

Central Maintenance Garage

369 kW_t Solar Wall Air Heating System

Final Report – January 2012



Technology

Monitoring

Best Practices

SolarCity Partnership

PROJECT SNAPSHOT

Address:	843 Eastern Avenue
Building Type and Use:	City of Toronto Vehicle Maintenance Garage
Owner:	City of Toronto
Contact:	Joel Arthurs
Phone #:	416-392-5177
Email:	jarthur@toronto.ca
System type:	Solar Air Heating
Collector Manufacturer:	SOLARWALL
System Size (kW):	369
System Size (sq. meters):	610
Installation Date:	September 2002

PERFORMANCE

Estimated Performance:	878,390 ekWh
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FINANCIAL

Installed Cost (taxes included):	\$277,000
External Funding:	\$102,000
Annual Savings*:	\$29,750
Simple Payback (excluding external funding):	9.3 years

*Assuming the offset of 85,000 cubic metres of natural gas at \$0.35/cubic metres

MONITORING

Monitoring equipment installed:	No
Overview of the monitoring plan:	A reasonable approximation of solar wall performance can be achieved by using the manufacturer's specified airflow combined with temperature sensor data and damper status readings from the BAS.
Cost of M&V (% of total project):	Unknown
Who is analyzing the data?	Unknown
Is there a dedicated staff person responsible for system operation management?	No

Photos by
Danielle Murray

BACKGROUND

The City of Toronto's Central Maintenance Garage serves as a vehicle maintenance workshop and garage. It also houses a driver's training school and related administrative offices and has a total building area of 7,887 m² (84,897 ft²). The building, which is over 40 years old, is a single-storey building with a flat roof, a steel frame, and perimeter walls consisting of 66% single-pane glass. The entire south wall (300ft by 22ft) was made up of single-pane glass with a very low, R-1, insulation value. A large quantity of cold infiltration air estimated to be about 48,000 cfm entered through the building envelope. The combination of poor insulation and a south-facing glass wall caused the interior of the building to be chronically hot in the summer and cold in the winter.

Another important consideration was the indoor air quality. As it is a repair facility for City vehicles, like garbage trucks and snowplows, fresh air is needed to replace fumes which are exhausted. Maintaining an adequate level of ventilation air within the building was essential. As well, the ventilation system exhausted more air than was brought into the building which created a negative pressure situation.

The City decided to install a Solar Wall to replace the south-facing glass wall. The Solar Wall consists of over 600 square meters of solar air heating perforated-plate collectors mounted on the south wall of the Maintenance Garage. Ventilation fans draw in outside air, which then circulates through the collectors and is heated by the metal panels. The warm air passes through ducts to fans and warm, fresh air is distributed throughout the building.

The Solar Wall would provide better insulation, preheat the incoming air, reduce energy costs, provide adequate ventilation, improve the building façade, and relieve the negative pressure situation.

PERFORMANCE ISSUES

The Central Maintenance Garage experienced a number of issues that caused the Solar Wall system to significantly underperform, relative to estimated performance.

The building's conventional heating system consists of 4 steam-fired and 4 gas-fired units, all of which are very old with non-functioning louvers. To integrate the Solar Wall with the conventional system, the steam-driven space heaters would be turned off when the Solar Wall was supplying heat. However, this did not occur as there were no full-time on-site staff trained to operate the Solar Wall.

The system, as it is currently installed, is a fresh air ventilation system. If new conventional heating equipment were to be installed, the Solar Wall could become a pre-heat system which would be much easier to integrate with the conventional heating system.

The Solar Wall was installed in conjunction with upgrades to the BAS, including changes to the exhaust fan and new carbon monoxide monitors.

The Solar Wall provides ventilation and removed the negative air pressure problem that the facility had before its installation, but it is unclear what, if any, energy savings are being achieved.

Several trees on the south side of the building shade the system, which may reduce winter performance as the trees grow. However, the trees may reduce solar gain in the summer.

As the south-facing glass wall was replaced with the opaque Solar Wall, there is a lot less light in the building which has resulted in employee complaints.

There was interference with the system (e.g. turning it off, cutting the controls) by the mechanics working in the building who did not like the extra noise the system made and were not trained on the system's benefits. The site manager had to padlock the controls, threaten installation of a security camera and put a sign saying anyone tampering with the system would be subject to disciplinary action. At the same time, the fans were turned down to reduce the noise.

RECOMMENDATIONS

As it has been 10 years since the system was first installed, it is recommended that the system undergo recommissioning.

An improved operating and monitoring plan should be investigated with the original installer.

FINANCIAL

The Solar Wall was installed in September 2002 for \$277,000, tax included. Natural Resources Canada contributed \$67,000 and the Toronto Atmospheric Fund provided \$35,000 for monitoring and reporting purposes.

Based on the estimated offset of 85,000 cubic metres of natural gas use at \$0.35/cubic metres, the project would save approximately \$29,750 per year and provide a simple payback, before grants, of 9.3 years.

However, the financial case should be re-evaluated once more accurate monitoring equipment has been installed.

Figure 1. Installation of solar wall.



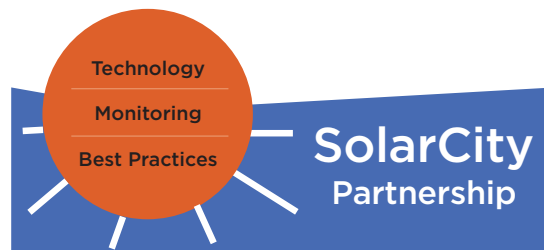
About the SolarCity Partnership

The SolarCity Partnership is a joint initiative of the Toronto Atmospheric Fund, Toronto and Region Conservation Authority and the City of Toronto designed to promote best practices and careful monitoring of large solar installations. SolarCity Partnership is an information-sharing hub for both public and private organizations involved in deploying solar power. Our SolarCityPartnership.ca website provides case studies, research, and solar weather data to help with the effective use of zero emissions energy from the sun.



We want to hear from you!

If you have further best practices recommendations, insights into system design, deployment or maintenance or a project to profile, please get involved with the SolarCity Partnership! Contact us at:



info@solarcitypartnership.ca
416-661-6600 ext. 5337
www.solarcitypartnership.ca

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This feasibility study was carried out with assistance from the Green Municipal Fund, a Fund financed by the Government of Canada and administered by the Federation of Canadian Municipalities. Notwithstanding this support, the views expressed are the personal views of the authors, and the Federation of Canadian Municipalities and the Government of Canada accept no responsibility for them.