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Drying lumber—with solar energy

In British Columbia, a pilot project using a solar hybrid kiln to dry lumber has delivered good results—and offers the potential of savings for a forest industry that is always looking to cut its energy costs

By Paul MacDonald

Just as hybrid cars are now part of the solution for achieving fuel efficiency on the road—and delivering cost savings—for drivers, hybrid kilns could be part of the solution in the future for a forest industry that is looking to cut its energy costs.

Each year, Canadian lumber producers spend millions of dollars on energy to heat their wood drying kilns.

But in British Columbia, utility BC Hydro is involved in a pilot project that involves the use of a solar hybrid kiln, with an aim to reduce electricity consumption—and produce quality lumber.

The Lower Mainland of B.C.—known for its cloudy skies and abundant rainfall—may seem like an odd choice of location for a solar power pilot project. But in some ways, it makes perfect sense. If you can design and operate a system that works here, well, it will work almost anywhere.

The project originated when Markus Zeller of BC Hydro was introduced to a novel solar energy collector used to pre-heat air for ventilation and crop drying, called SolarWall. Zeller manages the Industrial Technology & Innovation initiatives of BC Hydro's Power Smart program.

Zeller asked a lumber drying expert at AMEC Americas, Sita Warren, whether it could have applications in the forest products industry. Coincidently, Warren had been approached by post and timber manufacturers for a simple and economical way to dry timber products for house construction and aesthetic timber. They were looking for a way that was faster and better than air drying.

The standard answer would be forced air drying, basically using large fans to force air through stacked timbers. Warren made the connection: what if the fans drew the ambient air through the SolarWall system, thereby heating the air and reducing its humidity? This would not dry the timbers too quickly, and avoid causing splitting and degrade—and it would cut the drying time, with no need for other heat sources.

BC Hydro liked the idea and proposed an industry-based demonstration project to explore the concept and find how best to apply it. And although the solar hybrid kiln project is still in its early stages, it shows the promise of delivering significant energy—and financial—savings to the forest products industry.

The focus for the pilot project is what looks to be a standard steel shipping container that sits near the massive kilns of Southcoast Millworks, a large custom lumber drying operation in Maple Ridge, B.C., just outside of Vancouver.

Chris Luke, general manager of Southcoast Millworks, says their operation is always looking for ways to improve their efficiency, which explains their involvement with the demonstration project.

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The solar hybrid pilot project could present an opportunity for cost savings, and be applied on a larger scale down the road. “It really makes sense for us to explore the options for alternate energy sources,” says Luke.

It especially makes sense for this custom operation because they are all about drying lumber for customers—they do not actually manufacture any lumber on site—and that involves significant amounts of energy for their seven kilns.

“We’re very motivated to find ways to reduce our energy costs,” adds Luke. “We’re dependent on natural gas and electricity to power those kilns. The economics of solar energy vs. other alternatives is part of what we are looking at.”

Essentially, Southcoast Millworks is looking at ways in which they can achieve lower unit costs for drying, and energy is one of their biggest costs. If they can achieve even small savings there, it drops right to the bottom line, since energy is generally considered a fixed cost.

And the successful model for energy savings, like a hybrid car, could be an approach that combines existing technologies, perhaps dehumidification, or biomass, and solar energy. It’s important to note that although it holds great potential, solar energy in the forest industry will likely be developed in small increments—no one is going to be able to go out and build a 100 per cent solar energy kiln tomorrow.

“However, using solar energy when it is most abundant in the summer for an industrial process that operates year round, instead of using solar energy for traditional space heating applications in winter only, increases the solar harvesting and effectiveness by a factor of at least three,” says BC Hydro’s Zeller.

The solar hybrid kiln at Southcoast Millworks is fairly straightforward. The demonstration kiln is manufactured out of a standard steel shipping container, eight feet wide by forty feet long. The drying compartment takes up twenty feet and the other twenty feet houses the control panels and monitoring equipment.

The kiln has standard sides all around, except for the side facing south, which has a Solarwall.

The Solarwall looks like conventional metal cladding, but it performs like a solar energy collector. But rather than delivering power, it heats air.

The Solarwall system looks like conventional metal cladding from a distance, but it performs like a solar energy collector. But rather than delivering power, it heats air.

The SolarWall technology was developed by John Hollick of Ontario-based Conserval Engineering, who in the 1990s set out to find effective ways to harness the sun’s energy to help heat buildings. SolarWall systems have since been installed on thousands of buildings.

A SolarWall solar air heating system comprises two key parts: perforated aluminum or steel cladding, installed on an exterior wall or walls (usually the sun-rich south-facing wall) and simple ventilation fans to draw the heated air into the space to be conditioned.

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According to the company, SolarWall systems produce up to 600 watts/m2 (60 watts/ ft2) of thermal energy.

When the sun warms the surface of the SolarWall, heated air is drawn inside through thousands of tiny holes on its surface.

The system essentially takes the heat out of the air, heat that is provided, of course, by the sun. In the case of the BC Hydro pilot project, the solar-heated air is then distributed and re-circulated throughout the kiln, to help dry the lumber. In effect, the SolarWall system displaces the need for most of the heating in the kiln, meaning absolutely no natural gas will be required.

The components of the solar hybrid kiln at South Coast Millworks are fairly simple. There is a 16" small horsepower solar wall fan that moves air at a rate of 1200 CFM; three fans inside the kiln that circulate air through the kiln and the stacked lumber; and a mobile, plug-in style dehumidification unit is used to extract the moisture removed and keep the kiln charge warm to continue gentle drying at night. The system is 230 volt, single phase power. The total power draw is on average less than 1 kW (1000 W) for this size kiln; that is less than the power requirements for a typical household kettle.

The kiln itself and its ventilation system were fabricated by Mike Sprague, of M. Sprague Incorporated of Sherwood, Oregon, from a design prepared by Sita Warren, of AMEC, who were consultants on the project. M. Sprague has extensive experience working with dry kilns and heat exchangers.

"Mike was really the one who made the hybrid kiln a reality, drawing on his extensive drying and heat recovery experience," says Warren, who herself has many years of experience working with dry kilns in the forest industry.

The trials have shown that the SolarWall system will provide anywhere from 10 to 25 degrees Celsius of heat, heat that does not have to be provided by burning natural gas.

The system heats up the air that is in the kiln. So if the ambient temperature is normally 21 degrees, the system will raise it to 31 degrees or even as high as 46 degrees.

The first charge of lumber that went through the solar hybrid kiln at Southcoast Millworks was 4 X 4 hemlock, in random lengths. Over the course of six weeks, moisture content went from 59 per cent to 22 per cent. "The customer really liked the end result," says Sprague. "There was no drying degrade, and the wood came out fair in colour." Hemlock can normally get quite dark in colour when it's dried.

"It was the first kiln charge I have ever dried where there was no drying degrade," added Warren. "We went through the wood, and graded every piece and there was no drying degrade at all."

The first load of wood dried in the hybrid kiln was sold to a Southcoast Millworks customer.

The potential for energy savings for a sawmill or custom drying operation, like Southcoast Millworks, are significant, says BC Hydro's Markus Zeller. Zeller says that BC Hydro was looking at ways that could generate added value to customers in the forest industry with this initiative, and save them money. "Some wood products have been very difficult to dry in

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the past, and we are always looking for an energy efficient solution for our customers in the forest industry.

"The energy savings would be very significant because the potential for replication and application in B.C.'s forestry sector is so significant," says Zeller. And with those energy savings, of course, would come financial savings for the mills and drying operations.

"Having done this first trial, we see additional opportunities as we move into more conventional lumber drying," says Zeller. With its high moisture content, drying 4 x4 hemlock is almost a worst case scenario. "If it can work with hemlock here in the Lower Mainland of B.C., it will work pretty much anywhere else in B.C. The trial has gone very well."

Zeller emphasized that it was important that solar hybrid energy systems be practical. For that reason, the utility purposely opted for Solarwall technology rather than other solar collectors. "Typical solar thermal technologies can be quite complicated, with glycol solutions, vaccum tubes, and potential leaks." The Solarwall collector is much simpler, and also more rugged, a must for the forest industry, he added.

"If someone were to accidentally damage a panel with a fork lift, you replace the panel—it's as simple as that."

Work will be continuing with the solar hybrid trial, to gather more information. They will dry further loads, take measurements, fine-tune the controls, and further automate the system. But there has already been interest shown in solar hybrid kilns by a number of forest companies— even First Nations groups located in remote areas of B.C., have shown interest.

Because the set-up is modular and mobile, it could easily be transported to remote locations. "In some situations, rather than transport green lumber that is water-heavy to a larger kiln, you could plug-in the solar hybrid kiln and dry timber on site, and then transport much lighter dried wood for further processing."

Zeller said that in the future, BC Hydro can make the technology available through its existing programs either as a performance based or prescriptive solution, with financial support for every square metre of solar panels installed, for example. "It will be simple to adopt it into our Power Smart programs."

Chris Luke, of Southcoast Millworks, says the results of the solar hybrid kiln trial have been interesting. "If we can find a system that gets the wood dry, without defects, without appearance loss and it reduces energy costs, and our customer likes the product, well, we're in business," he says.

Since the system is fairly straightforward and does not involve a lot of costly technology, it appears to address one of Luke's concerns: the capital cost of a large scale system. "Investing in alternative energy sources can be an expensive proposition, and we need to see a payback on it. Anything that requires significant capital is a non-starter."

Project manager Sita Warren says the project could not have been a success without the involvement of all the parties: Southcoast Millworks, BC Hydro, Natural Resources Canada, M. Sprague Inc and AMEC. "With this project, we had the right people and the right talents—and they made it a success," she says.