

Initial Insights on Evacuated Tube Versus Flat Plate Solar Water Heating Systems - A New Zealand Perspective

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Introduction

•New Zealand has great solar potential (Approx. 2000 hrs bright sun annually), but our cool night temperatures mean heated water HAS to be stored in a well insulated cylinders. Otherwise daytime solar gains will be lost, as morning inward cold water can even be colder than that held in ground level pipes.

•Such storage is best done by pumpless thermo-siphons, but this needs a suitable roof pitch profile for high tank mounting and best suits new homes rather than retrofitting. This elevated water filled tank can be HEAVY as well (causing possible structural issues)

•Pumped systems allow panel positioning anywhere, but will NOT work during power cuts/emergencies, as of course the pump needs energising power. P.V powered pumps can alleviate.

•It may make slight noise through the pipes when running - possibly annoying.

Flat Plate (D.O.C Nelson)



Evacuated Tube Array (Wanaka)

Analysis

Flat Plate Solar Heating Systems

•Typical base costs for commercial Australian flat panel systems (Solarhart etc) are NZ\$3000 **excluding labour**, although this may be offset somewhat against approx. NZ\$1000 for an immersion hot water cylinder otherwise needed in a new house.

•Notoriously expensive plumbing charges can easily add another \$2,000-3,000 resulting in ~NZ\$6000 installed system.

•New Zealand has an "airing cupboard" culture whereby waste cylinder heat is used to air clothes - a health benefit of course.

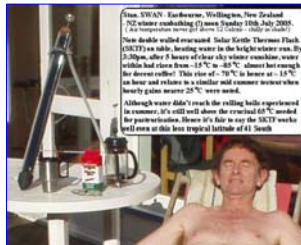
•Long standing NZ ripple control off peak water heating allows the energy load demand to be VERY usefully spread.

•Late 70s tests by the then DSIR showed that even the best site (Nelson etc) with 4square meter of quality panels would only save ~2000 kWh "units" per annum, worth approx. NZ\$300 at today's charges of ~15c a unit. Although this indeed serves to halve a typical homes water heating bill, much of this gained energy occurs in high summer when folks are away on holiday/ swimming/ wearing fewer clothes etc - it's WINTER that hot water is most valuable of course, although NZ overall gets good low angle winter sunshine.

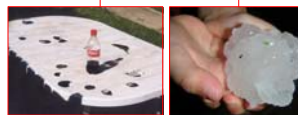
•MAINTENANCE can be costly - especially with prevalent tradesmen charges! Broken glass, frost /wind/ UV light damage, loose wires, leaking fittings etc can translate into a \$50-\$100 a year repair bill – a significant factor in a system that'll have maybe a 20 year life.

•Loss of interest on capital - \$6000 borrowed at say 7% will cost ~ \$400 p.a to service = the approx savings!

•The rather infamous late 1970s solar subsidy scheme of \$600 (~NZ\$5000 in todays money) lead to numerous local designs that often were substandard or flawed (perhaps even cooling overnight below ambient temperatures).



Frost and hail can seriously damage any solar water heater (SWH), but evacuated tubes are more resistant - due to curved tube sides and vacuum insulation.



Hail damage Sydney 1999

Evacuated Tube Water Heating Systems

Advantages

- Light weight
- Automatically solar orientated throughout the day
- Better suit architectural integration - "less visual pollution"
- Occupy less roof space
- Immune from frost
- Offer annual NZ energy gathering ~3000 units p.a (~ twice that of larger flat panels)
- Much higher efficiency (typically 70% of the incident solar energy will be available for water heating)
- MUCH higher water temps are delivered, even in winter, which if too hot can be safely moderated with a tempering valve to ~55C



Disadvantages

- Evacuated glass tubes are similar to toughened elongated thermos flasks in action, and have several downsides -
- The tubes themselves are fragile - 2 of 3 imported from Asia were broken in transit.
- Once installed however they're tough (even with hail!) and as they only serve to concentrate the solar energy (the heated liquid itself is contained inside copper pipes) they can easily be individually replaced if broken.
- Although traditionally more costly than flat plate systems now on offer in NZ are much the same cost as flat panels since they're largely made in China, meaning 20 tube domestic systems can be installed for ~ \$5000 in an existing NZ home.
- A pump is usually still needed to give flow rates ~ 3 litres a minute (180 l/hr) although thermosiphons can be used if roof suitably pitched.

Conclusions

A 1 year old system for example in Nelson is providing almost ALL the homes hot water needs, with a saving of hence ~ twice that of a flat panel for much the same installed cost. It's overall economics are hence much more attractive, with a likely payback period of ~10 years