Bishop James Memorial Camp and Conference Centre.

Solar air heaters:
Simple, sustainable savings

HVAC&R Nation finds out how four community facilities are benefiting from solar air heaters, an alternative to traditional means of heating and cooling.

Visitors to Audrey Brooks Memorial Pre-School, small and large, can now benefit from solar heating in the main classroom and the office space.

Additionally, Bishop James Centre, Selwyn Neighbourhood House, and Swan Hill Uniting Church are all benefiting from the same technology, providing internal warmth without producing greenhouse gas emissions.

Four different community buildings, located around Victoria, have been improved in terms of both quality and sustainability by the incorporation of simple, reliable and cost-efficient solar air heaters.

This low maintenance technology enables heating and cooling of buildings without using the fossil fuels that conventional heating, ventilation and air conditioning systems use. The result is a tranquil, comfortable building environment, sustainable outcomes, and reduced energy and maintenance bills.

Community facilities opt for a solar solution

Bishop James Memorial Camp and Conference Centre

The Bishop James Centre was one of the first community buildings to become a partner under the Victorian Solar Innovation Initiative (VSII) and receive funding towards installing innovative solar energy technology. The centre, located in Stuart Mill just south of St. Arnaud, demonstrates the use of solar heaters in their building extension—a new accommodation facility. The building has been constructed using rammed earth and contains 12 rooms, with the ability to sleep 48 people under a single roof line. Four solar air heaters have been installed onto the roof of the accommodation building to provide heating to the rooms.

Swan Hill Uniting Church

Swan Hill Uniting Church conducts services, meetings, workshops, and provides a space for community group activities in a large church hall and adjacent meeting rooms. Historically, the large open space inside the building created problems with uncomfortable heat in summer and coolness in winter. The installation of four solar air heaters has improved the indoor climate, making the building comfortable for the occupants without generating large energy bills, therefore minimising greenhouse gas emissions.

> "Every room is a single thermal zone; the occupants can regulate their own room temperature by opening or closing the door and window." Revd Warren Rumble, Bishop James Centre

Selwyn Neighbourhood House

Selwyn Neighbourhood House in Craigieburn is a community facility for child care, functions and other activities. Hume City Council conducted an assessment of the building prior to deciding on an appropriate energy-efficient retrofit of the building. The result was the installation of solar air heaters on two of the facility rooms; the function room and childcare centre.

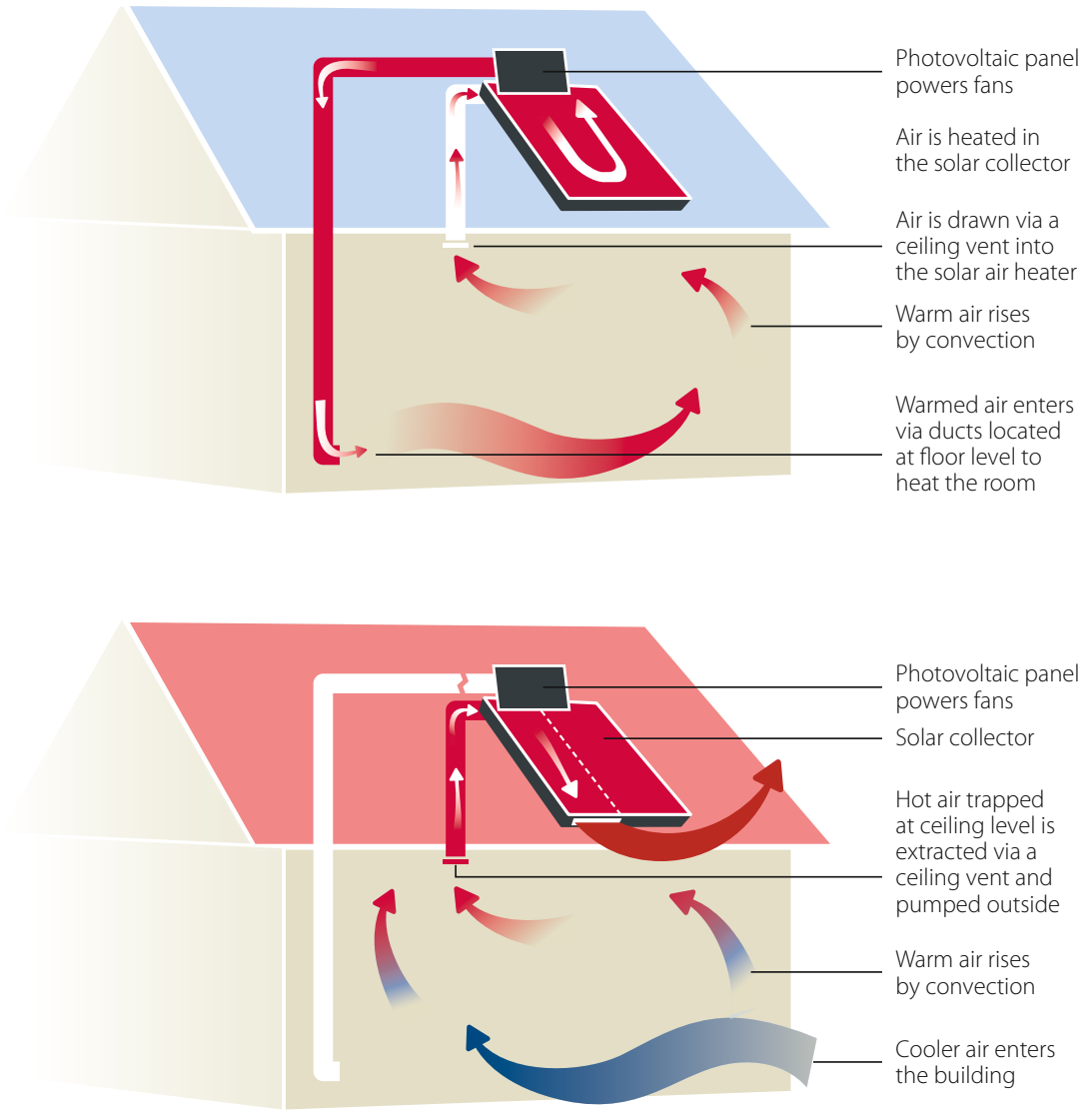

Figure 2: Operation of solar air heater in summer mode.

Audrey Brooks Memorial Pre-School

During an energy audit of council buildings, the Banyule City Council identified Audrey Brooks Memorial Pre-School as a facility with the potential to significantly reduce its energy consumption. The pre-school now has two solar air heaters installed onto the roof of the main school building to simultaneously improve the heating and cooling of the main classroom and office space, providing a reduction in energy use.

How solar air heaters work

Solar air heaters provide free interior heating. The sun rays heat the solar collectors, warming the air; the warm air is then conveyed into a room. The basic components of a solar air heater include solar collector panels, a duct system and diffusers to control flows of warm and cool air according to the building requirements. Systems can operate with or without a fan.

Winter mode

Warm air is taken from inside the building at ceiling height via ducts and passed through the solar collector where it is warmed. A fan then pushes the warm air through the ducts to outlet vents inside the building, located at floor level. As the warm air rises inside the building, ceiling-mounted inlet vents recapture the warm air and send it back to the solar air heater for reheating and recirculation back to floor level. See figure 1.

> "One of the best aspects about the system is that no electrical connection is required, as all the fans and pumps within the system operate on solar energy." Paul Brown, Banyule City Council.

Summer mode

By altering the arrangement of flaps and vents, the solar air heater can work in reverse in summer. Hot air from the upper air space in the building is extracted via the ceiling vents and propelled outside using the solar fan. The solar fan works when light is in contact with the solar collector panels, the more light reaching the panels, the faster the fan will operate. The solar fan reduces the build up of hot air inside the building, and encourages the flow of cool air around the building, reducing the need for air conditioning. See figure 2.

North versus south

In a well designed passive solar building, occupants tend to find the north side comfortable and the south side cool. The solar air heater can solve this problem by taking the warm air from the ceiling of the northern rooms, passing it through the solar air heating system to increase its temperature, then pumping it using the solar fans into the south side of the building.

Costs and benefits

The solar air heater uses no mains electricity, which means it uses no fossil fuels in operation, generating no energy bills. Each unit should last 20 to 25 years, costs approximately $2,500 plus installation, and can provide heating and ventilation for an average 100 sq m house or an energy efficient building up to 150 sq m. Solar air heaters are simple, with few moving parts, and can be installed relatively easily.

Evaluation

For each of the four projects, there are 'win-win' benefits of reduced energy bills and greenhouse gas emissions compared to conventional heating and air conditioning systems.

Based on the four projects, the average cost to supply and install a solar air heater is approximately $3,000 per unit. Generally cost is not reduced by bulk installations. Variation in cost may be attributable to site conditions, such as access for installations varying at each facility. Where ducting cannot be installed in existing wall cavities, new housing units need to be constructed and elevation frames may be required when the roof pitch is not to specification.

For Audrey Brooks Memorial Pre-School and Selwyn Neighbourhood House, it is predicted 50 per cent

Case studies

Audrey Brooks Memorial
Pre-School, West Heildelberg, Victoria
ESD consultant
Colin Gillam
Alternative Fuels and Energy

Bishop James Memorial Camp and Conference Centre
Stuart Mill, Victoria
ESD consultant
Terra Firma Brickworks, Bealiba, Victoria

Selwyn Neighbourhood House
Craigieburn, Victoria
ESD consultants
Sustainable Resource Technical Officer
Hume City Council
Colin Gillam
Alternative Fuels and Energy

Swan Hill Uniting Church
Swan Hill, Victoria
ESD consultant
Colin Gillam
Alternative Fuels and Energy
Builder
Maurice Krahnert

Solar air heater on the roof of the Audrey Brooks Memorial Pre-school, and internal outlet vent in the main classroom.

and 80 per cent respectively of heating needs will be provided by the solar air heaters, reducing the need to depend on gas heating and saving over $300 in energy costs.

Swan Hill Uniting Church and Bishop James Centre, which do not have main gas supply, have higher predicted energy costs savings as the solar air heaters will provide 100 per cent of the heating needs. Energy costs and greenhouse gas savings are greater where the avoided fuel consumption is fossil fuel based electricity, not natural gas.

Beyond these savings are the wider benefits from the educational value of the projects to building users and future generations. For example, at Audrey Brooks, the children are inspired by the idea of a box on the roof blowing hot air into their school.

"The solar air heaters have been a fantastic system for the Pre-School. It is great to see the little kids go to the vents, feel the hot air and then look at the panels on the roof and know that the sun is heating the room up. It is a really hands-on learning experience for everyone who comes through the Pre-School," says Paul Brown, Banyule City Council.

Learnings and outcomes

Solar air heaters are not instant heaters; instead they provide background heat, so occupants may take some time to adjust to their operation. In the Bishop James Centre, there are information posters in the accommodation building to educate guests about the solar air heaters and how they work. This was a result of short-term visitors changing the controls, affecting the operation of the system. The information requests people keep external doors and the windows closed during the day and let the solar air heater do its job.

Solar air heater on the roof of the Selwyn Neighbourhood House, with the duct located in the roof space.

As the Audrey Brooks Memorial Pre-School is occupied for the majority of the day, they have found that some additional heating is required to warm the building early in the morning. Once the solar air heating system begins to work as the sun rises, no additional heating is required. To maximise the hours of sun light hitting the solar air heater, the system is generally installed to face north. An interesting feature of the application of solar air heaters to the Audrey Brooks Memorial Pre-School was that the building only has an east and west sloping roof. Therefore to overcome this problem, two solar air heaters were installed—one on the eastern slope to capture the morning sun, and the other on the western slope to capture the afternoon sun. This installation allows the building to be heated throughout the day. Ceiling insulation was also installed to achieve greater efficiency in heating and cooling the school. ■

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