tr>
<th>Flat plate collector selective absorber</th>
<th>Evacuated tube selective absorber</th>
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<tr>
<td>CSIRO research in 1950’s &amp; 1960’s on copper oxide and chrome black selective surface coatings.</td>
<td>Sydney University development of magnetron sputtering of aluminium nitride cermet coatings for absorbers in vacuum tubes.</td>
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<td>Wide spread adoption of selective absorbers for coastal and southern locations in 1960’s.</td>
<td>Still used in most evacuated tubes; over 100 million tubes in 2010.</td>
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Water-in-glass Integral Solar Water Heater

The “water-in-glass” collector concept was developed in Sydney in 1984 as part of a project involving Univ of Sydney, Univ of NSW and Rheem Water Heater Division.

A commercial evacuated tube manufacturing plant was established in Sydney in the early 1980’s, however production did not proceed as evacuated tubes were said to be uneconomic compared to existing flat plate collectors.

Water-in-glass evacuated tubes plugged directly into the tank, proposed in the 1980’s in Sydney but not commercialized.
SUNTRAC HEAT PIPE SOLAR WATER HEATER
Bisley Qld

Solar collector array with heat pipe energy transfer directly into the tank
Prof Zhiqiang Yin from Tsinghua University Beijing visited The University of Sydney from 1982 to 1984 and worked on the development of selective surfaces for evacuated tubes with Geoffrey Harding. Prof Yin also worked with Morrison at the outdoor test facility at UNSW.

Yin took the ideas for the plug in “water-in-glass tubes” and the Suntrac plug-in heat-pipes to China when he returned in 1984. The rest is history.
Worlds most common solar water heater designs

Derived from Univ of Sydney “cows-udder” concept and Suntrac plug-in heat-pipe concept of the early 1980’s in Australia

Water-in-glass, evacuated tube integral solar water heater

Plug-in heat-pipe, evacuated tube integral solar water heater
Water-in-glass Integral Solar Water Heaters in China

More than 100 Million tubes were produced in 2010.

These products are the largest selling solar device worldwide.
Solar & Heat Pump Domestic Water Heaters Installed in Australia

Correct total but yearly distribution uncertain.
TOTAL WORLD CAPACITY OF SOLAR WATER HEATERS 2010  MW$_{th}$
Figure 9: Total capacity of glazed flat plate and evacuated tube collectors in operation by economic region and in kWth per 1,000 inhabitants by the end of 2010.
UNGLAZED SOLAR WATER HEATING 2010
\[ \text{kWh/ 1000 inhabitants} \]

- **Australia / New Zealand**: 146.9 kWh
- **United States / Canada**: 41.0 kWh
- **South Africa**: 11.5 kWh
- **Europe**: 4.9 kWh
- **Central / South America**: 4.3 kWh
- **MENA Region**: 1.8 kWh

DESIGN AND PERFORMANCE STANDARDS

- Design and component performance standards - 1980’s

- System performance rating standards - 1990’s
  Introduction of computer modelling in place of annual outdoor performance monitoring.

- Heat pump water heater performance standard - 2000’s

- Solar space heating and cooling standard  2013

- Australian quality requirements and performance assessment methodology adopted for International Standards.
Quality of products and installation

• Periods of rapid market expansion attract short term profit takers.

• Late 1970’s rapid market growth resulted in many inadequate products appearing for a few years.

• Late 2000’s step change of market saw the number of suppliers grow to more than 30; many with little technical knowledge of the products (cardboard box sellers).

• Auditing of standards requirements in the late 2000’s has not been managed well by JAS-ANZ.
Auditing SWH Certification

• Qualification requirement for Renewable Energy Certificates is certification to AS/NZS 2712.

• The rapid expansion of the market has meant that the demand for design and testing services has increased significantly.

• The supply of rating services has moved from research based organisations to commercial testing labs who have inadequate understanding of the technology and standards requirements.

• Auditing of claims for certification has become haphazard due to inadequate skills of Certification Bodies and a lack of control by the Joint Accreditation System of Australia and New Zealand (the manager of standards certification).
THE FUTURE!

• Expand use of solar water heating

• Upgrade quality certification process.

Technologies

• User interaction through Wi Fi communication with water heater controls and solar weather predictions
• New concept solar/gas systems
• Combined PV-thermal collectors
• PV water heaters
• Expanded range of heat pump water heaters
• Sell hot water rather than solar water heaters
• Solar space heating (hydronic)
• Solar cooling
Solar preheater bolted onto a full capacity instantaneous gas heater
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PHOTOVOLTAIC WATER HEATER

no plumbing to the roof, no freeze problems

Photovoltaic array

Auxiliary element

Peak power point control by element switching
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