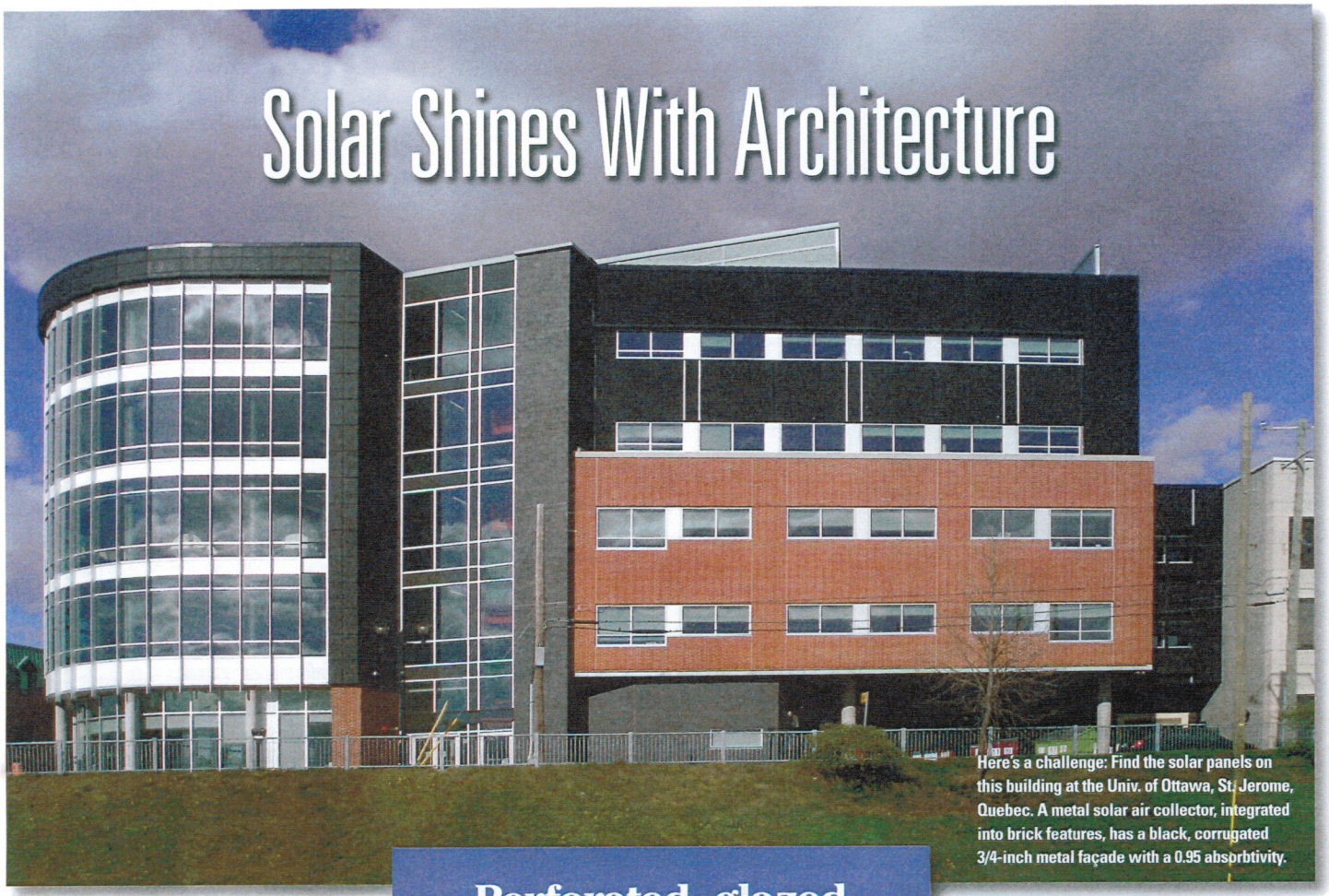
Solar Shines With Architecture



Here's a challenge: Find the solar panels on this building at the Univ. of Ottawa, St. Jerome, Quebec. A metal solar air collector, integrated into brick features, has a black, corrugated 3/4-inch metal façade with a 0.95 absorbtivity.

Perforated, glazed solar air collectors allow architects to incorporate solar technology without sacrificing aesthetics.

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Engineers love solar energy, but the same can't always be said for architects. Most architects believe solar energy is essential to the world's progress toward sustainability, but they also see solar as an unsightly distraction to their architectural works of art—and in many cases they're right.

It's no secret that few solar applications are well-integrated into the building design. Solar water heating involves rooftop solar panels, and solar-electric generation uses photovoltaic (PV) cells that may not be concealable. Additionally, there are piping and other visible support structures that protrude and detract from the clean lines of a building's architecture. Solar retrofits are especially unaesthetic, typically added without considering a building's architecture.

Despite a lot of effort toward making solar-energy generation more aesthetically pleasing, even new-construction solar water and PV installations don't blend well with a facility's architecture. Many solar-project decisions are based on payback, which mandates functionality, regardless of form.

While solar energy has been typified as masses of gleaming PV cells reflecting up toward the sun or wall-to-wall solar panels on racks and roofs, there is a solar-energy category that's more efficient and aesthetic, albeit less publicized: solar air heating.

A solar air-heating collector is an external, wall-mounted metal- or glazed-panel system that is typically used for complementary heating of a building's outdoor air for ventilation, as is required by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Atlanta, and the ASHRAE Standard 62—Ventilation for Acceptable Indoor Air Quality.

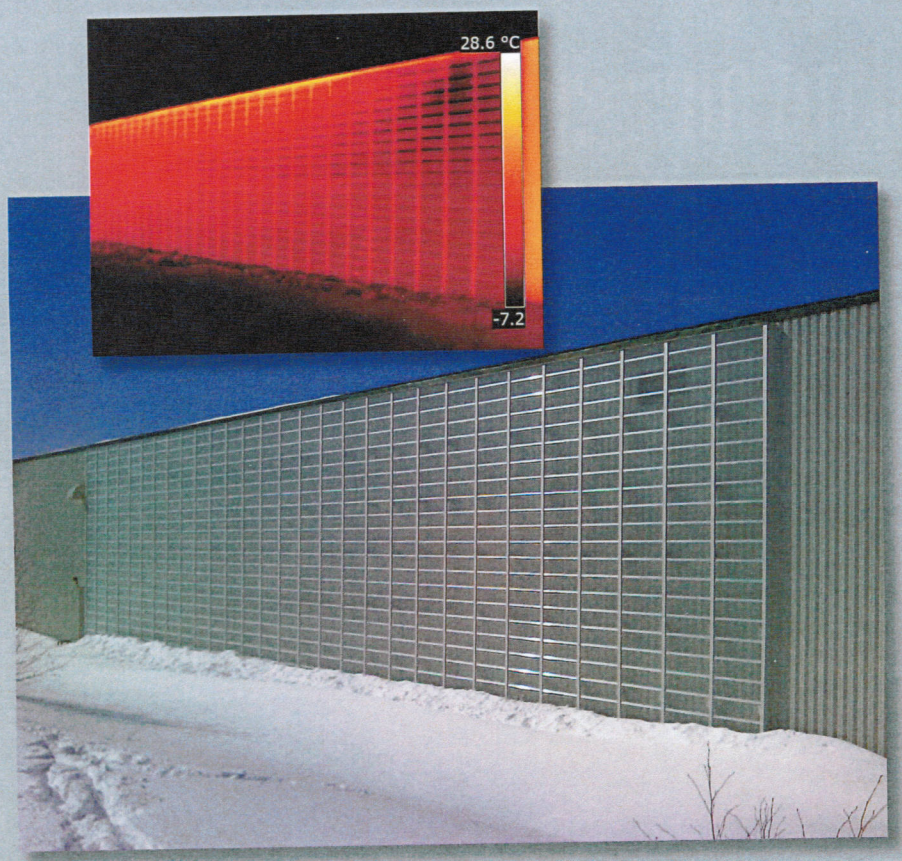
How solar air heaters work

Metal and glazed solar air collectors, typically 2 inches to 12 inches deep, partially or entirely cover a wall, preferably one facing due south. Metal collectors can be painted to match the wall portions the collectors don't cover and thus simulate the building's architectural style. The darker the color, the higher the solar performance. Glazed models, which architects favor over metal because their transparency makes them appear to be a wall of windows, can also have panels custom colored in the plastic injection-molding process.

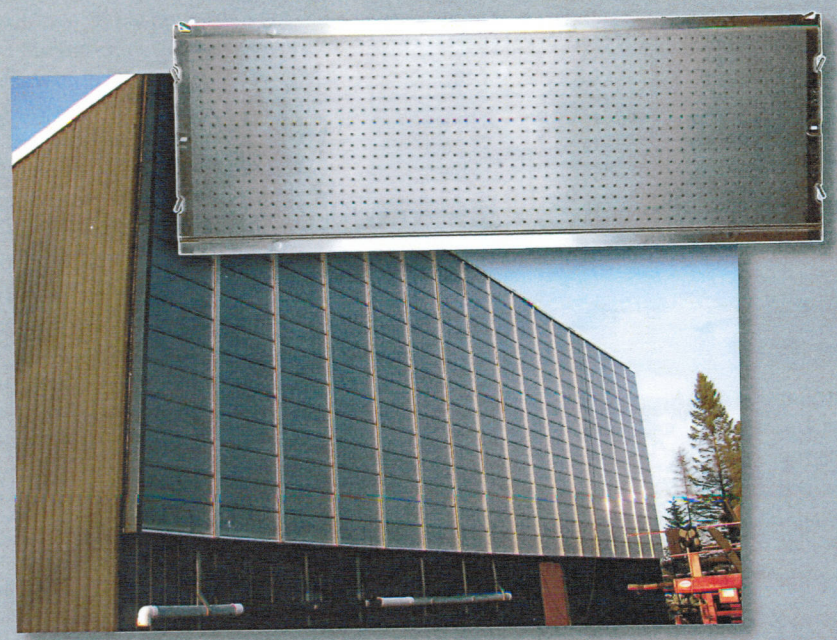
Wall-mounted solar air heaters work quite simply. Solar radiation heats the metal facade in metal models. Glazed models use the back wall for absorption of the radiation that comes through the translucent glazing.

As the air temperature inside a collector rises, air is drawn from the collector by a fan that moves it to the building interior. In summer, heat escapes from the building through the collector.

A fan may be mounted on the inside of



Although a wall standing above the snow at Plastech Inc., Sherbrooke, Quebec, may be unremarkable in appearance, a thermographic image of the same wall shows how much heat the Lubi collectors have harvested from sunlight.



Lubi perforated glazed panels turn an entire exterior wall into a solar collector.

the common wall it shares with the collector and simply dump the warm air into the building, which is popular in industrial applications. In buildings where air comfort is more critical for occupants, such as offices, hospitals, and schools, warm air is drawn into the facility's HVAC system by a thermostatically controlled damper, mixed with conditioned air, and distributed through the building's ductwork system.

Depending on the size of the facility, geographic location, and heating needs, a wall-mounted solar collector can provide a significant percentage of pre-heated outdoor-air needs throughout the winter. Depending upon the efficiency of the collector and rebates and incentives from federal, state, and local governments and utilities, payback can range anywhere from zero to seven years.

Payback time

In new construction, a solar air collector can provide almost immediate payback when it is designed as an alternative to a masonry wall. Brick walls, for example, cost approximately $26/sq. ft. Substituting a metal wall collector with glazing panels on top is significantly less expensive. The metal wall, which most architects dislike for its industrial appearance, "disappears" behind the glazing. Therefore, the solar collector looks like a wall of windows while offering years of energy savings. Planning with the mechanical engineer to place the building's rooftop or ground-level HVAC system near the wall-mounted solar collector reduces ductwork-integration costs.

The world's third largest aircraft manufacturer, Bombardier, Montreal, used a wall-mounted solar air heater in a retrofit to preheat outdoor air at one of many plants it operates in North America. Previously, solar wasn't an option for its green mission because the publicly held company's two-year-payback criterion limits the consideration of many alternative-energy concepts.

However, at the company's 40,000-sq.-ft. Mirabel, Quebec, research-and-development facility, the plant's engineering group authorized the installation of a Lubi wall-mounted solar air heater from Enerconcept Technologies Inc., Magog, Quebec. With its perforated glazing, it demonstrates the highest efficiency of any solar device. Serge Dumont, P.E., engineering and tooling manager at the plant, selected the Lubi because it demonstrated a two-year payback was possible after incentives by Natural Resources Canada (NRC) and a rebate from the Energy Efficiency Fund (EEF) of natural gas utility Gaz Metro.

The 145-foot by 12-foot solar collector, which covers about 25% of the 7,600-sq.-ft.

masonry wall, supplements an existing natural-gas-fired make-up air unit by preheating wintertime outdoor air for the 52-foot-tall, hangar-style building. The solar retrofit is delivering an annual 16-ton reduction of CO_2 emissions and a $5,000 (Canadian) natural-gas savings. Over the course of its expected minimum 20-year life, the natural-gas savings will undoubtedly rise well past $100,000 when considering inevitable fossil-fuel price escalations.

Beauty as it heats

From an aesthetics perspective, the Mirabel solar collector appears to be rows of windows atop the building wall. The challenge of integrating the collector with the rooftop ductwork air-distribution system was creatively solved by topping the collector with a parapet that looks like an architectural embellishment while it conceals the ductwork connection.

Besides parapets, wall-mounted solar collectors offer many other design options. They can:

- circumvent nearly any building feature imaginable, such as columns and windows
- follow unusual forms such as curved walls to any degree of radius
- form shapes by massing the 1-foot by 3-foot panels in the case of glazed collectors
- take on unusual decorative shapes, such as a company logo or geographic design
- provide custom colors to match any building exterior or corporate colors
- match the metal backing to building exteriors or the glazing material itself
- match the dampers and louvers, which are sometimes seen through the glass, to the building
- be mounted on penthouses and rooftop mechanical rooms
- be mounted on 45-degree or gable-style roofs to look like skylights.

Architects usually gravitate toward glazed versions because of the glass-like appearance. For best solar performance, metal must be painted a dark color that might not complement the color scheme of the building. The fact that glazed solar collectors work with white or lighter colors offers architects and building owners yet more design flexibility.

High-performance solar

The emergence of glazed solar collectors has also increased the performance of wall-mounted solar. Perforated glazing collectors outperform their metal counterparts by 20% on a black wall and 58% on a white wall. Compared with other solar technologies, solar air pre-heaters outperform solar water heaters by 25% and photovoltaic by 75% on the basis of kWh delivered/surface area. The Lubi panel, in particular, reaches 80.7% peak heating efficiencies, which is the highest efficiency recorded for any solar air technology, according to certification tests by the Canadian Standards Association, Mississauga, Ontario. It produces temperature increases as high as 81 F above ambient outdoor temperatures and is rated as the world's most efficient solar equipment by the National Solar Test Facility, a Mississauga-based third-party laboratory.

Unlike wall-mounted metal solar collectors that suffer significant thermal losses on their exterior metal surfaces, perforated glazing panels greatly reduce thermal loss because of their transparency and the cooling effect of outdoor ambient air being drawn through the perforations by the building's HVAC air-handling system. The cooler outdoor air traps the heated air behind the panel. Perforated translucent panels are 58% and 18% more efficient with black buildings and white buildings, respectively, compared with other wall-mounted solar collectors.

At Plastech Inc., a Sherbrooke, Quebec, manufacturer of thermoplastic components, residual heat from injection-molding processes provided free heating to the 26,000-sq.-ft. production area. However, the 5,500-sq.-ft. shipping area used $6,000 annually in propane-heating costs for employee comfort. Company managers wanted a wall-mounted solar collector to heat the shipping area, but didn't want to paint its modern white-metal building a darker color or hang a darker collector on the wall, so they chose a Lubi solar collector with transparent panels that match the building. A white collector is 40% less efficient than a darker model, but engineers offset that disadvantage by installing a collector that covers 40% more of the 200-foot by 24-foot wall. Temperature increases of 55 F were recorded over the most recent heating season. Payback is estimated at approximately four years after incentives from NRC and a rebate from Gaz Metro's EEF.

The emergence of wall-mounted solar, metal and glazed, is good news for architects. Instead of avoiding solar products because of poor aesthetics, architects can now integrate wall-mounted solar products with a building. Perforated glazed solar collectors can be a high-payback feature that looks like a wall of windows while saving energy and reducing carbon emissions. CBD

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