**The Shouldice Hospital uses traditional evacuated tube collectors**

# COOLING *with heat*

## Solar chiller technology may offer solution for over-burdened electrical grid

*By Bruce Nagy*

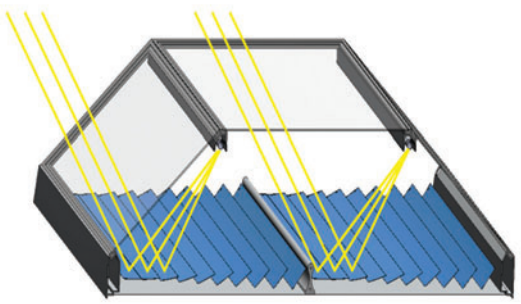
Lars Sjoberg is still smiling. The former Volvo engineer hopes that solar chiller technology will one day capture as much business in North America as it has around the world; but he has been through a bit of an adventure with a solar AC project in suburban Toronto during the past few years. And this project is a metaphor for the struggles facing the Canadian solar thermal cooling and heating industry as a whole.

The 89-bed Shouldice Hospital in North York, Ont. (Toronto) has five operating rooms, 131 solar thermal evacuated tube panels on its roof, and 10 Climatewell solar chillers to provide cooling. The full system is designed to save more than 90 percent on domestic hot water (DHW), 44 percent on heating, and 36 percent on cooling; and critically, reduce peak cooling loads by 80 percent or more.

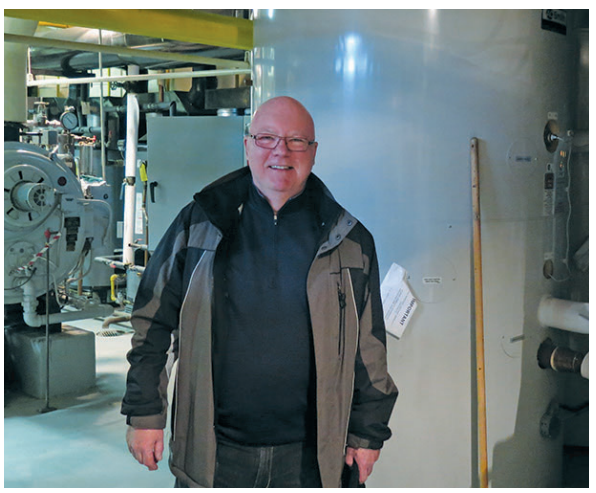
Some of these savings are undoubtedly being realized, but there have been technology integration problems, and one of the companies involved went under during the project, so the data is still inconclusive after three years.

Another medical facility in California had similar integration challenges at first, but is now achieving its goals. At about 6,000 square metres (64,000 sq. ft.), the Crow Canyon Medical Centre in Danville uses 75 Chromasun micro-concentrating panels and a Thermax chiller. It is saving 145,000 kWh of electricity and 1100 therms of natural gas and is again supplementing all three: air conditioning, heating and DHW.

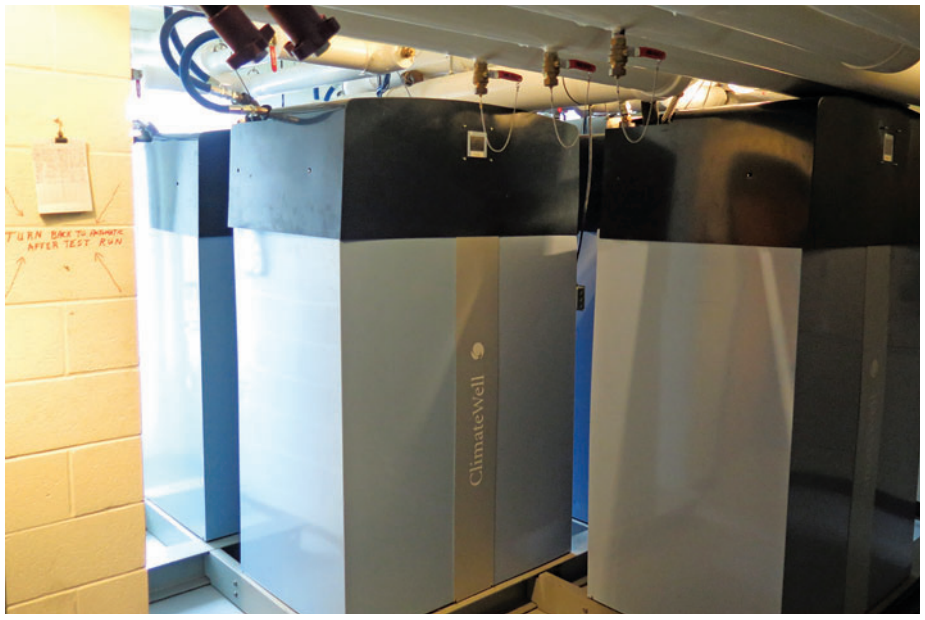
These projects used two very different kinds of solutions; and in the solar air conditioning world, there are several more. The Sholdice Centre uses traditional evacuated tube collectors with a somewhat innovative approach to the chiller. Crow Canyon uses innovative collectors with a more traditional chiller. Robert Waters, solar product manager for Viessmann Manufacturing in Waterloo, Ont. says: “Chiller technology around the



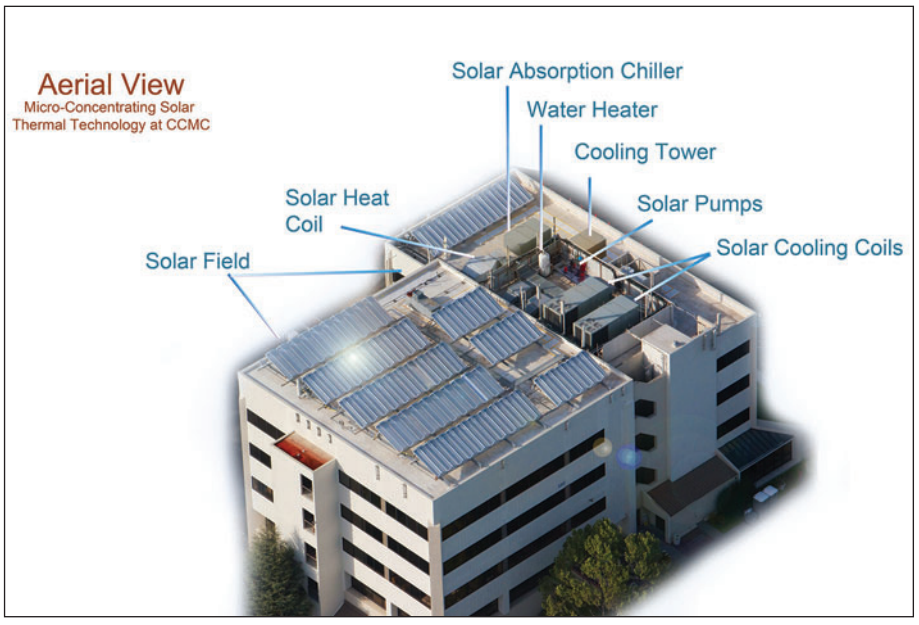
**A series of mirrors inside each Chromasun collector tracks the sun as it moves across the sky.**



**In the mechanical room, Lars Sjoberg believes that solar cooling has a bright future in Canada.**




**Ten solar chillers provide cooling at the Shouldice Hospital.**




**All equipment is roof mounted at the Crow Canyon project in California.**

world is still being developed with players working on different combinations and variations."

But it does make a lot of sense because air conditioning is needed the most when solar radiation is at its peak.

## How it works

Despite more than 200 installations worldwide cementing its reputation, the Climatewell absorption chillers in North York are considered experimental because the brand is still somewhat new to North America. It is basically a heat pump that generates chemical reactions between two tanks. One contains water; the other contains lithium chloride salt. Heat energy from the panels and a vacuum state initiate a reaction between the salt solution and solar heated water, creating pressure and temperature differentials.

Sjoberg explained that unlike a conventional absorption chiller, with this unit there is no pumping of saline solution and very little electricity is required. Each chiller unit is actually two pairs, with one pair charging while the other is distributing cooling. It provides cooling for several hours after the sun has set. Solar storage capacity at Shouldice Hospital is 4364 litres and this system boasts a COP (co-efficient of performance) of .333.

Because the system was installed as a retrofit while the hospital continued to serve patients, the operating rooms actually continue to use the old air handlers, with the rest of the hospital cooled by the new system. That integration had to be managed and another of the challenges was to fit the new equipment into the building. "We put a little in each of three mechanical rooms," says Sjoberg.

## A new type of collector

The concept developer, Peter LeLievre, took the idea for Chromasun micro-collectors from his experience with the really large solar farms. A micro-collector uses a series of mirrors sealed inside the solar thermal collector to reflect sunlight onto a pipe in each, containing water. The mirrors move, tracking with the sun's changing location and optimizing angles. The concentration of the sun's energy on the pipe heats the water inside to temperatures in the neighbourhood of 171°C (339°F).

Justin Weil, president of Sunwater Solar in Novato, California says they are easy to install and anchor onto the roof very securely, almost like flat-plate collectors. "It's the largest installation we've ever done in a single day," he says, referring to Crow Canyon. He also says the big question will be about maintenance and how they perform over the life of the system, given that they contain moving parts.

At the Crow Canyon facility, the mega-hot water from the micro-concentrating panels fuel a double-effect absorption chiller, which uses lithium bromide as the absorption solution. The heat from the building is rejected via the cooling tower. When there is not enough solar energy, a built-in natural gas boiler assists. The chilled

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# Difficult times

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water produced by the chiller is pumped through coils installed in the two existing compression chillers. If the absorption chiller cannot keep up with the cooling load, existing compression chillers activate.

## An industry on life support?

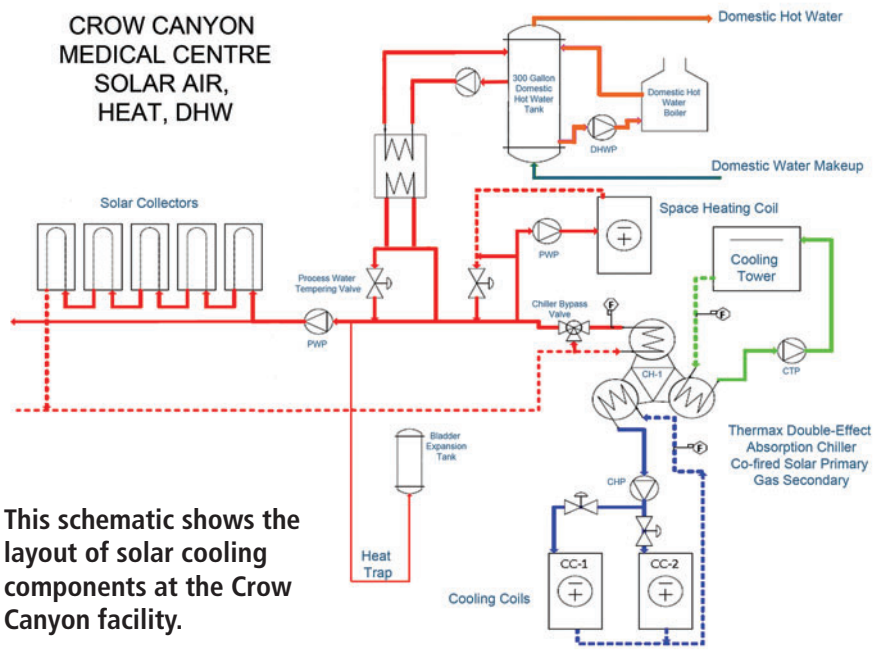
You may have heard that these are boom times for the solar industry, but in North America that applies more to photovoltaic (PV) solar, than to solar thermal. It also applies to California, Arizona, Hawaii, North Carolina, New Jersey and New York; not so much to Canada.

"Solar thermal heating and cooling technology was becoming popular for a while," reported John Gorman, president of the Canadian Solar Industries Association (CanSIA). "Then the (federal) EcoEnergy programs ended at the same time as natural gas prices dropped, creating a perfect storm for solar thermal."

Meanwhile in the U.S., both PV and solar thermal are growing at a torrid pace. PV grew by 41 percent in 2013 adding $13.7 billion in new solar, with more installations in the past 18 months than the total of the previous 30 years. They accounted for 29 percent of all new electricity generation capacity.

In it's 2013 report the Solar Energy Industries Association said: "The U.S. solar market showed the first real glimpse of its path toward mainstream status… The combination of rapid customer adoption…improved financing terms, and public market successes indicated clear gains for solar in the eyes of both the general population and the investment community."

Gorman remains hopeful that the solar explosion in the U.S. will spill into Canada. "Although we seem to have a short-sighted view based on the current price of natural gas, Ontario and Alberta have stated that they have plans to explore returning to their support of solar thermal heating and cooling."




**This schematic shows the layout of solar cooling components at the Crow Canyon facility.**

In Europe, China, Japan and the Middle East, solar thermal heating and air conditioning continue to boom. Europe has 70 GW of solar, 75 percent of the world's total, in a climate very similar to Canada. And that's why Lars Sjoberg is still smiling. ✚

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