Thermal Co-Generation with PV Solar Tile® and PV Airflow® Battens

'Innovation in Australian solar energy by PV Solar Tiles' - By Jackson He

The Photovoltaic system installed at a house in Surry Hills is a 1.5 kWp size designed to provide both grid connected electricity and thermal output using air. Thermal co-generation not only reduces the carbon emission from space heating but also improves the operating efficiency of the installed solar modules.

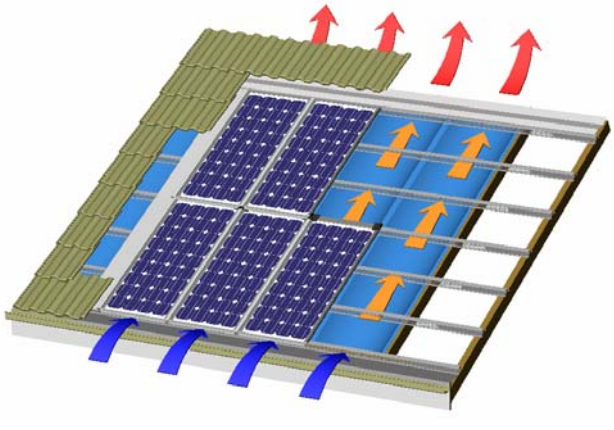
System Design

The 1.5kWp system is made up of 20 x 75W PV Solar Tiles. The solar modules in the Solar Tiles can heat up in excess of 50ºC during a sunny day. The low grade heat radiated into the roof space - which would normally be wasted - can be directed into the living space of the house using low cost ducting and energy efficient fans. Otherwise it is vented out via roof vents.

Operation

The system operates using natural thermal buoyancy effect. Heated air behind the panels expands and rises, drawing cooler air in behind the Solar Tiles from outside through a PV AIRFLOW batten vent opening the width of the PV array bottom edge. This cools the solar cells allowing them to operate more efficiently.

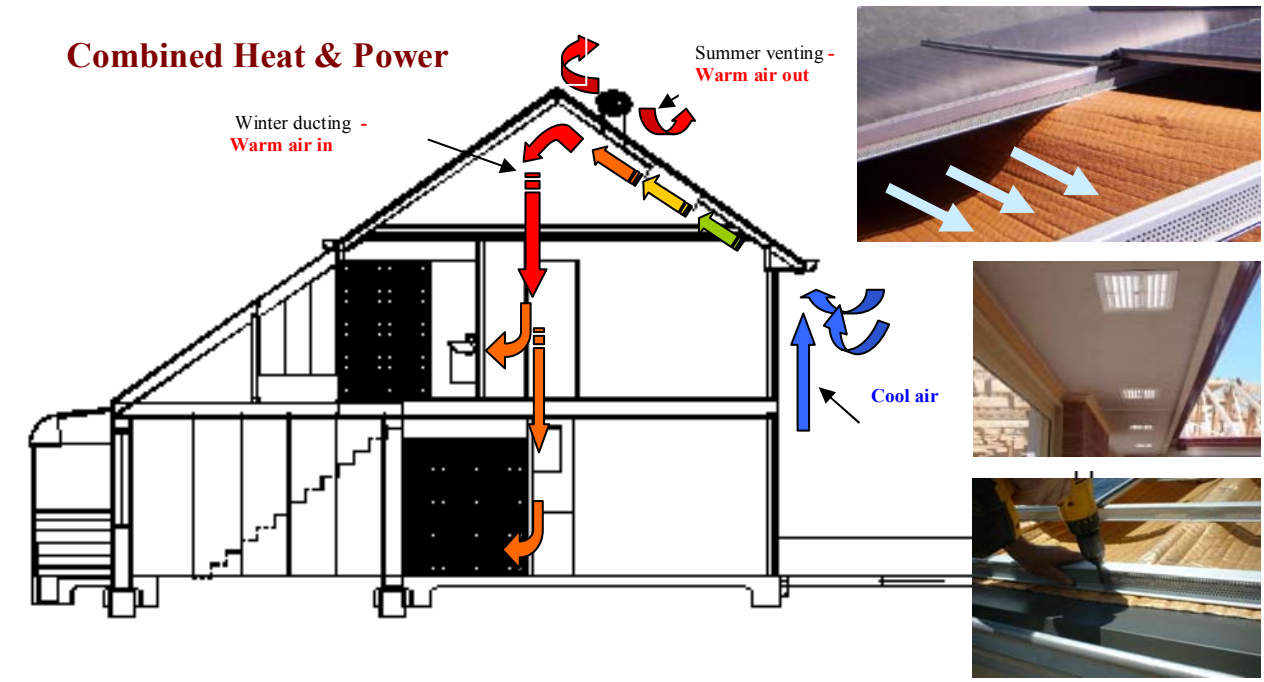
Added Value: In summer the warm air is expelled, during winter the air can be used to warm the house and reduce the need for heating derived from fossil fuel sources of energy supply.



The PV AIRFLOW® system

- **Improves PV Module performance**
- **Reduce heating needs in winter**
- **Thermal output is 1.8 times the electrical capacity**
- **Greater carbon emission reductions**

Solar Thermal set up with PV Solar Tiles at Mackey Street, Surry Hills
House design by Julie Cracknell & Peter Lonergan Architects, Sydney



Useful winter heat is collected from the solar array by adding low-cost ducting and fans.
Air cools PV cells, and recovers waste heat that is used for space heating to improve comfort. Warmth stored in the building interior can persist, delaying the need to use additional heating. *The array cools down on summer nights and the same system can be used for cooling air.*

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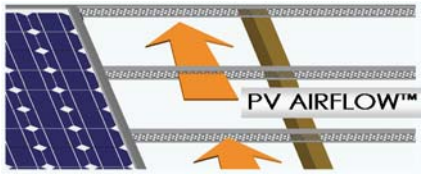

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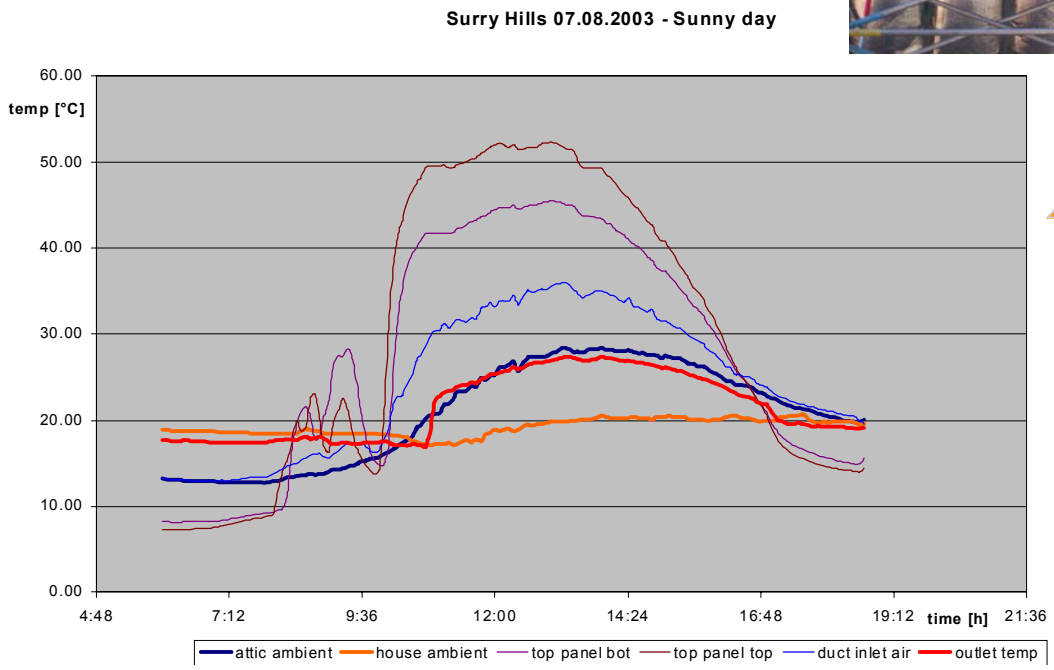
Temperature Control

When the ambient roof temperature rises above the ambient interior temperature, warm air is pushed down into the living space by the fan. The fan turns off when the ambient roof temperature difference falls below a set point. The fan is enabled by a standard wall plate switch in the living space, but its operation is controlled automatically via a thermostat. The fan can also be connected with a interior room thermostat to maintain the desired room temperature.
During summer the warm air can simply be vented out of the roof via twirly air-vents, drawing cool air from below the PV array, cooling the PV cells and the roof space. With this system there are also other possibilities with summer operating cycle to save energy and improve comfort.

System Effectiveness

The graph below shows data recorded from the Solar Tile heat recovery system for a sunny day in August 2003 - late winter. On the day of measurement the PV/Thermal system increased the temperature in the main living area by about 4°C without the need for gas or electric heating.



Emission Reduction

Research has been carried out in conjunction with the University of NSW on this building integrated PV/Thermal co-generation. Tests concluded that heat could be collected in winter at a ratio of around 1.8 times the rated solar PV power of the system. For example if 6 kW-hours of electricity was produced on a sunny winter day, then about 11 kW-hours of heat can be generated. This would be equivalent to a 1 kW fan heater operating continuously for 11 hours, but without the 12 kilograms of CO_2 emission by coal fired electricity generation. Over winter the system might save about 1100 kg of CO_2. Conventional non-integrated PV mounting without co-generation would only save around 460 kg of CO_2.

PV Airflow® Battens

The efficiency of the system is improved using PV Airflow™ battens. PV Airflow™ battens are made from perforated Zincalum coated steel based on the LYSAGHT Topspan® 40 batten. The PV Airflow™ battens are designed to provide the conditions for a sufficient free flow of air behind the solar modules. Having good circulation reduce the working temperature of the PV modules hence improving the system power output and protecting the PV laminate from heat stress. Normally PV Solar Tiles™ are mounted with PV Airflow™ battens and insulation sarking to reduce heat transmission between the PV modules and the roof space. The PV Airflow™ battens' effectiveness is confirmed in testing at The University of New South Wales, SolARCH test facility.

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