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A NEW ERA IN HEAT TRANSFER

Calgary company makes a global impact In renewable energy sector

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By Jamie Zachary

A New Era in Heat Transfer

Calgary company is making an immediate global impact in the renewable energy sector

How do you keep the lights on when the sun goes down if you're dependent on solar power? Is it possible to capture useful heat that's otherwise emitted into the air? Can you recycle energy?

Questions like these keep Neville Jordison up at night. They are also what gets him out of bed in the morning.

"This isn't about applying new technology here that's been developed elsewhere. This is very much an 'invented in Alberta' story."

Solex Energy Science leadership team. From left, Neville Jordison, chief executive officer; Ashley Byman, chief technology officer; David Moon, senior engineer.

Photo: Solex Energy Science

Jordison is the chief executive officer at Solex Energy Science, a newly formed Calgary-headquartered company that's focused on applying the science of bulk solids heat transfer to emerging challenges associated with sustainable initiatives such as solar power, waste heat recovery and carbon capture.

"Imagine being able to use hot sand as a way to store large quantities of energy to help decrease the cost of producing electricity? That's just one of the doors that we can help open by uniquely adapting already-proven heat transfer technology to handle extremely high-temperature solid particles and then re-use the energy from that heat elsewhere," says Jordison.

Solex Energy Science was created earlier this year as a spin-off from Solex Thermal Science, which continues to specialize in heating, cooling and/or drying applications within the fertilizer, oilseeds, sugar and other bulk solid-based industries.

Much of Solex Energy Science's early work has been focused on solar – or to be more specific concentrated solar power (CSP). The technology has emerged as a leading candidate in overcoming the limitations that come with traditional photovoltaic (PV) technology, which, as Jordison reminds us, only produces electricity when the sun is shining.

"Storing electricity in PV applications is difficult. If you're looking for 10 hours of storage, for example, the batteries you would need would be too expensive to commercially produce," he says, noting battery storage at the multi-hundred-megawatt-per-hour scale becomes challenging due to battery chemistries, manufacturing technologies and system specific characteristics.

"So instead, the attention has turned to concentrated solar where the sun's energy is converted into heat that is stored in a solid particle such as sand – and at extremely high temperatures that can sometimes be upward of 1,000°C. Then it's about extracting energy from that solid to power turbines. And to do that, you need a heat exchanger that transfers heat from the solid to a fluid – whether that be high-pressure hot air, steam or supercritical carbon dioxide – which then goes to the turbine. That's where we come in"

Early partnerships

The company has already started working with several large research organizations on the application of solid particles such as sand to CSP technology. One of the company's initial installations involves a partnership with Sandia National Laboratories in the ground-breaking development of a new generation of concentrated solar plants.

The Albuquerque, New Mexico-based research organization, funded by the U.S. Department of Energy, is working with Solex on solid-particle-to-supercritical-

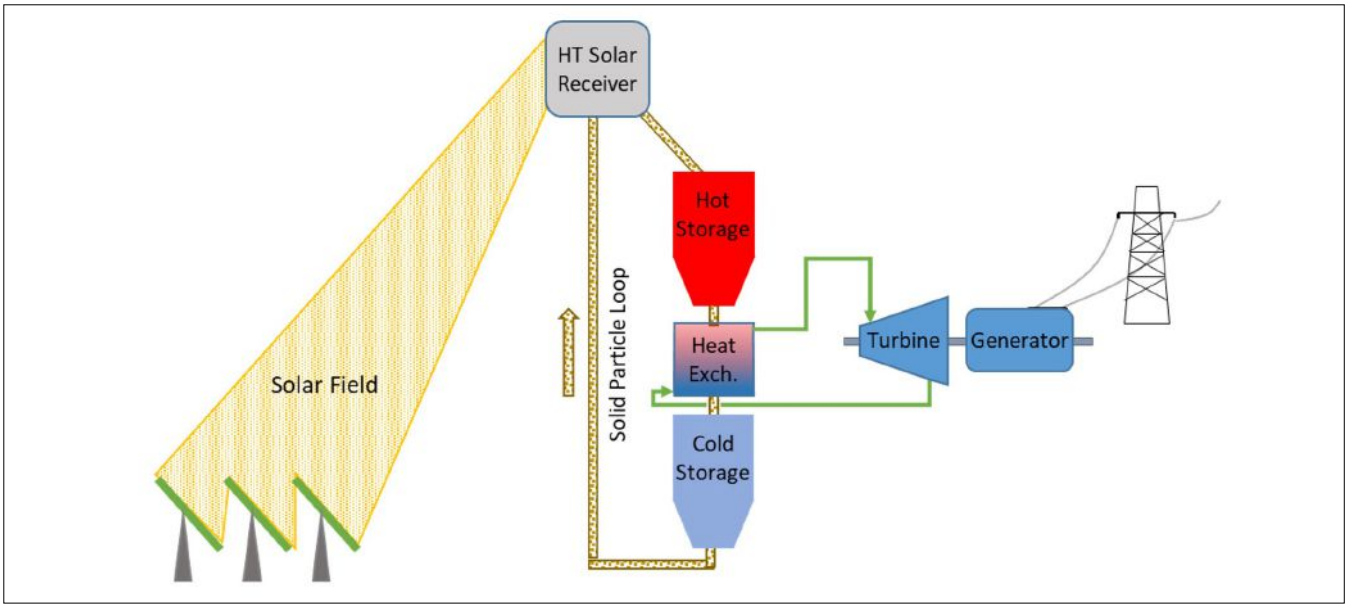

Photo: Solex Energy Science

Process diagram of a concentrated solar plant with solid particle energy storage.

CO2 heat exchange technology that will be used to power high-efficiency CO2 turbines.

Solex Energy Science is also working with Brayton Energy, which is the primary contractor on a U.S. government-funded National Renewal Energy Laboratory project. The New Hampshire-based company is focused on leveraging high-temperature heat transfer technology in the design, prototyping and testing of turbomachinery and gas turbine systems with applications in everything from CSP to energy storage, hybrid vehicles and aircraft propulsion.

Another important collaboration for Solex Energy Science is with Echogen Power Systems, an Ohio-based company with a focus on scalable heat-to-power systems. This collaboration is focused on developing solutions for long-duration electrical energy storage that will help enable the penetration of renewable generation into the electrical grid.

Photo: Courtesy Cliff Ho, Sandia National Laboratories

Kevin Albrecht, a mechanical engineer with Sandia National Laboratories, stands next to a particle-supercritical CO2 heat exchanger designed in collaboration with Solex Energy Science.

Invented in Alberta

"There's a sense of pride in where we have been able to take this thus far," says Jordison of his company's early partnerships, noting Solex Energy Science is also working with organizations in Australia, China, Germany and Saudi Arabia, to name a few. "There's some major players interested in what we are developing, and we're seen as being the experts."

Jordison points out that no other company in the world is doing this type of work – specifically the type that requires working with bulk solids at such extreme temperatures. And that brings him a certain pride, not to mention a bit of irony in that it's happening in the heart of Canada's oil patch.

"It's recognized that while oil and gas remain very important to the future of the province, for a strong performance over the years we have to diversify that economy. Renewable energy is big part of it," he says. "We're very much a part of that solution. We're part of our province's efforts to diversify. It's what gets me excited.

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"This isn't about applying new technology here that's been developed elsewhere. This is very much an 'invented in Alberta' story."

Jordison notes the reason why others have not yet been able to apply high-temperature solid particle streams to renewable energy applications is because of the complexities that come with it.

"Heat transfer with bulk solids is extremely complex. Operating at high temperatures, anything in excess of 400°C, just adds to the challenge. There is no textbook heat exchange theory when it comes to these types of situations," he says.

"Without the decades of past experience developing and understanding the science of bulk solids heat transfer, we wouldn't have been able to evolve it to the point that we can now apply it to these complex challenges."

A century of experience

The "we" Jordison refers to includes a leadership team that has more than a century of combined experience in bulk solids heat transfer – starting with a familiar face to many in the industry.

Ashley Byman has been named the company's chief technology officer. Byman joined Solex Thermal Science in 2001 and, as Jordison notes, has been instrumental in every major technical advancement within the organization since.

With several patents already to his name, his focus is now on developing new product lines, such as high-temperature energy recovery units, supercritical carbon dioxide heat exchangers, air-to-bulk solid heat exchangers and steam generation units.

"The continued development of CSP energy storage, in particular, is going to be important for us during our early days," says Byman. "I see a lot of our focus on applying it to larger installations, accommodating higher duties and even increasing the temperature even further while still trying to make it competitive."

Joining Jordison and Byman is senior engineer David Moon, who joined Solex Thermal Science in 2018 after previously spending more than seven years with an upstream oil and gas company at a large oilsands plant. His experience is on developing new technology for commercial applications, as well plant startups, steam boilers, hydrocarbon processing and capital project stewardship.

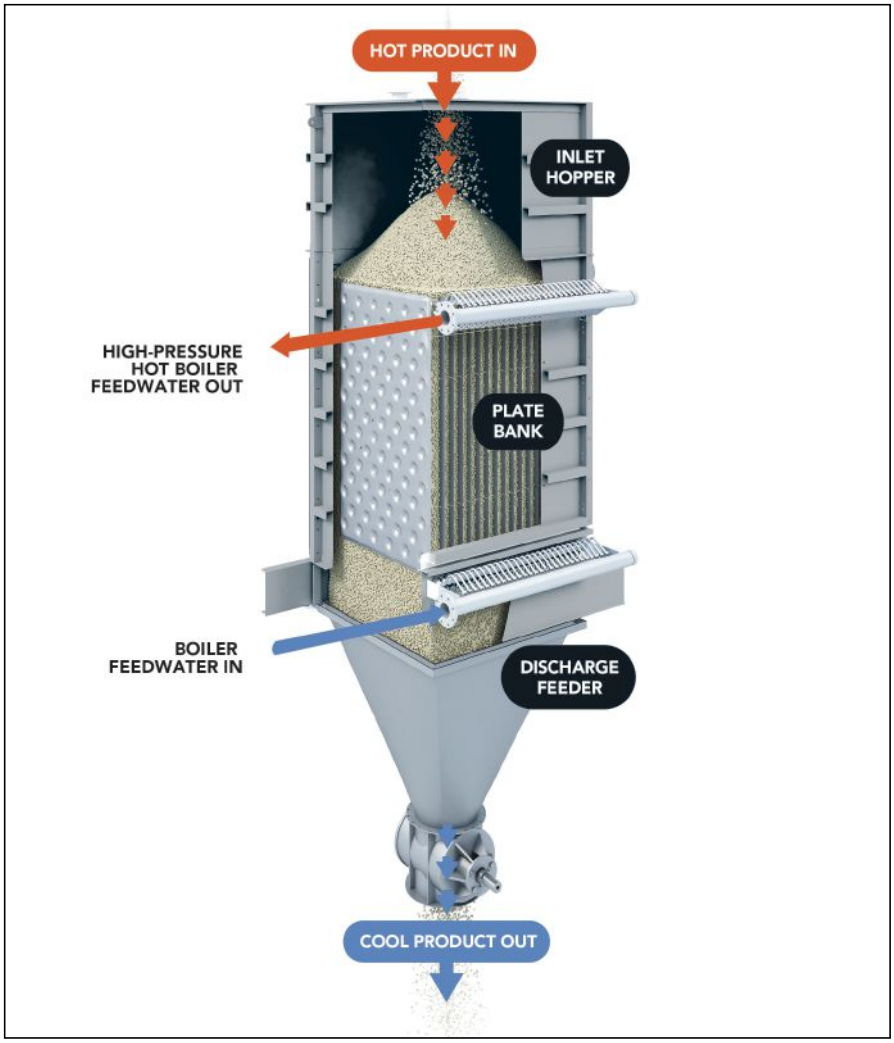

Illustration of a plate unit that is designed to recover waste heat from a bulk solids stream. Installed as an economizer to preheat boiler feedwater.

"One of the applications I'm most excited about is that involving high-temperature heat recovery," says Moon. "It's going to be a game-changer for plant operators who are working with hot bulk solids and are looking to improving their overall process efficiency. This is especially relevant today as industries are incentivized to recover this waste heat instead of emitting it into the atmosphere."

Solex Energy Science is also backed by a continued partnership with Solex Thermal Science and consultants such as Peter Huang of Consize, a Canadian-based pioneer in thermal modelling.

Jordison emphasizes that Solex Energy Science is not a research and development organization, but rather a group that is focused on applying proven technology to emerging applications.

"Much of the work being done in the renewable sector can be boiled down to making the technology more commercial; to making it more cost-effective," says Jordison. "To that end, you can't just be research and development-focused. You have to keep your eye on the ball and, at the end of the day, be focused on supplying the solution in the form of a piece of equipment"

For more information, visit solexenergy.ca.

Photo: Solex Energy Science