

COVER STORY: SOLAR POWER

LESSONS FROM GERMANY'S ENERGY RENAISSANCE

The world's alternative-energy superpower has lured companies from around the world with offers of funding and support they can't refuse. Canada still has time to capitalize on the demand for clean, sustainable power



ERIC REGULY
MARCH 22, 2008

BERLIN -- Solar power will cost next to nothing. The fuel - the sun - is free. The price of the photovoltaic cells used to covert sunlight into electricity will plummet.

Just give it time.

That's the theory of Ian MacLellan, the founder, vice-chairman and chief technology officer of **Arise Technologies**, a Canadian photovoltaic (PV) cell company. But there's one small hitch: Arise doesn't have time.

PV cells are still expensive. The solar energy market needs priming. Arise shareholders want profits. Mr. MacLellan is 51 and would like to see his company make a buck before he's a senior citizen.

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Enter Germany. The ever-so-generous Germans tracked him down and made him an offer he couldn't refuse - free money, and lots of it - as long as Arise promised to build a PV factory on German soil. The German love-fest even came with flowers for Mr. MacLellan's wife, Cathy.

Today, Arise's first factory is about a month away from completion in Bischofswerda, a pretty eastern German town about 35 kilometres east of Dresden, in the state of Saxony. Covering two storeys and 100,000 square feet, the sleek grey metal building will have some 150 employees and produce enough PV cells each year to power the equivalent of 60,000 houses. The value of the annual output, based on today's prices, will be \$375-million, or more than three times the company's current value on the Toronto Stock Exchange.

"I couldn't build this in Canada," Mr. MacLellan said. "Germany is a very high-quality environment for us. I have nothing to worry about."

Arise couldn't build the plant in Canada because the level of financial incentives, engineering and

construction expertise and general awareness of the growth potential of renewable energy simply don't exist there.

Those factors are abundant in Germany and it shows: The country has become the world leader in renewable energy technology, manufacturing, sales and employment. The German map is dotted with hundreds of renewable energy companies. They make PV cells, wind turbines, solar thermal panels, biofuels and technology for biomass plants and geothermal energy.

No PV cells are made in Canada. The Canadian solar industry, lured by money and markets, is jumping across the Atlantic and landing in Germany and a few other European countries with generous incentives.

The German and Saxony governments, with a little help from the European Union, offered Arise about €50-million (\$80-million) in financing. The package included a €25-million grant, which is being used to offset half the cost of building the factory and installing the three assembly lines, and €22.5-million of working credit lines and equipment loans at highly attractive rates.

The land was cheap and included a handsome, though abandoned, brick building from 1818 that began life as an army barracks, became a dance hall after the First World War and a Soviet military barracks during the Cold War.

Arise plans to restore the old pile and use it as an office and corporate retreat. "We're turning an old military base into a solar factory - how 21st Century is that?" Mr. MacLellan asked.

Germany has created 240,000 jobs in the renewable energy industry, 140,000 of them since 2001, said Matthias Machnig, State Secretary for the federal Ministry of the Environment. Renewable energy technologies already make up 4 to 5 per cent of Germany's gross domestic product; Mr. Machnig expects the figure to rise to 16 per cent by 2025.

Renewables generated 14 per cent of the country's electricity last year, significantly ahead of the 12.5-per-cent target set for 2010. "We are making a huge investment in the markets of the future," Mr. Machnig said.

How did Germany turn green technology into a leading industry? And is the aggressive effort to attract renewable energy companies, backed by scads of taxpayers' money, a formula that should be imitated in Canada or its provinces? Mr. MacLellan thinks so. "I think Ontario is in a leading position to clone Germany," he said.

GERMANY'S VAST renewable energy industry is a careful and deliberate blend of industrial, political and green policies. Wind power has been leading the charge. Germany is a windy country and the ubiquitous wind farms generated 7.4 per cent of Germany's electricity last year.

With onshore wind energy growth starting to level off - offshore wind probably will take off once favourable regulations are in place - the Germans are injecting the photovoltaic industry with growth hormones. "In a few years, the PV industry could be bigger than the German car industry," said Thomas Grigoleit, senior manager for renewable energy for Invest In Germany, a government investment agency.

It should come as little surprise that Germany has become green energy's focal point. The country is a natural resources desert. It lacks oil and natural gas and its coal production, which is heavily subsidized, is falling. The country has a moratorium on nuclear energy development. Renewable energy is more than just a feel-good exercise; Germany sees it as securing its energy future in a world of disappearing fossil fuels.

There's more to it than energy security. Germany is both latching onto, and propelling, an industrial trend. It wants to do to renewables what it did to the car industry; that is, create a jobs and export juggernaut. "We are at the beginning of the third industrial revolution," said Mr. Machnig, referring to the growth potential for renewable energy.

Germany is using its political might to ensure it benefits mightily from the green revolution. The country is Europe's biggest economy and the continent's (and the world's) biggest exporter. As the economic heavyweight, it has a lot of political influence over its neighbours, said Paul Dubois, Canada's ambassador to Germany. "This is the key country," he said.

Nineteen of the European Union's 27 countries count Germany as their main trading partner, he noted. The figure for France is only three (Germany, Spain and Malta) and only one (Ireland) for the United Kingdom.

The upshot: If Germany builds green technology such as wind turbines and solar panels, its friendly neighbours will be sure to buy them, or so the German government believes. That translates into the things politicians and economists like - jobs, export earnings, trade surpluses, international prestige.

There's more. As Europe's most influential country, Germany can pretty much guarantee that renewable energies will be the growth machine of the future. How? By insisting on aggressive, EU-wide carbon reduction targets, care of Angela Merkel, the German Chancellor who is no doubt the greenest European leader.

In February, the EU vowed to reduce greenhouse gas emissions by 20 per cent by 2020 and said it would try to raise the target to 30 per cent. "If you take climate change seriously, we have to reduce carbon dioxide emissions by 60 to 80 per cent by 2050," Mr. Machnig said. "This is the biggest industrial change ever. This means reducing emissions [in Germany] from 10 tonnes per capita to two to four tonnes per capita."

Germany doesn't think the reductions are possible without a broad effort that includes renewable energy, the EU emissions trading system and, of course, a fortune in subsidies to kick-start the green technologies and guarantee them a market for many years. The main subsidy for renewable energy generation is the "feed-in tariff," which was established in 2000 under the Renewable Energy Sources Act.

As far as subsidies go, this one is a beauty. The feed-in tariff for solar electricity is about 50 euro cents per kilowatt-hour, or almost 10 times higher than the market price for conventionally produced electricity (the subsidy for wind energy is considerably less, though still well above the market rate).

German utilities must by law buy the renewable electricity. The cost, in turn, is passed on to the consumer and is buried in his electricity bill. "The feed-in tariff has put Germany on the world [renewable energy] map," said Mikael Nielsen, the central European vice-president of sales for Vestas, the Danish wind turbine company that makes turbine blades in Germany. "If it weren't for the tariff, you wouldn't have a market like this."

The subsidy for all forms of green energy, largely wind, with solar just starting to come on strong, costs the government about €3.5-billion a year. The figure is expected to rise to €6-billion by 2015, and then will slowly decline. No wonder the renewable energy industry is on fire in Germany.

But Germany's lunge into renewable energy is not without its critics. The solar industry in particular is sucking up tens of billions of euros of grants and the question is whether taxpayers are getting value for money. "The construction of a solar power plant is currently an almost riskless investment," the German newspaper Berliner Zeitung said in November.

RWI Essen, a German economic research institute, published a paper earlier this month [March] called "Germany's Solar Cell Promotion: Dark Clouds on the Horizon," which concluded the feed-in tariff has not accomplished two of the government's most cherished goals - job creation and carbon reduction.

The subsidies for German solar energy probably rank as the highest in the world, thanks to the feed-in tariff and other subsidies. RWI estimated the total subsidies per job created in the PV industry (based on the subsidies and direct PV employment in 2006) at an astounding €205,000.

The tariff has created more demand than the German PV market can satisfy. In fact, most of the PV cells have been imported, creating jobs abroad, not in Germany (though this may change as Germany attracts manufacturers like Arise). RWI argues that billions of euros in subsidies have crowded out investment in other, perhaps more promising, technologies and has probably made the PV industry less efficient than it might otherwise be.

RWI said "the subsidized market penetration of non-competitive technologies in their early stages of development diminishes the incentives to invest in the research and development necessary to achieve competitiveness."

Finally, RWI says the feed-in tariff "does not imply any additional emission reductions beyond those already achieved" by the EU emissions trading system. Its argument is that reductions under the cap-and-trade system would be made whether or not the feed-in tariff existed.

The indictment is dismissed by the German Environment Ministry and by the PV industry. Mr. MacLellan notes that every form of energy is subsidized to some degree and that the PV subsidies will help Arise's German factory become profitable quickly, allowing the business to pay income taxes within two years. "This is not charity," he said.

For his part, Mr. Machnig said the subsidies will help establish an export market - three-quarters of the wind turbines made in Germany are exported, for example - as the number of technology manufacturers expands. Furthermore, he said, renewable energy can only make Germany more competitive as the price of fossil fuels rises. By 2020, renewables will provide 27 per cent of Germany's electricity production.

ARISE TECHNOLOGIES was launched in 1996 by Ian MacLellan, an amiable motormouth and Ryerson electrical engineering graduate who calls himself a "solar geek with a spread sheet." Five years later, it formed a partnership with the University of Toronto to develop a high-efficiency "thin-film-on-silicon-wafer" solar cell.

The company, whose headquarters are in Waterloo, Ont., went public in 2003 in Toronto (it's also listed in Frankfurt) and at times came close to running out of money. Its fortunes reversed in the past couple of years as energy prices soared and Arise displayed a remarkable talent for snagging government freebies. The feds' Sustainable Technology Development Canada fund handed the company \$6.4-million in 2006. The general enthusiasm for clean energy technologies allowed Arise to raise \$34.5-million in a bought deal last October.

The company's biggest break came entirely by accident. In March, 2006, a German PV magazine called Photon International carried a story on Arise. Two months later, Mr. MacLellan was in Hawaii for the World Photovoltaic Conference. "A guy from Invest In Germany tracked me down," he said. "We met and he said: 'We're very interested in your company and we want all the best companies to build in Germany. We'll give you half the money.' "

Invest In Germany has offices around the world (though not in Canada) and its 80 employees, most of them young, multilingual and highly educated, are considered superb salesmen and women. Its goal is to convince foreign companies to build plants and create employment in Germany and the appeal is quick, one-stop-shopping.

The team offers everything from assistance in site selection and construction engineering to German financing and incentives from the European Union. Boozing even features into the sales pitch. In the "Quality of Life" section of the promotional literature, the agency cheerily notes the country is home to "1,250 breweries with more than 5,000 different kinds of beer" (a statistic not lost on Mr. MacLellan, who loves German beer).

The agency has had particular success in attracting renewable energy companies. Some of the industry's best-known players - among them Shell Solar, EverQ, First Solar, Nanosolar and Signet Solar - have built factories in Germany and created thousands of jobs. "We work hard to find suitable companies," said Mr. Grigoleit of Invest In Germany. "We go to conferences and trade fairs. We open up kiosks and we have offices in Chicago, Boston, Shanghai, Tokyo and other cities. What we can offer is speed of entry into the German market."

Mr. MacLellan was impressed by Invest in Germany's efficiency. Within months of the Hawaii meeting, the financial and engineering machinery for the German plant were in place. The funding package, including the €25-million grant, was approved in December, 2006, only seven months after the Hawaii encounter. Construction of the factory started last August and the first cells will roll off the assembly by the end of April. "This is amazing," he said. "We've gone from the first meeting to production in less than two years."

He optimistically predicts PV cells made by Arise and other companies "will hit a wall of infinite demand" and he's evidently not alone. At last count about 55 solar companies had set up in Germany. The majority are in the former East Germany, where the incentives are fatter because the employment rate is lower than in the industrialized western half of the country.

There are a similar number of wind energy companies. More of both are coming. The German government's "GreenTech" environmental technology atlas, which describes the technologies and lists companies that develop and build them, runs 500 pages.

In July, a Quebec company called 5N Plus will open a plant in Eisenhuttenstadt, a town on the German-Polish border southeast of Berlin. The plant, its first foreign operation, will employ 45 and make high-purity metals for thin-film PV panels. Jacques L'Ecuyer, the CEO, said he built there because of the incentives - Germany provided about one-third of the plant's €9.5-million cost - and because he wanted guaranteed access to the European market. "If we have a presence in Germany, it will be easier for us to do business in Germany and in Europe," he said.

CANADA SEEMS to have taken notice of the German example. Make that parts of Canada.

The West is still obsessed with oil. Quebec has few incentives for wind and solar power, probably because it has so much cheap (and renewable) hydro power, Mr. L'Ecuyer said.

But Ontario, battered by manufacturing job losses and the high dollar, has made renewable energy part of its industrial salvation plane. The province now has its own feed-in tariff for renewable energy and recently announced a five-year \$1.15-billion program, called the Next Generation of Jobs Fund, to help finance everything from "green" auto research to pharmaceuticals manufacturing. Arise may tap into the jobs fund to expand in the Waterloo area, where it is building a plant to refine silicon for PV cells.

Ontario's new incentives, Mr. MacLellan said, "are not as attractive as Germany's but they're getting close." With Germany still on top, Arise is already making plans to add a second, and possibly third, PV factory, in Bischofswerda, next to the one opening in April. Arise has more than enough available land and the town, one of eastern Germany's Cold War victims, would welcome the jobs.

More foreign companies are bound to rush to Germany while the financial goodies last. Mr. Grigoleit said Invest In Germany is targeting other Canadian renewable energy companies. He won't say how close they are snagging them but seems confident they will be unable to resist what he calls the "magnet" effect.

Even if Canada decides it wants a renewable energy industry of its own, it will face formidable competition from Germany.

By the numbers

Germany's renewable energy industry (wind, solar, biomass, hydropower, geothermal)

NUMBER OF EMPLOYEES

2001: 100,000

2007: 240,000

2020*: 500,000

TOTAL RENEWABLES SALES

€22.9-billion

GERMAN INVESTMENT IN RENEWABLES (AS OF 2006)

€9-billion

ESTIMATED INVESTMENT BY 2020

€200-billion

PER CENT OF GERMAN ELECTRICITY GENERATED BY RENEWABLES

2000: 3%

2020*: 20%

2050*: 50%

BREAKDOWN OF WORLD'S PHOTOVOLTAIC CAPACITY

Germany 56%

U.S.: 8%

Japan: 17%

Rest of the world: 19%

Sources: Invest In Germany, German Environment Ministry, German Solar Industry Association.

Trapping the light fantastic

Photovoltaic (solar) cells work by converting the energy present in sunlight into an electric current. Here's

how it works:

CROSS SECTION OF A SOLAR CELL

Glass

Anti-reflective

coating

Metal conductor

Semiconductor material such as silicon. Two layers are treated to create an electric field

Metal conductor

1. Sunlight is made up of photons, small particles of energy, which vary in strength. Not all photons are absorbed by the cell.
2. When enough photons are absorbed electrons are knocked free from the semiconductor material.
3. Drawn by the electric field, the electrons flow along a circuit (this, by definition, is electricity). It can be stored in a battery for later use

SOURCE: ARISE TECHNOLOGIES CORPORATION, NASA

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