

Air collectors in commercial buildings: ventilation systems that save energy



Air collectors are an easy way to use the power of the sun. Nonetheless, they have had a hard time making their way onto commercial buildings. Now, rising energy prices are changing that.

The idea is almost 130 years old. In 1881, Edward S. Morse patented the first solar air collector in the US. The box with a glass cover contained a black plate of metal. Air would enter at the bottom of the box, warm up as it passed the metal plate, and flow directly into the room behind the box after rising naturally through the top of the box. Morse managed to sell some of his air collectors, but they were not a commercial success. The idea came back to life in the 1970s. Back then, the energy crisis had led authorities in the US and Canada to set up research programmes for solar air heating systems.

The research was a success – at the beginning of the 1980s, more than 80 firms in the US offered solar air collectors. But when the government stopped funding the research in 1985, it also stopped the further commercial success of the systems. Most manufacturers had to give up. Canada followed suit in 1998, putting an end to the brief comeback of air collector technology. Only one company survived: Conserval Engineering Inc. of Toronto continued to optimise its concept, which initially resembled Morse's. Glass or plastic panes were set up in front of heat absorbers, and air heated up in the space in between. Later, the company got rid of the expensive panes and simply perforated the absorber, which it hung directly over the façade.

Commercial halls are especially suited

The company's hard work paid off. It has now installed more than 1,000 air collector systems worldwide on façades and roofs to provide solar heat for production and inventory halls, gymnasiums, indoor pools, schools, and museums. The largest such system in Europe is found in Świdnica, Poland. Called the Solarwall, the 2,000 m² of air collectors provide 55,000 m³ of air heated by the sun for the production hall of ladder and scaffolding manufacturer Krause-Werk. In 2007, the Solarwall was installed on the building's southern façade: 0.7 mm thick perforated aluminium trapezoidal metal sheets with a dark coating and 13 cm of space in between them. The solar radiation creates little pockets of heat on this wall, and a ventilation system draws it in through the perforations. On a sunny day, the air can almost reach 30 °C. Even on cloudy days, the Solarwall can heat up the air by 10 °C. That is often enough to meet the minor temperature demands of commercial halls.

But that is only one reason why commercial buildings are ideal for solar air heating systems. Usually, industry and production halls have air heating and ventilation systems already because the ceiling is so high. Air collectors can therefore be installed relatively easily and

The high-bay warehouse of Leister Process Technologies in Sarnen, Switzerland. The firm says that the additional investments for the air collectors on the façade paid for themselves in only two years.

Photos (2): Solarwall Europe



Technicians install air collectors on one of automotive supplier Palmela S.A.'s warehouses in the eponymous city in Portugal.

Photos (2): Grammer Solar



Europe's largest Solarwall uses solar radiation to preheat air for Krause-Werk's production hall in Świdnica, Poland.



72.5 m² of air collectors are installed on this brewery in Neumarkt, Germany. Per hour, up to 5,500 m³ of air is heated by solar energy, equivalent to a thermal nominal output of 48 kW.

inexpensively, even if the building is already complete. It does not matter whether the systems already installed are heating radiators, hot air devices, or directly fired air heaters. Air collectors also do not take up any space in commercial halls. Usually, such buildings have sufficient façade or roof space for this solar technology. And there is another general benefit: While solar water collectors usually have to heat up the transfer medium to at least 30 to 50 °C, air collectors can make use of every degree.

Drawing heat through perforations

More and more businesses are using solar air heating systems to compensate for rising oil and gas prices. "I now get inquiries from people I have been trying to chase down for years, but they never wanted to talk to me", Solarwall's European representative Robert Seidemann describes the current situation. Including assembly and collar plates, his solar ventilation system costs 100 to 120 €/m². The system usually pays for itself in five to seven years. A system for the high-bay warehouses of Switzerland's Leister Process Technologies of Sarnen had already paid for itself in two years. Seidemann says that the systems are designed to provide enough fresh air to cover half of the building's volume per hour. For instance, if the building's air volume is 40,000 m³, 400 to 500 m² of the air collectors would have to have a throughput of 40 m³/m²*h to provide 20,000 m³ of fresh air per hour.

But as straightforward as this calculation looks in theory, implementation in practice is nonetheless difficult. For instance, solar technology is usually only taken into consideration for commercial buildings after construction. Another problem is getting different trades to work together as solar ventilation installers, Seidemann says. "Air collector systems are simultaneously façades and heaters. And it sometimes takes a while to get the façade installers and the heating technicians to agree on how to do things." Nonetheless, over the past two years he says that everyone involved has become much more willing to deal with solar technology.

Air has many benefits as a heat medium

Another Canadian company offers a system quite similar to the Solarwall and also reports growing demand. In June, Matrix Energy Inc. of Québec City presented its system for the first time at Intersolar in Europe. A provider of energy-efficient heating and lighting systems alongside stand-alone power supply systems that run on renewables, the firm has already installed a number of solar air systems in Canada, including for Bombardier Inc., a global leader in the transport sector. Matrix Air is the only one of its products manufactured in-house, and therefore the only one sold in Europe. In its current form, it has been in the company's portfolio for around a year. Now, air enters at the bottom of the building. The collectors are slightly slanted so that the distance between the wall and the collector is largest at the bottom as is the volume of air flowing through the collector; the pressure loss therefore remains relatively constant as air



Matrix's project developer Frédéric Mélançon presented the Matrix solar air system at this year's Intersolar.

Photo: Eva Augsten

passes through the system. Project developer Frédéric Mélançon says the system costs some 75 €/m². This price only includes material, not the cost of installation. As with the Solarwall, air is drawn through the holes in the perforated collector. Usually, the system is used with heat recovery units, Mélançon explains. The air volume that the collector can heat up varies relative to the desired temperature difference, with the value usually lying around 100 m³/m²*h.

While air may not be an optimal heat storage medium, it does heat up quickly and is easy to distribute. It does not freeze, and it does not boil. Any leaks that occur in the distribution system will not eat away at the building. For more than 30 years, Grammer Solar GmbH has been using these arguments to convince its customers. Based in Amberg (Germany), it is a bit of a pioneer for solar air technology in Germany much like Conserval Engineering of Canada. The difference is that Grammer's air collectors are similar to conventional water collectors, with an absorber inside an insulated metal frame with a glass cover. The absorber is designed to allow air to flow through several channels. A 20 m² standard collector in the Jumbosolar series can move as much as 2,300 m³/h of air, enough to provide heated fresh air to a room with 200 m² of floor space. As much as 1,400 litres of heating oil could then be saved per annum. Jumbosolar collectors can be integrated on façades, though they are generally installed on slanted or flat roofs. For instance, 72.5 m² is installed on the Lammsbräu brewery in Neumarkt (Germany) with an output of 5,500 m³/h of heated air, which is equivalent to a thermal nominal output of 48 kW.

Rudolf Ettl, Director of solar air technology at Grammer, also likes to talk about a second reference project. In Palmela, Portugal, automotive supplier Palmela S.A. installed 480 m² of Jumbosolar collectors to ventilate its 15,000 m² of storage halls; in the process, the parts on inventory are also protected from corrosion. "This example shows that there is a need to keep buildings dry even in southern countries. Our air collectors prevent moisture from condensing in these halls close to the sea when it is colder inside than outside," Ettl explains. While the Grammer system is some 350 €/m² more expensive than the Solarwall, the German government covers almost a third of the cost of the first 40 m². Companies that require larger collector areas can also now take advantage of a low-interest loan especially offered for air collectors; subsidies are also available to cover 30% of the principal. Edward. S. Morse could only dream of such support.

Joachim Berner

Further information:

Conserval Engineering Inc./Solarwall Europe: www.solarwall.com

Grammer Solar: www.grammer-solar.de

Matrix Energy: www.matrixenergy.ca

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