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A ray of sunshine for solar energy

A new solar-cell system could one day make power from the sun as cheap as electricity from fossil fuels

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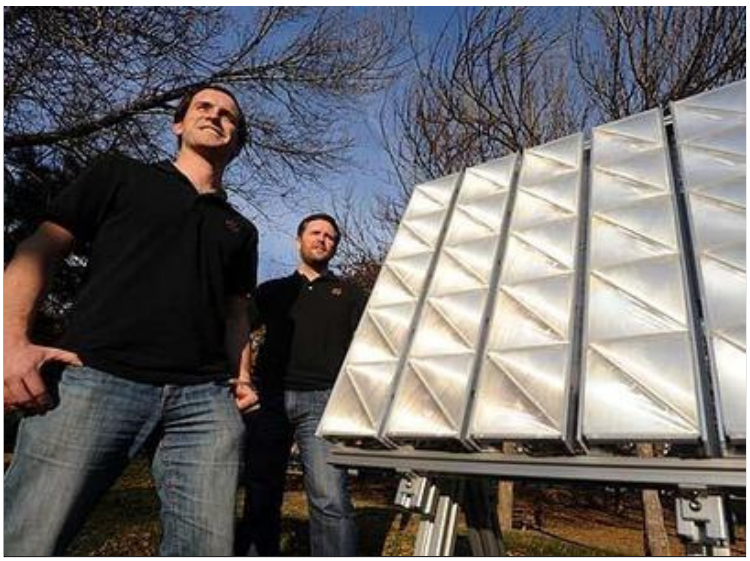

RICK EGLINTON/TORONTO STAR
Morgan Solar founder Jean Paul Morgan, left, with his brother Nicolas, developed a lower-cost solar panel to bring cheap electricity to developing nations. (Nov. 4, 2008)

John Paul Morgan was a cutting-edge engineer at JDS Uniphase Corp., back when the optical telecom giant was a market titan and solar power was still perceived by many as a backwoods technology for off-grid tree huggers.

Seven years later, the high-tech whiz kid has become a solar hotshot. Morgan has developed a new type of solar panel that, like many other systems on the market, concentrates the sun's rays on to high-efficiency solar cells. The big difference is the simplicity of his design and the lower-cost materials used to build it could soon make power from the sun as affordable as electricity from fossil fuels.

All he has to do now is prove it. "We have to show this technology is bankable," he says.

Morgan's path from telecom to solar panels wasn't a straight line. A graduate of engineering science from the University of Toronto, he joined JDS in 2001 while in his mid-20s. Within three days at JDS he impressed higher-ups with his first invention and within three months broke the company record for most inventions in a year.

But the telecom market crashed and Morgan grew bored. As his older brother, Nicolas Morgan, explains, "developing products to make the Internet faster didn't inspire him." He quit JDS in 2003, and travelled a year through South America, Australia and Asia before heading back to UofT to get his graduate degree in electrical and biomedical engineering.

Following through on a lifelong goal, Jean Paul then went to the Democratic Republic of the Congo where he handled logistics and construction projects for Doctors Without Borders. To him, the work was loaded with meaning, and while he returned a year later, he spoke of going back to continue with the cause.

That's when his father, Eric Morgan, stepped in. He talked his son out of going back, arguing that if he really wanted to help people he had an obligation to use his smarts to solve bigger problems.

Jean Paul stepped up to the challenge. While working as a research associate at the Catholic University of Chile (where his family has roots), he decided that the best place to focus on was energy.

"I came to realize electricity was a fundamental human right and if you don't have electricity you're living in the dark ages," he recounts. "I decided there to devote my life to the problem of developing inexpensive, ubiquitous electricity. Solar was the obvious choice."

At first, Jean Paul looked for solar companies he might like to work for, but after researching the market he quickly found there was a technology gap that needed to be filled. Most of the solar-system designs that appealed to him were clumsy and complicated. He decided his goal should be to come up with a novel design that eliminates that complexity.

So began another adventure. Within just a few months an invention emerged, several patents were filed, and by June 2007 Morgan Solar Inc. was founded. Jean Paul, who turns 30 in December, now has six employees working out of a nondescript office near Richmond St. and Bathurst St., and his company has a prototype that was displayed for the first time last month at an international solar conference in San Diego.

As more people see it, "we know we're going to blow people out of the water," says brother Nicolas, who heads up the company's business development. Their father, a senior executive at managing consulting firm Capgemini, has thrown in some angel capital and provides guidance as chair.

It's not that Morgan Solar is alone in its mission. The biggest expense today in manufacturing a solar panel is the materials, usually silicon, that make up the solar cells within. Researchers are racing to discover and commercialize methods to reduce that cost.

Some companies have developed ways to make solar cells using high volume roll-to-roll processes. This is similar in many ways to how we print newspapers or paper currency, and companies such as First Solar, Nanosolar, Konarka and OptiSolar – all U.S. companies, by the way – are leading the pack.

Thin-film solar cells use less material but are generally less efficient than traditional cells. This shortfall, however, is supposed to be offset by their lower cost of production. In other words, low-cost volume makes up for the loss of high-cost efficiency.

At the other end of the spectrum are companies trying to dramatically improve the efficiency of solar cells, such as Ottawa-based Cyrium Technologies Inc., which uses a number of exotic materials in addition to silicon to make multi-layered solar cells that can absorb more energy-rich light. Spectrolab and Emcore are two U.S. companies leading this side of the market, but their product is pricey.

Morgan Solar is attempting to build a bridge between low cost and high efficiency by concentrating an immense amount of solar energy on to a tiny thumbnail space lined with a superefficient cell from a Cyrium, Emcore or Spectrolab.

The idea is that such a small fraction of the costly solar cell is needed and so much of the sun's energy is focused on it, that material costs can be kept to a minimum and efficiency can be increased.

It's an approach dubbed "concentrating photovoltaics," or CSP, and a number of companies are in the race, among them U.S. ventures GreenVolts, Energy Innovations, and SolFocus, as well as Ottawa-based Menova Energy.

Some, like SolFocus, use mirrors to focus the light on a solar cell as if 500 suns are shining down. Others claim the same goals by using specially designed lenses or prisms that concentrate the light like a magnifying glass on the cell.

It's a tricky thing to do. The target, often a tiny little chip no larger than a square centimetre, must be hit with pinpoint precision. Structures must be able to handle strong wind and special tracking systems are needed to make sure the sun is always shining directly. Being off by a few millimetres isn't good enough. Also, the heat that results from focusing 500 suns, and up to 2,000 suns for some technologies, requires some creative cooling to keep the cells from melting.

Morgan Solar has come up with a completely different approach that relies on what it calls a light-guided solar optic. Basically, pieces of acrylic or glass are designed to capture sunlight as it hits a triangular surface less than a centimetre thick. Once inside the material, the sunlight is trapped and corralled through a bottom layer to one corner, where a tiny sliver of solar cell is positioned to absorb the barrage of concentrated light.

The triangles are packaged together to form a square about the size of a Compact Disc case and dozens of these squares make up a single panel.

"It's bloody amazing," says William Masek, president and chief technology officer of Brockville-based Upper Canada Solar Generation Ltd., which has plans to build 50 megawatts of solar farms in Ontario. In the next few weeks he will begin field-testing Morgan Solar's prototypes. "They probably have the most breakthrough solar technology announced in a long time."

Masek says the cost savings for him could be enormous if the technology, as claimed, can affordably convert more of the sun's energy to electricity per square metre than conventional solar panels. "With traditional solar panels we'll need over a thousand acres of property. But if we switch to their system, we can cut that land requirement in half and also substantially cut our costs," he says.

The materials that make up the panels are nothing fancy or expensive, Nicolas Morgan says during an interview at the company's office. The solar panels are flatter than the competition, lighter, cheaper to build and can concentrate the light at up to 1,500. "This is completely new. Nobody has done it this way," he says.

Now comes the tough part – turning it all into a commercial product without falling into the valley of death, that point in the life of a technology start-up where the difficulty of finding funding ends up starving promising companies.

Morgan Solar's office shows that the company is prepared to operate lean, making the most of the $600,000 is has raised so far from Eric Morgan and a grant from the Ontario Centres of Excellence. In one presentation room an old wooden door found in a nearby alley is being used as a conference table. On the wall, plastic shower lining purchased at Home Depot functions as a makeshift whiteboard for brainstorming sessions.

Nicolas says the company is talking to venture capitalists but doesn't plan to raise private equity until its prototype has been proven to work. This will depend on the results of several demonstration projects, including two in Spain and one at the Earth Rangers Centre in Woodbridge. Commercial production of the product, dubbed Sun Simba, is targeted for 2010.

Jean Paul realizes tremendous work lies ahead, but his goal of developing cheap solar power for the developing world keeps him focused and driven.

"It's what motivates me to work 14 hours a day every day, and I don't get tired, because I know this work is important," he says.