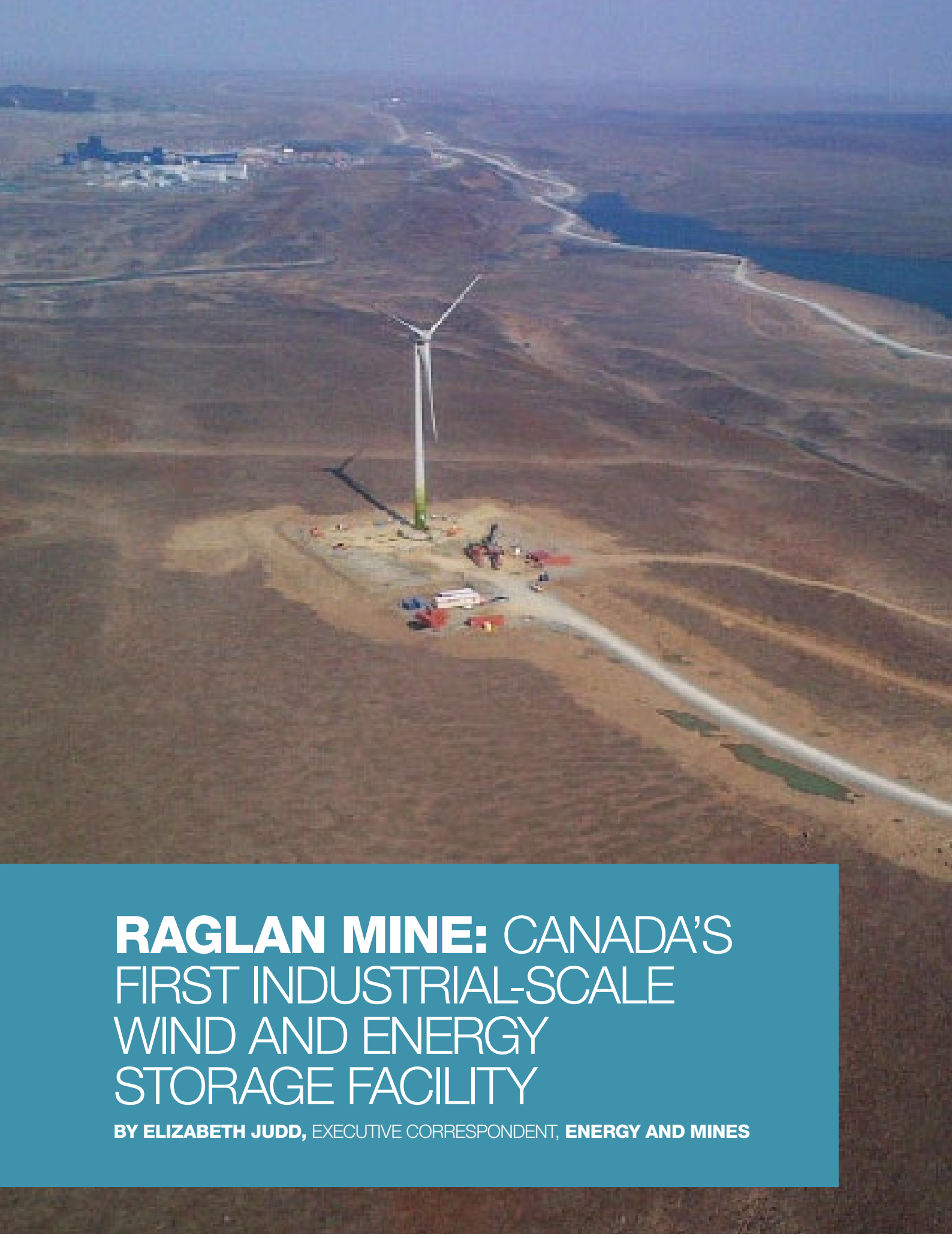

RAGLAN MINE: CANADA'S FIRST INDUSTRIAL-SCALE WIND AND ENERGY STORAGE FACILITY

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RAGLAN MINE

> **Design first and then assess.** A pilot lets you understand and train your people. And when you understand your risk profile, then you can go with a larger scale.

The decision to install a three-megawatt wind turbine at Glencore's Raglan Mine came after nearly five years of careful investigation, assessment, and analysis, says Jean-Francois Verret, Director of Strategy, Projects, and Public Affairs. Because of the Arctic conditions at the mining site, which sits on the Ungava Peninsula in Nunavik, roughly 1,800 kilometres north of Montreal, gathering in-depth data was an essential first step.

This summer, Raglan Mine began installing its first wind turbine, manufactured by Enercon in Germany. If all goes as planned, Verret predicts that this wind turbine will replace approximately 5 percent of the mine's diesel consumption-- or 2.4 million liters of diesel.

A project like this also holds out the promise of significant cost savings. At Raglan Mine, energy typically accounts for 18-to-23 percent of operating costs. If the wind pilot goes well, Raglan Mine is considering installing additional wind turbines that could generate a total of 9 to 12 megawatts of energy, slashing the mine's overall diesel consumption by 40%.

The Decision Process

In 2009, Raglan Mine launched a study to investigate options for its fully diesel-powered operations. The nickel-copper mine's remote locale means that it's impossible to connect to the hydroelectric grid or to the natural gas network.

Very quickly, says Verret, the study showed that wind was a promising option. Raglan Mine placed wind measurement systems around the property and began collecting data.

Only after simulations and the gathering of concrete data did the mine team approach corporate for approval. Verret emphasizes the importance of having actual numbers to bolster the first approval request, which was made in 2010-2011. "The intention of that re-

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With innovative storage technologies the penetration level of the wind turbine can increase up to 35-55%.

Raglan Mine Location

quest was to inform corporate that Raglan Mine was sitting on a very intensive wind current, and it was worthwhile to study [wind] technologies," he says.

Next, Raglan Mine conducted a benchmark study in Alaska, Switzerland, and Scandinavia to observe how wind turbines fare in harsh climates. The company then embarked upon a scoping study, looking at how the investment framework would work with select manufacturers experienced at working with Nordic or Arctic parameters.

The company created a financial framework in November 2012, which combined government incentives for reducing greenhouse gases and grants available to companies using renewable energy. Once a financial framework was in place, the energy team again approached corporate.

Technology in Arctic Conditions

Choosing to buy from Enercon wasn't a difficult decision because there are so few manufacturers producing Arctic-class wind turbines, says Verret.

What is truly innovative was the decision to incorporate three storage technologies -- a flywheel, batteries, and a hydrogen storage loop with an electrolyzer and fuel cells -- in addition to the wind turbine.

Verret explains that wind turbines on their own might have a wind penetration of 15-20%. "The penetration level for wind turbines is very low," he says. "When the wind blows, it's good, but when the wind doesn't blow, you can't really leverage your assets."

With innovative storage technologies, however, the penetration level of the wind turbine can increase up to 35-55%. The purpose of this first project is to test the three storage technologies in Arctic conditions to be educated buyers when it comes time to deploy a larger wind farm at the mine site. The 3MW turbine was strategically located at the mining site, where it can be isolated from the grid. The objective of the project is to achieve high penetration on this micro-grid within the five year demonstration period for the storage technologies.

To illustrate the potential of storage technologies, Verret explains that Raglan Mine will use a flywheel to help "smooth the energy curve" because the levels of wind produced in a given area aren't stable. The flywheel increases and improves upon the wind energy available to the company's own internal power grid.

Raglan Mine is considering installing additional wind turbines that could generate a total of 9 to 12 megawatts of energy, slashing the mine's overall diesel consumption by 40%.

Overcoming Obstacles

In the northern Quebec region where Raglan Mine is based, summer generally lasts just a single month, and, in fact, construction during this July had to be halted because of snow, says Verret. In addition, the fact that the mine is not linked to roads means that all wind turbine components, which were built in Germany and Quebec, had to be transported by ship. "The construction schedule is very tight so you need to manage the internal project management-- that's one of the most critical components," he says.

Once Raglan Mine's first wind turbine is in operation, the company will embark upon the construction and implementation of the second phase of the project: the three storage components. The second stage of construction is slated to run from September until March 2015.

Permitting is a key component of the project management timetable. Another challenge is the financial framework. "It's always a challenge for the mining industry to invest in renewables because most of the time the renewables are a little bit more expensive," says Verret.

Financial challenges are exacerbated by the fact that the mining industry tends to be extremely volatile. For renewables, however, provincial and federal grants help to reduce financial risk, he says. Raglan Mine's partner TUGLIQ Energy was of great help identifying eligible governmental programs and obtaining the funds.

Start Small -- and Test

Raglan Mine began its shift towards renewable energy with a pilot involving a single wind turbine-- a scaled approach that Verret would recommend to others contemplating similar initiatives. "Design first and then assess," recommends Verret. "A pilot lets you understand and train your people. And when you understand your risk profile, then you can go with a larger scale."

One method of storage -- using the hydrogen produced by wind turbines for other purposes-- might eventually lead to a wider array of green opportunities at Raglan Mine, says Verret.

He explains that wind energy takes a molecule of water and creates both H2 and O2. By storing the H2 in a tank, the mine can later combine the hydrogen to create energy for running vehicles. "We'd like to test using the hydrogen produced by the wind turbines for our own vehicles instead of using diesel," he says.

At the Renewables and Mining Summit in October, Verret hopes to explore innovative ways of using the energy generated by its new wind turbine. "I look forward to having some good discussions about how we can use that technology for other ground mining opportunities," he concludes.

Jean-Francois Verret will be speaking about the Raglan mine project at the Renewables and Mining Summit and Exhibition, Toronto, October 15-16. Details at www.energyandmines.com/toronto.

Key Statistics for Wind Facility at Raglan Mine

- Historic power source: 100% diesel
- Wind power to be generated from initial turbine: 3 megawatts
- Wind penetration from turbine without storage: 15-20%
- Potential wind penetration with storage technologies: 35-55%
- Amount of diesel displaced by initial wind turbine: 2.4 million liters (5% of total diesel consumption at mine)
- Ultimate wind power goals: Additional turbines generating 9-12 megawatts