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Solar PV Energy Case Study: Horse Palace at Exhibition Place, Toronto

The Project: A solar photovoltaic (PV) project with a peak operating output of 100 kW, that will generate 120,000 kWh of electricity per year and that will be expanded to a 1 to 2 MW facility within the next two years.

The Principals: The project is owned and operated by Exhibition Place, which received funding for the project from the Federation of Canadian Municipalities' Green Municipal Fund, Toronto Atmospheric Fund and the Better Buildings Partnership of Toronto.

Generating Facility: The installed system is comprised of four sub-systems, each using a different combination of solar panels, inverter and mounting technologies and brands. Both Sharp and Evergreen photovoltaic cells were installed.

The system was designed by Carmanah Technologies at the direction of Exhibition Place and in cooperation with the City of Toronto's Energy Efficiency Office.

Background

Opened in August 2006 in Toronto's Exhibition Place, at the historical building known as the Horse Palace, the project was intended to be both a fully-operational photovoltaic (PV) facility and a "proving ground" for future PV projects in the 1 to 2 megawatt range.

Richard Morris, a former head of the Toronto Energy Efficiency Office and now a consultant with the Ontario Power Authority, was a major participant in getting the project off the ground. He says that the purpose of the project is to influence the development of PV markets by demonstrating the effectiveness of solar technologies in a harsh urban environment.

It will also contribute to Exhibition Place's goal of becoming energy self-sufficient by 2010, and to the City of Toronto's goal of having 25 percent of its electrical energy provided by renewable energy sources.

The project is designed to proceed in two phases.

Phase One

The first phase, as installed, is Canada's largest PV facility, with an operating output of 100 kW. The system includes 536 solar modules taking up 15,368 square feet of total surface area, including wind redirectors and array protection.

The use of four sub-systems, each using a variety of different technologies, including different brands of solar panels and inverters, allows for testing across a full range of weather extremes, temperatures, snow, wind and pollutants such as salt and diesel exhaust from the nearby freeway, Morris says.

"The electrical performance of each sub-system is separately monitored and compared, which should help determine the best overall combination of technologies for use in the second phase and in future PV projects," he says.

The performance of each sub-system is available on the web site noted below, and a physical view of the system is available through the site's Web cam view.

Exhibition Place was chosen because it is known as a centre for demonstration of new technologies, and the Horse Palace because it is a large and substantial heritage building.

"The building didn't require many changes or need to be rebuilt, and an important consideration was that the roof did not need reinforcement or extensive repairs," says Morris. "To install solar PV technology, the building and roof need to be in a state of good repair, because removing or replacing the PV system to make repairs would increase the overall costs."

"So it's important to carry out a comprehensive inspection and repair of the roof prior to the installation of the PV system. In certain cases, it could be necessary to carry out a complete roof replacement for the areas of the roof that will be covered by the PV."

The project team used several mounting angles for the PV panels (20 degrees, 10 degrees and 1 degree) in order to determine the preferred angle for a full-scale project of 1 to 2 MW. Other factors considered were accumulation of snow, accumulation of dust, temperature of the cells, angle of incidence of sunlight versus PV output, and the frequency of cleaning required.

Permits and Incentives

Municipal permits required for the project were building permits, electrical, mechanical and structural permits. To avoid potential delays, a contract with the local distribution company for connection to the electricity distribution system was reached early in the process.

Photovoltaic projects are exempt from both the federal and provincial environmental assessments.

A very important factor was that the draft rules of the Standard Offer Program allowed for very simple and low-cost connection and metering requirements – reducing costs from around $180,000 to less than $1,000.

"This is a clear example of the OPA listening to a developer's concerns and designing program rules to eliminate barriers," says Morris.

The project relied on incentives.

- A grant of $250,000 was received from the Federation of Canadian Municipalities
- A grant of $250,000 from the Toronto Atmospheric Fund
- A $600,000 interest-free loan was obtained from the Better Buildings Partnership

Business plan development

The project was first developed on a theoretical basis by "shopping around" plans for both 50 kW and 100 kW facilities.

"We were looking for industry input on costs per kW installed, monitoring and verification, and how to gain industry and investor acceptance," says Morris. "Through the request for proposal process we found that the estimated capital costs of a 50 kW system were $750,000, or $15,000 per kW, versus $1.1 million or $11,000 per kW for a 100 kW system, so there were some economies of scale in the larger system. In fact, the costs of the second 50 kW were half the costs of the first 50 kW, which is an important learning for the industry."

The project cost a total of $1.1 million. Annual electricity revenues are expected to be $50,000. The simple payback would be 22 years if the 42 cents per kW hour were paid for 22 years. (Note: the Standard Offer Program contract only runs for 20 years.)

The project will contribute reductions in greenhouse gas emissions by 115 tonnes annually.

Construction

Construction of the first phase took twenty weeks (the entire project took 18 months). The team engaged two consultants, one expert in load profiling and the other in PV installation. Careful selection of contractors was a critical success factor, Morris reports.

"Because this was the largest PV project the contractors had ever undertaken, it was a learning process for

all involved and there was some smoothing over of minor issues," he says.

"It was easy to construct for the 20 degree and 10 degree angles of inclination, but for the 1 degree option the mounting system had to be re-fabricated."

Lessons Learned

Morris says that the cause of most lost time on the project was in getting estimates for what different configurations would cost.

"I strongly recommend keeping it simple, while including a contingency fund of 10 percent of the budget," he says.

Another important factor, he notes, was to have a coherent message and purpose for the project all the way through.

Related Links

Horse Palace at Exhibition Place, Toronto
http://view2.fatspaniel.net/FST/Portal/TorontoHorsePalace/
In August 2006 the Horse Palace became home to Canada's largest solar photovoltaic installation.

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