

Canada: A Green Energy Superpower

A special report from Global Business Reports and *POWER*

The Peace Canyon Dam and powerhouse in northern British Columbia.

The earth structure in the reservoir behind the dam is an anti-vortex dike to protect the dam against debris and prevent reservoir users from getting too close to the dam for safety reasons. *Courtesy: BC Hydro*

Canada's "Clean" Image Extends to Clean Power

Canada's extensive natural resources are the driver of its powerful economy, and energy is Canada's single most important export. Yet policy makers across the nation are currently dealing with the consequences of a generation of under-investment in the electricity system and deciding what the new grid and supply mix should look like. Several provinces are competing to lead the charge in renewable energy and grid intelligence. Policy makers hope that such efforts will not only provide for Canada's electricity needs but also create the green economy jobs that will drive the nation's next generation of economic development.

By Tom Willatt and Sharon Saylor, Global Business Reports

The Canadian power system is almost entirely controlled at a provincial level, with each of Canada's 10 provinces and four territories operating distinctive energy markets. Each jurisdiction displays different values, politics, and attitudes toward energy and power generation. "The Federation of Canada is not unlike the European Union in how the weight of responsibility lies. The decisions on power generation, transmission, or distribution are a provincial responsibility," explains Dr. Murray Stewart, president of the Energy Council of Canada.

This provincial focus allows each province to work to the strengths of its resources. It does, however, limit the ability of the federal government to advance a single vision for the nation's energy sector. Despite this fragmentation, common themes emerge as each prov-

ince works to create a favorable environment for power investment.

In spite of its sparse population, Canada is the sixth-largest producer of electricity in the world, allowing vast opportunity for exports. "The electricity trade represents a few billion dollars a year. We sell more than we buy in the end, but there's a lot of electricity that moves back and forth," explains Pierre Guimond, president of the Canadian Energy Association.

In the post-global financial crisis environment, many investors are favoring long-term secure investments with minimal political risk, which Canada seems to offer. Its banks weathered the financial crisis comparatively well, and the country is well established as a hub for energy investment. Sandy Taylor, president and CEO of ABB Canada, adds that from an investment point of view, "Canada

has incredible wealth in natural resources combined with a very stable and predictable government and economic environment."

Power investment levels can generally be tied to the growth in demand, which in turn is typically a derivative of economic growth. However, market participants see added opportunities in Canada due to the fact that large portions of the system require refurbishment or replacement. This has been noted by Luc Benoit, global managing director for energy at AECOM. AECOM is an engineering consultancy that has been on a rampant acquisition trail in Canada, most recently acquiring RSW, an international engineering firm, in September 2010. "Energy is following the growth of the economy, but beyond that, we are replacing, and that is why energy is becoming an increasingly important business for us," Benoit says.

1. Multi-use land. A farmer grazes his herd near Northland Power wind turbines that dot his farm in Matane, Québec. Northland negotiated more than 60 leases covering 6,000 hectares (nearly 15,000 acres) of private and public lands for the 127.5-MW Jardin d'Éole wind farm. *Courtesy: Northland Power*





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John Brace, president and CEO of Northland Power, one of the earliest independent power providers (IPPs) in Canada believes that “The opportunities for our company have never been so great as they seem now with the movements towards clean and green power” (Figure 1).

His opinion is shared by William Smith, senior vice president, energy sector for Siemens: “Canada represents an energy superpower with excellent political and economic stability. It has grown dramatically in im-

portance, particularly in the past two years. Through the financial crisis, we managed to maintain a reasonably steady level of investment from our customers. There was a need for investment, and the government ownership of utilities meant that energy was used as a form of indirect stimulus.”

This transition is creating opportunities throughout the industry. Engineering, service, and equipment companies that previously focused on the oil and gas or mining sectors are increasingly aware that the great-

est opportunities now lie in power. Turgay Ozan, president of Atlas Copco Compressors Canada, states: “We see great potential as the entire power generation mix is investing in expansions or in new projects. The traditional thermal, hydro, and nuclear projects will continue to come on stream, as well as the new emerging renewable methods such as wind and solar.”

Generation Options

Across North America, jurisdictions are clamoring for green credentials and encouraging the establishment of wind, solar, and other renewable generation sources. Although a number of Canadian provinces can already boast impressive hydro generation capabilities, policy makers are targeting significant investment in other renewables. “The electricity sector right now is 75% clean, and the idea is that over a well-defined period of time we’ll be a 90% clean electricity sector,” explains Dr. Stewart of the Energy Council of Canada.

Hydro. Hydroelectricity is Canada’s number one source of power generation and, in 2009, it accounted for over 60% of the nation’s total electricity generation. The provinces of Manitoba, Québec, British Columbia (B.C.), and Newfoundland and Labrador all generate more than 90% of their electricity from hydropower.

The storage capability and dispatchability of its large hydro assets provide Canada’s greatest electrical trade advantage: “These provinces make half their profit by buying electricity at night, when power is very cheap, from jurisdictions that operate thermal plants, which must run continuously. They can then produce excess electricity during peak daytime hours, which can be sold at up to five times the price,” explains AECOM’s Benoit, an engineer with extensive experience in major hydro projects across those provinces.

Canada is said to have undeveloped potential of over twice the current hydro capacity, and every province and territory boasts some level of hydropower development potential. Although many large-scale projects, such as B.C.’s Site C and Newfoundland’s Lower Churchill Falls, have been mired in protest and delay, developments are being studied and planned throughout the country that range from major storage dam proposals to myriad smaller, run-of-river projects. “A huge market is developing in small and medium-sized hydro opportunities in Canada. Good regulation is being put into place, and due to the small environmental impact, it is much easier to get local acceptance,” says Denis Tremblay, president of the Power Division at BPR, a Québec-based engineering consultancy firm that has worked extensively in this field.

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2. New gas-fired cogeneration plant. Northland Power's newest thermal energy plant, a cogeneration plant in Thorold, Ontario, opened on budget and on schedule in 2010. The 305-MW plant delivers power to the grid as well as electricity and process steam to a nearby Abitibi-Consolidated Co. of Canada paper plant. *Courtesy: Northland Power*



Canada has been associated with excellence in hydropower for more than a hundred years but continues to innovate in order to make better use of its hydro resources. Nik Argirov, business unit leader of MWH Canada Inc., the world's leading wet infrastructure company, follows these developments closely. He says, "This is a very old industry, but while hydroelectric processes are already very efficient, we continue to invest in research and innovation. The most exciting technologies that I see now are coming from hydrokinetic research and its river and tidal application."

Hydrokinetics is the harnessing of the energy potential from natural water flow in rivers or ocean currents using turbines that operate without the need for dams or penstocks. One such example is the TREK turbine, which is being developed by RER (Renewable Energy Research), recently spun off from engineering firm RSW during its sale to AECOM. The TREK turbine can generate up to 333 kW and guarantee 10 years of maintenance-free performance. The September 2010 installation of two of RER's TREK turbine prototypes in the Saint Lawrence River, Québec, was the result of two years of in-house research and development.

Imad Hamad, general manager of RER explains: "Hydrokinetic technology sits on the river bed, has no visual impact, does not sacrifice land, makes no noise, and works 24 hours a day and 365 days a year. It is foreseeable, it is predictable, and it is repeatable. We have made resources assessments and,

with the dimensions of our machine, we found 30,000 MW of technically, environmentally, and economically viable potential projects around Canada. In the U.S., we found another 77,000 MW in a small selection of rivers and estimate a total potential market of 200,000 MW in the U.S."

Similar technology is being developed to utilize Canada's rich tidal resource. The Bay of Fundy boasts one of the highest tides in the world and is gaining a reputation as a global center of excellence for tidal energy innovation. Emera, a private corporation that owns Nova Scotia Power, in addition to a broad range of generation, utility, and transmission assets across North America, has been a key player in this development. Christopher Huskison, CEO, explains the potential resource available: "The Bay of Fundy actually affects Nova Scotia, New Brunswick, and Maine. More water flows in and out of the Bay of Fundy on any given day than all the rivers in the world. It has the highest tides in the world, in excess of 20 meters. It's a huge resource. The testing here has been the most aggressive in the world, but you can deploy this type of technology in other locations, including those where tides are not as strong."

Fossil. In addition to its vast renewable resources, Canada is also rich in fossil fuels, none more so than coal, of which it is estimated to possess more than 100 years of supply. Oil and natural gas are also abundant. Canada has 269 fossil fuel thermal generating stations that represent a combined installed capacity over 36,000 MW.

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These fuel sources remain economically competitive and play a vital role in grid reliability as dispatchable generation sources. However, politics and concerns over the risk of forthcoming carbon pricing legislation mean that new coal plants are likely to be limited in the near term.

Although coal-fired generation development seems unlikely in Canada, internationally it continues to pick up pace. Steve Snyder, CEO of TransAlta, one of the country's largest diversified energy companies, believes that Canada should see this as an opportunity to protect the viability of one of Canada's most important resources and industries. "Coal is not the problem; the emissions are the problem. If we want to solve the problem of CO₂, we're going to have to find somebody to develop the technology."

The relatively cleaner option of natural gas generation is enjoying an upswing due to the falling price of gas as well as the need for a reliable counterbalance to the enormous investments in inconsistent wind and solar capacity.

As the cleanest form of thermal generation available, natural gas plants—which are also quicker to construct than coal plants—seem likely to be a popular choice, along with renewables, in the short term for Canadian developers (Figure 2). "The new finds of shale gas brings the economics of natural gas projects much more into play. I feel that, especially in Ontario and probably Eastern Canada also, we'll see natural gas play a more important part in the mix going forward," says Stephen Somerville, director of development at Competitive Power Ventures, an IPP that has developed a number of renewable and natural gas projects across Canada.

Peter Stalenhoef, president and COO, PCL Construction, the largest construction company in Canada, also sees gas-fired generation as the most likely replacement for coal: "In the U.S., I've heard of as many as 40 to 60 coal-fired plants that need to be retired now. Nuclear won't come on quick enough to replace that generation. I think you're going to see a lot of gas-fired generation filling the void on retiring coal-fired units."

TransAlta's Snyder is cautious about these possibilities: "Natural gas has potential to be an interim player, as you can build quickly and at a reasonably low cost. However, the challenge is that the cost of the electricity is 25% based on the cost of natural gas, which has historically been very volatile in price. Its viability also hangs on future CO₂ regulations, and cost legislation."

Nuclear. A number of factors tie Canada to the nuclear industry. Currently, Canada is the world's leading supplier of uranium, and Canada's nuclear capacity is eighth in the world. Ontario, New Brunswick, and Québec are the three provinces that produce electricity from nuclear energy.

Canada was the second country in the world to undertake a controlled nuclear reaction and has been building nuclear plants since 1945. Canada led the way in reactor design through the development of the CANDU (Canadian Deuterium Uranium) pressurized heavy water reactor. Today, 34 CANDU reactors, along with 16 other heavy-water reactors based on the CANDU design, have been built or are under construction on four continents.

However, the majority of Canada's existing plants will reach the end of their service lives within the next 20 years, and many questions remain concerning Canada's nuclear future. (For details on CANDU nuclear plant extensions, see "Bruce A Proves There Are Second Acts in Nuclear Power" in *POWER*'s August 2010 issue.)

Kurt Strobele, chairman and CEO of Hatch, one of the world's largest engineering companies, believes that nuclear development will triumph: "I see an increasing role for nuclear. It's a necessity, not a choice, because of its reliability. There is a lot of inertia, however, and the new projects and new technologies and developments have not been as successful as hoped. Once we get past that first



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hurdle, I think there will be a very fast climb in nuclear build."

This view is shared by Randy Karen, managing director of WorleyParsons Canada Ltd.: "Nuclear is now rejuvenating itself as a green, non-carbon-emitting option. Nuclear energy was not legislated out of play but priced out by the permitting that had to be put in place. Now, because of the increased technical understanding and control, it has reached a different level of acceptability. The renaissance is real, but the proof will be in how well projects can be delivered in terms of cost and schedule." WorleyParsons is an international engineering firm that serves the hydrocarbons, power, infrastructure and mining industries; it hopes to become a major contributor to a Canadian nuclear renaissance.

A political tussle has developed between the provincial and federal governments regarding Atomic Energy Canada Ltd. (AECL), the steward of Canada's nuclear technology. AECL is a Crown Corporation and, therefore, under the control of the federal government, which decided to put the AECL up for sale in December 2009. At present it is unclear how much of the corporation is to be sold and to whom. Until this restructuring is complete, AECL is unable to sell any more CANDU reactors.

This delay is of particular concern in Ontario, where the authorities have been waiting on these decisions in order to build two new reactors at the Darlington site. Ontario Minister for Energy Brad Duguid remains committed and hopeful that the process will be completed soon and that the province's new build plans can go ahead: "We believe Canadian nuclear technology is among the best in the world, and our preference is to purchase these two new units with AECL. We're in a vigorous process now to find a way to do that."

It is calculated that the nuclear industry supports 70,000 high-tech jobs in Ontario alone. Babcock & Wilcox Canada (B&W Canada) provides high-tech services to a range of nuclear plants, mostly from its large manufacturing facility in Cambridge, Ontario. Michael Lees, president of B&W Canada, highlights the concern that many market participants feel over the future of AECL: "Canada has a robust service community dedicated to servicing CANDU plants. The real risk is that if new builds do not move ahead, we may lose that capability. Any nuclear industry relies on the domestic market to sustain it, from which an export market can be built."

However, some market players believe that the most effective way of protecting Canada's nuclear industry is to move away

from CANDU technology and adopt light water reactors.

Jean-Francois Béland is executive vice president of Areva, which hopes to develop Canada's first light water reactor as part of the Clean Energy Park that it is planning with NB Power and the provincial government of New Brunswick. He says, "The Canadian nuclear industry learned the CANDU language 50 or 60 years ago. However, light water reactors now represent 92% of the market and heavy water is only 8%. For Canada's nuclear service providers, taking a share of this 92% is better than being the dominant player in an 8% market. It's a global industry now; national players no longer exist. It is a worldwide market, and it is focused on what is the most reliable and economically viable technology for the taxpayer."

Some Canadian companies, such as B&W Canada, have already made the leap toward servicing non-Canadian technologies in order to reduce exposure to AECL and CANDU as well as to access the U.S. market: "B&W Canada fortunately stopped relying on new build, moved into international refurbishment, and started working not just with CANDU equipment. This leaves us better protected than some of the other domestic suppliers," explains Lees.

As the industry does ramp up again, the issues of nuclear waste and plant decommissioning are additional challenges. Facilities for low-level radioactive waste are under development at Port Hope, and the potential for deep geological deposits at Tiverton and Chalk River, Ontario, remain under discussion. However, final decisions on these projects are still to be made.

Carol Wilson Hodges, president of Energy Solutions Canada, a firm that specializes in nuclear services, feels the management of waste is key to the success of the industry:

Brad Duguid, Ontario energy minister



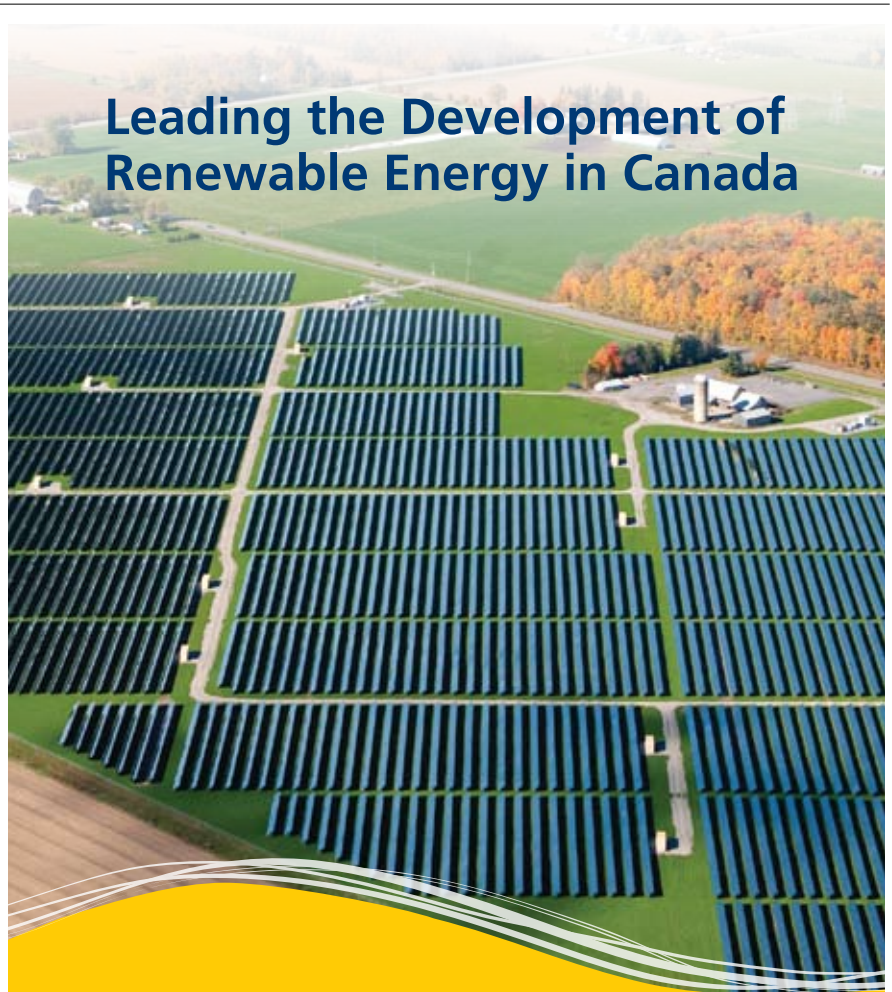
"We have some amazing host communities that are very supportive of nuclear development. As the nuclear renaissance gets under way, it's important that people see that the aging plants and their waste are properly managed." (See "Canada Moves to Rebalance Its Energy Portfolio" in *POWER*'s June 2009 issue for details of Canada's current and planned nuclear spent fuel storage systems.)

Wind. Wind power is expected to lead the growth of newer renewable generation technologies. Industry Canada estimates

that by 2015 there could be an installed capacity of 8,000 MW of wind turbines. According to the Canadian Wind Energy Association (CanWEA), Canada has a total of 92 wind farms and the leading three provinces for investment are Ontario, Québec, and Alberta.

RES Canada is the local arm of the German renewable energy company RES. It sees good opportunities in both developing and constructing wind projects. Peter Clibbon, vice president, says, "In the near

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term, I am very optimistic. It took Canada 15 years to build its first 1,000 MW of wind power. RES has now got plans to build 1,200 MW in Québec and Ontario in the next three- or four-year period.”

Another generation opportunity for Canada that is yet to see construction is offshore wind. The country has potential capacity on both its extensive coast lines and within the Great Lakes. Offshore wind obviously comes with increased cost pressures and the need for large transmission investments. “There is a strong, consistent wind resource with a low diurnal fluctuation,” points out John Kourtoff, CEO, Trillium Power Wind Corp. “There are 95 million people that live around the Great

Lakes. Relative to other international hubs of offshore wind development, the distance to get the power into the grid for usage is very short, and there is good interconnection between these jurisdictions.”

He sees this as a potential coup for Ontario’s power exports: “The transmission that is required for offshore will significantly lower the hurdle of connecting the U.S. and Ontario grids. This means that, through offshore wind, Ontario has the opportunity to position itself to be a provider of clean power from the East Coast to the Midwest of the U.S.”

Solar. Photovoltaic (PV) solar power is another newer generation source that is being encouraged in the hope of creating

vibrant domestic supply chains (Figure 3). According to the Canadian Solar Industry Association (CanSIA), the solar industry consists of more than 400 companies, employs more than 1,000 people in Canada, and grew at an annual rate of 25% between 1992 and 2006. It ranges from the residential to the utility scale, and solar players are pursuing opportunities across that spectrum. The world’s largest solar park (97 MW) opened in Sarnia, Ontario, in October 2010.

The cost of PV-generated solar energy has plummeted over the past three years. The price of inputs (panels, invertors, and balance of plant) is going down, and installation know-how, as well as the efficiency of panels and new technologies, is improving. “If we continue this rate, we’re going to be competitive with peak grid energy in parts of North America within the next two to four years,” believes Jon Kieron, director, solar, for EDF EN Canada Inc. and chair of CanSIA. “That would have been unheard of four years ago.”

“I never dreamed that solar technology would ever be at the cost it is today,” agrees Milfred Hammerbacher, president of Canadian Solar, one of the largest solar panel manufacturers in the world, which is opening a manufacturing operation in Ontario. He cites the government’s involvement as the key driver: “The government has shown willingness to make it an attractive market for manufacturing by lowering our corporate tax rates, which are scheduled to go down over the next several years. The truth of the matter is that it is very hard to compete with China for manufacturing. Without an incentive, we probably wouldn’t have been able to complete our projects here. As long as there’s a market driver, it’s an easy decision to make.”

Financing Generation Investments

In the aftermath of the global financial crisis, attracting finance to projects has become an even greater concern for developers. Power investment in Canada stems from a number of sources, both traditional and less conventional.

Although Canadian banks weathered the crisis fairly well, James Harbel, a partner at Canadian law firm Stikeman Elliott LLP, believes that the banks have yet to fully engage in the renewable sector: “They are learning about the technology, training their people, and educating their credit committees in a time frame where there is an unprecedented demand from them for financing. International players, particularly European financiers, are more comfortable with the technology but lack

3. Winter sun. Canada’s first 250-kW rooftop solar installation, in Cambridge, Ontario. Courtesy: AECOM



the financial depth. We are finding that consortiums are being formed and groups are learning to work together. It is taking a little while for these relationships to be formed.”

In addition to the banks, Canada’s pension funds play a large role in financing projects, explains Aaron Engen, managing director of Investment & Corporate Banking at BMO Capital Markets, one of Canada’s leading investment banks: “There’s a Canadian phenomenon going on with pension funds becoming involved in direct investing. In the U.S., the pension fund model is that investments are channeled through private equity firms. In Canada, pension funds can bypass these channels and have become world leaders in direct investing. They are very interested in power, as they are focused on assets that have long-term contracts with transparent earnings and cash flow profiles because they are trying to match long-term reliabilities.”

The role of pension funds in the industry is something that David Williams, managing director of Investment Banking at CIBC and head of the Power and Utilities Group, also sees as critical: “We see pension funds as a continuing theme in the marketplace. It makes sense, as pension funds can invest in infrastructure without taking currency risk and put long-term money against long-term liabilities. They might not be as helpful to the small developer, but we see this as appropriate, particularly for the larger-scale projects.”

Capital is hardest to acquire for the smaller developer, particularly at the earliest stage of a project, explains Frank Carnevale, president and CEO of Bridgepoint Group: “There is a huge void in the development capital space. An investment of a few million dollars in development capital can get a large chunk of a project at its early stage. The pension funds are not looking at opportunities of this size; they need to place large amounts daily, and it’s just too small.”

Bridgepoint Group is a boutique investment bank that specializes in these deals. It sees opportunities for both developers and lenders: “There is clearly a risk, but as long as this is mitigated and well managed, the returns are significant. It is the most profitable stage of the investment dollar. It’s not intended for large movers in the industry, but there are plenty of small and midsize players that need a friendly investor that won’t look to take over their company.” ■

—**Tom Willatt and Sharon Saylor**
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Transmission and Distribution in Canada

Like its neighbor to the south, Canada faces enormous costs to upgrade and expand its transmission and distribution system. The desire to integrate more renewable power into the grid, build a smarter grid, and export more power are providing the rationale for action, but capital and political will lag behind.

By Tom Willatt and Sharon Saylor, Global Business Reports

One of the great challenges facing any electrical system is the constant need for decisions regarding the transmission and distribution of power. Canada's high-voltage network consists of more than 160,000 kilometers of high-voltage lines. Beyond maintaining the aging facilities, operators are tasked with integrating more intermittent generation from renewable sources and incorporating smarter grid systems.

Like generation decisions, decisions about transmission are mostly made at a provincial level. Federal powers only intervene when international interconnection is involved and in certain intra-provincial matters. But it seems that across the country there is a need for upgrades. "There are cycles of activity in the renewal of transmission and distribution networks. We are coming to the stage of the cycle where large parts of the system need to be renewed. Power and transmission grids will be a good market for the next five to 10 years," predicts Franck Willier, managing director, Cicame Energie Inc. Cicame is part of Sicame, which purchased Alcan Accessories in 2000 and has since built up a broad service offering of equipment for utilities. "New technology can increase efficiency and take better decisions on the network, all the way up to decisions on new generation or transmission," Willier continues.

Canada has three power grids: the Western grid, the Eastern grid, and the Québec grid, which includes Atlantic Canada. More than from east to west, the grid is designed to allow for a flow of power down to the U.S. "If you look at a map where the transmission lines are shown, you'll see that most of them go north-south. It's the way that it developed," explains Pierre Guimond, president of the Canadian Energy Association. "We never really sold electricity east-west, because there were no customers, as the provinces were self-sufficient. Since the California market exploded in the mid-1990s, we've re-

1. Cross-border transmission. This aerial view of the static inverter plant at Sandy Pond in Ayer, Mass., is part of the long-distance high-voltage direct current Québec–New England transmission line that links Québec hydro power and New England load centers. *Courtesy: ABB*



ally had a lot of commerce in electricity with the United States."

This integrated grid means that Canada is a major supplier of power to the New England states, New York, and California, as well as to states in the Upper Midwest and the Pacific Northwest (Figure 1). Some Canadian players are now looking for longer-term contracts on their U.S. exports so that they can be leveraged toward further grid development. "B.C. has an abundance of renewable possibilities, but in order to exploit this potential we must find a market," says Bev Van Ruyven, deputy CEO and executive vice president of BC Hydro, the dominant electrical utility of British Columbia. "If we can lock in long-term contracts of 20 to 30 years, this will allow us to invest further in transmission and perhaps even invest in a green corridor to reach those U.S. markets."

Connecting Renewables

"One thing that often gets forgotten is that if you are a big supporter of renewable energy, you also have to be a big supporter of increased transmission. It is easier to build generation that has a small, defined footprint than to build a transmission line that covers hundreds of miles," insists Paul Murphy, CEO of the Independent Electricity System Operator (IESO), which was created to independently and reliably oversee the transmission system, administer the wholesale electricity market, and manage the import and export trade in Ontario.

Dealing with variable generation facilities is something relatively new to the industry. "Integrating renewables into the system and the market is the biggest challenge. Maintaining reliability is at the core of our reason for being. Maintaining reliability in a sector

that is transforming substantially is quite a test,” confesses Murphy.

Anthony Ciccone, principal, power sector at Golder Associates, notes, “We are seeing a lot more district energy and cogeneration facilities being developed across the country. The result of these ‘energy campuses’ is a more balanced load that is less dependent on the grid. These smaller, more neighborhood-friendly projects are well received in populous areas where residents are averse to the large transmission lines and power plants. This shift means a lot more projects and a lot more development.”

Nevertheless, the need for major investment in long-distance transmission networks could emerge as the greatest constraint on Canada reaching its renewable energy goals. Policymakers and utilities across the country are aware of this issue, but the expenditure and public unease associated with large-scale transmission projects will require continuous and concerted political will.

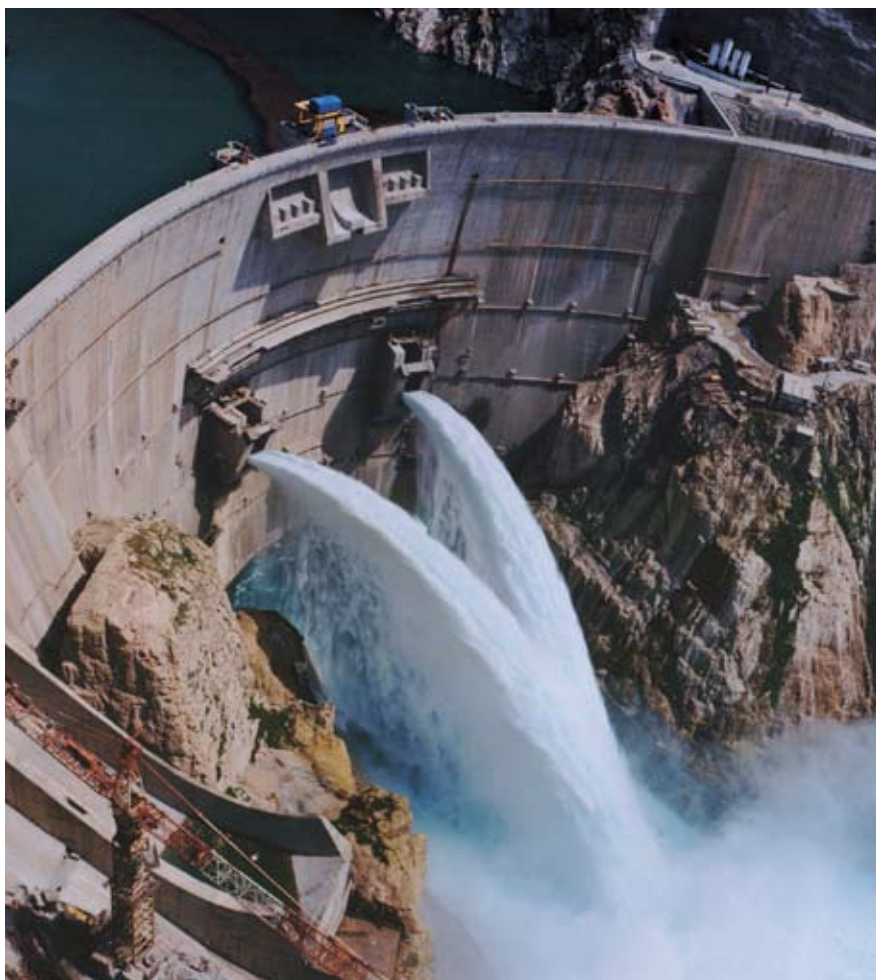
Smart Grid

Around the world, one of the most discussed infrastructure topics is the “smart grid.” Its definition varies, as Sandy Taylor, president and CEO of ABB Inc. Canada explains: “A lot of people think that smart grids are about the consumer and begin at the smart meter level. I think that smart, or smarter grids, can go far beyond that” (Figure 1).

“A smart grid extends from the generation, through the transmission and distribution systems, to the consumer. It incorporates the entire value chain. The evolving needs of a smarter grid are a really interesting opportunity for ABB,” he explains.

Ontario has engaged in a billion dollar program to install smart meters for all 4.5 million

Sandy Taylor, president and CEO of ABB Inc. Canada



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2. Harnessing power. Dessau handled the modernization and upgrading of Beauharnois power station, which was built more than 80 years ago along the waterfront, just 40 km from Montreal. It is considered a heritage site. *Courtesy: Dessau*



electricity customers in the province. Meters are just the first step. The challenge being faced by utilities now is managing the data that are being provided by the installed smart meters. “The sheer volume of data is much larger than ever before,” explains Jan Peeters, chairman and CEO of Olameter, a firm that provides outsourcing solutions for back-office activities within utilities. “Info is now being provided every half-hour of every day as opposed to one reading for every 30 to 60 days. The nature of that data and the technology available means there are always missing intervals. In the past, these could be made up using estimates. As the time-of-use rates become different from one half-hour to the next, it becomes critically important to collect every interval. Lost or corrupted data is proving to be a much greater problem than anyone anticipated.”

Distributors, which often represent the link between the customer and the utility, are at the front line of this development. Brian Bentz is president and CEO of Powerstream, a municipally owned Ontario distribution company that is responsible for more than 300,000 customers in the Greater Toronto Area. “The challenge is being commercial and innovative and having the correct risk appetite. The market requires an evolving delivery model due to the smart grid and decentralized renewable generation. It takes a different skill set to survive in that environment.”


Peeters reveals: “An expectation is being built up that utilities are now going to analyze the data and stream it in close to real time, allowing home owners to perform active load management. There is a disconnect between what the installed systems can do and what is expected of them. I think that utilities can overcome these challenges, but it’s going to take time, money, and experience.”

A number of companies see great opportunity as these systems are adopted across the country. Dessau, the Québec-based engineering giant (Figure 2), sees these developments as a key area for future growth. “Hydro-Québec is one of the leaders in smart grids, and we have been involved for the last five years in the automation of their substations and high-voltage transmission. We are currently working with them as they take the next step and move smart grids into their distribution network. We also look towards other utilities, across North America, as there will be huge investment in this sector.”

“There are a lot of electric utilities that will have to rapidly upgrade their network to incorporate the smart grid technology and automation,” says Michel Famery, vice president of National Development in Energy and Telecoms at Dessau. ■

—**Tom Willatt and Sharon Saylor**
(info@gbreports.com) are with *Global Business Reports*.

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Canada's Provincial Power Strategies

In Canada, as in the U.S., where you live determines the type of generation technology that provides your power. Here's how the four most energy-intensive provinces in Canada are responding to the challenge of providing reliable and cheap power in a sustainable way.

By Tom Willatt and Sharon Saylor, Global Business Reports

Due to the relative benefits of the different generation types, and their availability, Canadian policymakers in different provinces have taken very different approaches to their energy markets. Arda Yetisen, president of AEDON Consulting, a Vancouver-based engineering firm that specializes in utility services, believes their policies will be key: "I can't see great leaps in technology occurring. But taking proven methods, making the right decisions for the province and the country, and applying them effectively is what will be most important."

Ontario Dumps Coal for Cleaner Options

Ontario has attracted the attention of the global power community as it pursues a number of strategies to revolutionize its electricity system under the "Green Energy Act" that was passed in April 2009. Ontario has launched one of the broadest and most competitive feed-in tariff programs in North America and aims to remove all coal-fired generation from its mix. (See "The Feed-in Tariff Factor" in *POWER*'s September 2010 issue for details of this and other feed-in tariff programs.) The province has also launched the most comprehensive roll-out of "smart metering" in North America.

"We're in the midst of a generational change in energy that has taken place over the past seven years in Ontario," says Brad Duguid, the Ontario Minister for Energy. "It is providing a budding green energy economy, creating the next generation of jobs, while at the same time creating cleaner air."

The province of Ontario operates a 35,000-MW electrical system with a winter peak of 27,000 MW that provides electricity for 13 million people. Nuclear power accounts for almost half of the generation mix, which also includes significant hydro, gas, coal, wind, and solar assets. (See "Canada

Moves to Rebalance Its Energy Portfolio," in *POWER*'s June 2009 issue.)

The Ontario Power Authority (OPA) was created in order to enable private investment in generation. "There was a period of time when the proper attention was not being paid to making sure we were getting supply in place. Suppliers often didn't have confidence in the province, so we needed to come in and be a credit-worthy counterparty," explains the OPA's CEO, Colin Anderson. Developers enter into a contract with the OPA to enable the financing required to build long-term generation at a regulated rate of return.

Despite the participation of a strong independent power producer (IPP) community in Ontario, the majority of generation remains under the control of Ontario Power Generation (OPG). Tom Mitchell, CEO of OPG, says: "We generate between 60% and 70% of the energy in the province and view ourselves as the low-emission, low-cost energy backbone of Ontario. In many ways we are a foundation and an enabler to what is being done to change the supply mix in Ontario, including the developments in renewable and distributed energy. We are aggressively engaged to make the necessary investment to ensure that nuclear, hydro, and our thermal fleet is there to keep the lights on."

Building a Green Economy. Minister Duguid makes no secret of the fact that a key motivation behind the province's "Green Energy Act" is job creation and economic development: "We agree with President Obama when he says that the jurisdiction that leads the green energy economy will be the jurisdiction that leads the international economy. Ontario is now a leader in building a green energy economy. We're estimating 50,000 jobs being created as a result, and we're already seeing those jobs arrive across our province. The result is jobs being created and green energy enterprises popping up."

Tom Mitchell, CEO, Ontario Power Generation



David McFadden is a partner at Gowlings, a law firm with a large practice dedicated to power project development law. He has seen first-hand the buzz that this policy has created: "As a result of the Green Energy Act, in addition to the new and established Canadian players, we now have clients from Korea, U.S., China, and the European Union. Ontario has gone from a jurisdiction that was not well known for its green economy to a province that is considered innovative and highly interesting to the renewable energy community."

EDF EN, a renewables-focused subsidiary of French utility EDF, has noted the opportunity and has invested more than a quarter of a billion dollars in Ontario solar projects (Figure 1). Jon W. Kieran, director, solar, EDF EN Canada, describes his company's interest: "We feel that Canada is going to be one the most robust renewable energy markets in the world for a sizable period of time. Firstly, it is endowed with the natural resources to make renewable energy profit-

1. Rows of panels. The 23.4-MW Arnprior Solar Project near Ottawa, Ontario, began commercial operation in 2009. *Courtesy: EDF EN*



2. Big baseload provider. The four-unit Darlington Nuclear Generating Station has a total capacity of 3,524 MW and is located in the Municipality of Clarington, 70 km east of Toronto. It provides about 20% of Ontario's power. During the Darlington refurbishment project, each unit will be refurbished sequentially. *Courtesy: Ontario Power Generation*



able here. Secondly, there is a unique history of the development of the energy industry's infrastructure. Canada, and Ontario in particular, is disproportionately well invested in the area of energy. Thirdly, and most importantly, the Ontarian government was the first jurisdiction in North America to create a European-style feed-in tariff, thereby achieving a far-reaching policy perspective on creating green energy industries."

The development market is a mixture of established players and new entrants. The

Association of Power Producers of Ontario (APPRO) represents their concerns. APPRO President David Butters highlights how the IPP community's greatest desire is now for policy stability that would enable better financing of power projects: "People are just looking for a stable regime. A big part of the value proposition of power investments is their 20-year time frame. In order to raise money at the minimum cost, you need to have assurance of what the climate is going to be like throughout that cycle."

Closing Coal Plants. One of the key initiatives in Ontario is eliminating coal from the supply mix. Its contribution has already been reduced from 19% in 2005 to 7% in 2009, and the remaining capacity should disappear by 2014.

"Our premier decided to get out of dirty coal-fired supply, and by 2014 we will be the first jurisdiction in the world to accomplish that goal. We've seen a 70% reduction, and we're at the lowest level of coal generation in 45 years. We're closing four more coal plants by the end of 2010, four years ahead of schedule," says Minister Duguid.

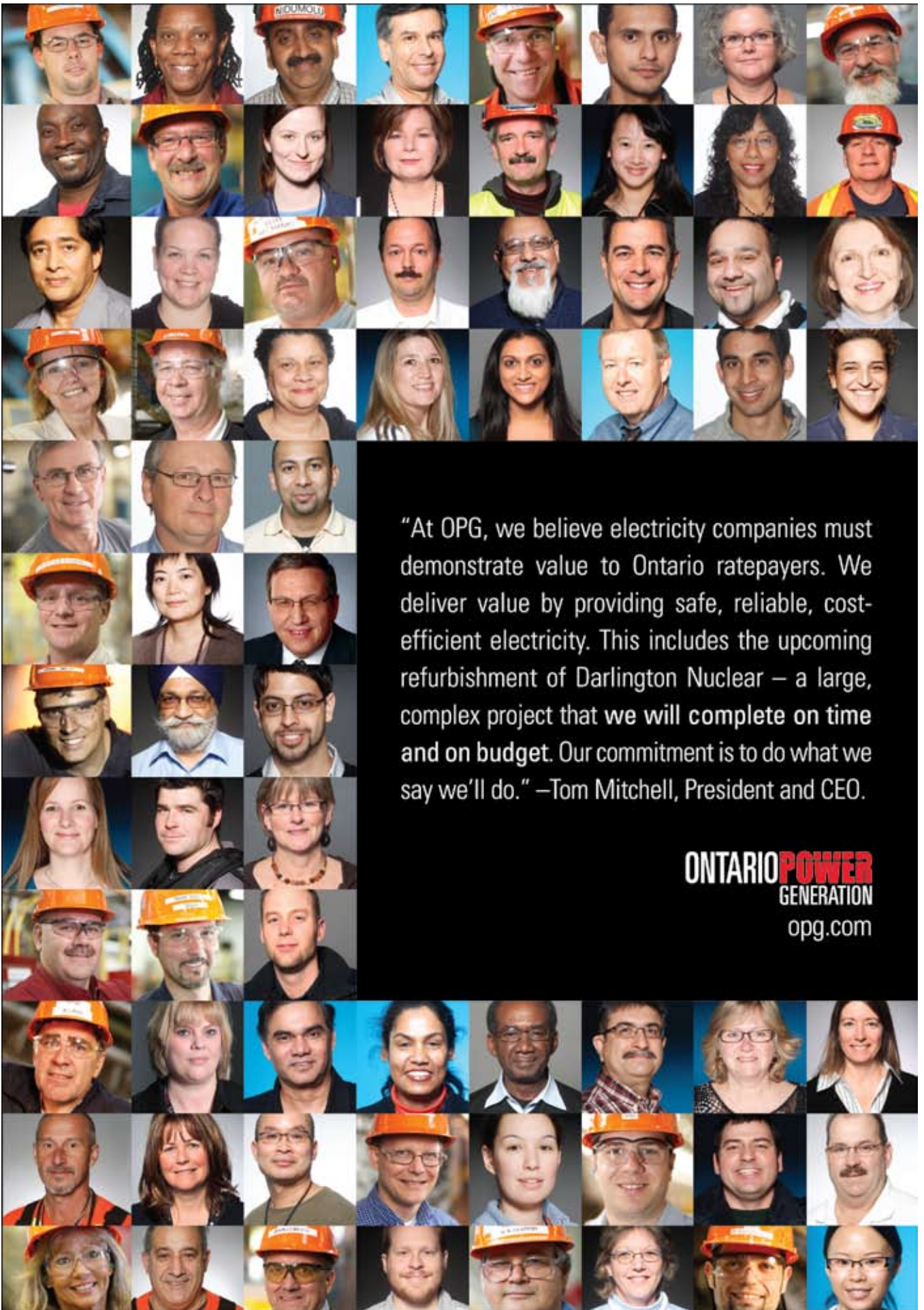
This policy will account for the majority of the government's greenhouse gas reduction target by 2014. "When you look at the reduction that this will make to greenhouse gas emissions, it's one of the largest climate change initiatives in all of North America," says the OPA's Anderson.

Two units at the Thunder Bay coal plant will be converted to gas, and Atikokan will be converted to biomass. OPG's Mitchell sees this as a great opportunity for the province: "We've been directed by the government to proceed with the detailed work to repower Atikokan Generating Station with biomass. As other utilities and entities around North America look to replace coal, Ontario has the opportunity to lead the way. This could generate a 'made in Ontario' fuel supply for use here, across Canada, and perhaps the world." (See "OPG Charts Move from Coal to Biomass" in *POWER*'s April 2010 issue for details of the repowering plan.)

A Critical Decade for Canada's Nuclear Hub. Ontario has about 95% of the country's total nuclear generation and is home to Atomic Energy Canada Ltd. (AECL) and the nation's greatest nuclear energy services hub. This is a critical decade for Ontario's nuclear industry, not only due to the new build decisions, but also because of the need to refurbish and extend the life of the existing fleet.

OPG owns a nuclear fleet of three facilities, the largest of which is leased to Bruce Power, while OPG operates the Pickering and Darlington Nuclear Power Stations that have a combined generating capacity of about 6,600 MW. OPG is proceeding with a mid-life refurbishment of the Darlington Nuclear Station (Figure 2) and continuing safe operation of the Pickering Nuclear Station for about a decade with a \$300 million investment.

OPG's Mitchell fully understands the importance of Ontario's nuclear history: "Ontario has been in the nuclear business for over 40 years and has designed, developed, and built a very viable technology that



“At OPG, we believe electricity companies must demonstrate value to Ontario ratepayers. We deliver value by providing safe, reliable, cost-efficient electricity. This includes the upcoming refurbishment of Darlington Nuclear – a large, complex project that we will complete on time and on budget. Our commitment is to do what we say we’ll do.” –Tom Mitchell, President and CEO.

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has been deployed across the world. As we renew the facilities here, we will be renewing our workforce to retool and service both Ontario's needs and support the safe, reliable, and economic deployment of nuclear energy around the world. Many specialists that have worked in the nuclear industry since its early days are now reaching retirement. What is exciting to me is the number of young people that are interested to work in the nuclear industry. We often talk about the physical equipment, but nuclear energy, more than any form of generation, is actually very much a people business."

Bruce Power was founded in 2001 as Canada's first privately owned nuclear operator. It manages eight 750-MW CANDU reactors. Bruce Power was formed originally to refurbish these assets. In its 10 years the company has refurbished two of its units and is now in the late stages of refurbishing two more. (See "Bruce A Proves There Are Second Acts in Nuclear Power" in *POWER*'s August 2010 issue for details of this project.)

McFadden feels that this private participation rejuvenated the nuclear sector: "Bruce Power had a wonderful impact on the Tiverton community. The refurbishment

project was able to move ahead, thousands of jobs were created, the community was stabilized, and a strong company with an excellent management team was created."

Duncan Hawthorne, president and CEO of Bruce Power, has his sights on refurbishing the remaining four units. "We remain focused on nuclear operations. You will see us commit to the \$12 billion investment in the refurbishment of the rest of our fleet. The market needs it, and the economics are compelling. That is under our own control, and within two years we should have made that commitment. There is no ideological opposition to this; it is just a matter of negotiating the terms."

Hawthorne is now looking to grow the size of Bruce Power to increase efficiencies: "Nuclear power stations are like potato chips: You can't have just one. Running one single CANDU unit means you have a lot of overheads. Considered purely on an operational basis, plants operate better economically when part of a larger utility."

The OPG begins its own refurbishment campaign at Darlington with confidence. Mitchell explains: "We've learned from our own experience and have also been very closely following the experience of

William Smith, senior vice president, energy sector, Siemens Canada




other refurbishments. We're actively engaged in being a sponge to the various lessons learned in not only technical issues, but also project management, contract structure, risk mitigation, and a whole host of things."

"We've focused very hard over the past three years on some very important nuclear projects internal to our company. Every 10 years we have to shut down our reactors for essential maintenance, which has been successfully achieved last year at Darlington and this year at Pickering. We also made a decision in 2005 to put two of our Pickering units into decommission, and we have just achieved this ahead of schedule and under budget. There was a lot of learning from that project in not only the planning but also in the choreography of the execution."

One of the unique elements of the Darlington refurbishment project is that the multi-unit station will be refurbished sequentially. Mitchell explains: "We'll be refurbishing a unit while operating the other units. The Pickering shutdown was also achieved in this manner; we were doing major work on two of the units while operating two of the units. 'Choreography' is the best word I can use to describe the process that has to occur between the operator and the refurbishment operation. We've learned that you can't split the two. They have to be very tightly integrated. We have also learned that the amount of planning and the ability to very precisely understand the scope of the work before you start is crucial. We are not planning on starting the Darlington refurbishment until 2016, but we have already started the intense planning six years ahead of schedule to precisely determine the scope. We are also engaging the private sector to come up with innovative ideas on how

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to do the work, particularly in the integration between the refurbishment and operational units.”

Feed-in Frenzy. A cornerstone of the Green Energy Act is the feed-in tariff (FIT) program. The FIT program establishes an open and guaranteed stable price structure under long-term contracts in order to make renewable electricity development economically viable. More than 1,000 FIT contracts are currently in place for clean energy projects. Minister Duguid enthusiastically supports the program: “We are leading the charge on green energy. The feed-in tariff system that Germany and Spain operate has been something we’ve looked at, and we’ve come up with our own Ontario version. Our FIT program has gone from design to launch in just a year and a half, and we’ve just awarded 2,500 megawatts of contracts. That’s \$9 billion worth of activity.”

In order to ensure maximum benefit from the blossoming of the green economy, these contracts include the caveat that participants must include a 50% minimum of local content in every project. This has led to a number of success stories for the provincial government, the largest of which has been the \$7 billion investment by a consortium that includes Samsung and Siemens, which have invested in a photovoltaic inverter and a wind turbine plant.

William Smith, senior vice president of the energy sector at Siemens Canada, explains: “When we looked at the potential in Ontario and the loyal customers that we had accumulated in the development community, we saw that it made sense as a manufacturing center. The factory is designed to meet local content rules for any developer, including the Samsung Consortium, and is a logical extension of our global supply strategy for wind turbines. Our first priority is to serve the Ontario market, then over time to export as a part of the overall supply chain within North America.”

Smith notes, “This process began three or four years ago when Ontario started to open up its renewable market and we started developing wind projects. The success of these projects demonstrated our ability to realize project costs effectively and on time, which has allowed us to capture over 50% of the market over the last 18 months.”

Ensuring that green energy jobs are created is a vital way of demonstrating the value of the policy to rate payers. Nevertheless, the domestic content requirement terms of the FIT program have been criticized by some as a protectionist measure that is not in the interest of establishing truly efficient renewable energy supply chains.

Despite these concerns, it is clear that the international renewable energy community sees this as a huge opportunity. “Ontario has begun a program to create a renewable energy hub through its progressive government policy. These programs represent the most attractive incentive that exists in North America for solar development,” says EDF EN Canada Inc.’s Kieron.

Québec Capitalizes on Hydro

Québec has a population of 7.8 million, an installed capacity of 38,000 MW, and a winter peak of 34,000 MW. The province is served principally by Hydro-Québec, a government-owned monopoly that is Canada’s largest utility, operating one of the biggest systems in Canada for the generation and distribution of electric power. Hydro-Québec manages 83 generating facilities that supply virtually all of the electric power distributed in Québec. In 2009, Québec exported about \$1.5 billion worth of electricity and the government of Québec received more than \$2.17 billion in dividends.

Québec’s greatest energy resource is its hydropower, which generated about 97% of the province’s electricity in 2008. Oth-

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er sources of electricity include nuclear, wind, and thermal generation. As most of Hydro-Québec's generation stations are located at substantial distances from consumer centers, its transmission system is one of the most extensive and comprehensive in North America.

While other Canadian provinces had periods of little or no generation development, Québec has remained fairly consistent in building new assets. Since 2003, Hydro-Québec has commissioned eight

new hydropower facilities and currently has six more projects under construction. The company's total investments in generation, transmission, distribution, and energy efficiency for the 2009–2013 timeframe are expected to reach \$25.1 billion. In April 2010, Minister of Natural Resources and Wildlife Nathalie Normandeau announced the latest strategy, which included spending an additional \$32 billion by 2035 to expand capacity by 3,500 MW.

Québec also hosts one nuclear generating

3. From mill to power. The Sainte-Marguerite I hydroelectric generating station is 25 km west of Seven Islands, Québec, on the first set of falls on the Sainte-Marguerite River. The facility is located on the site of an abandoned wood mill originally used for pulp and paper manufacture. The mill ceased operations in 1968, and the site was idle for 20 years before being acquired by Hydromega in 1989. At the base of the existing dam, an entirely new generating station was constructed between April 1992 and December 1993. It is powered by an 8,500-kW Francis turbine. *Courtesy: Hydromega*



station, Gentilly 2, which has a net installed capacity of 635 MW. The facility began commercial generation in 1983 and is currently undergoing a \$1.9 billion refurbishment that is expected to be completed by 2012.

"The power business has been very strong in Québec, and we see that continuing," maintains Denis Tremblay, president of the Power Division at BPR, a multi-disciplinary engineering firm that has been active in power generation for 10 years and has developed close ties with Hydro-Québec as a preferred supplier. "The government and its utility have committed to a great deal more investment in generation, and that will also come with the need for increased interconnection and lots of grid improvements."

Québec IPPs. Although Hydro-Québec remains the dominant player, opportunities for IPPs do exist in Québec. Hydromega became the province's first IPP in 1987 and has since developed a series of hydro and wind power projects. Jacky Cerceau, president and CEO of Hydromega (Figure 3), relates: "Hydro-Québec launched a series of RFPs [requests for proposals] in the early nineties. It led to the development of a series of privately developed projects. They were mostly hydro but also included some wind and biomass. In 2002, the focus of Hydro-Québec was mainly on hydro. However, suitable hydroelectric projects were becoming more and more difficult to find, there was opposition

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from the community, and it was difficult to build a greenfield project.”

Hydro-Québec decided to broaden its generation mix. It launched an RFP in order to stimulate the development of 1,000 MW of wind generation. Cerceau continues: “The first RFP was focused purely on the Gaspé Peninsula region and included a 30% domestic content requirement, as part of the intention was to open up development in the Gaspé region. This region had become very economically depressed but possessed an excellent wind regime. This has been a very successful policy for the region. After the success of the first RFP, Hydro-Québec launched a second 2,000-MW RFP.”

“The key benefit of wind in Québec is in its combination with the phenomenal hydro assets. The load peak for Québec is in winter, which is when there are also the strongest wind conditions. The province already has a great dispatchable hydro resource and can now use this more for export purposes, as increasing domestic supply can be met by wind,” calculates Helmut Herold, regional manager for Québec and East Canada with REpower Systems, one of the world’s leading manufacturers of onshore and offshore wind turbines. REpower Systems manufactures towers, blades, and converters in Québec and is now preparing for towers and blades to be constructed in Ontario.

A third call for tenders, this time for 500 MW of wind power, is expected to proceed. This new capacity will increase total wind power installed capacity in Québec to 4,000 MW by 2015, which represents approximately 10% of the total peak demand (if wind operated at 100% capacity, which it does not). In the longer term, additional calls for tenders will follow at the rate of 100 MW of wind power for each 1,000 MW of additional hydroelectric power developed by Hydro-Québec.

“By 2016, there will be over 3,600 MW of wind generation in Québec,” predicts Michel Famery, vice president for national development of energy and telecom at Dessau, an engineering firm that participates in wind development in the interconnection process. “New types of energy are sometimes difficult to access or are inconsistent for the grid system. Therefore, we are looking to optimize their connection to the grid and to ensure their stability.”

The largest wind development in the region is that of the St-Laurent Energy Consortium, made up of European renewable energy giants REpower Systems AG, EDF EN, and RES Canada. These partners created a framework in order to develop, construct, and operate five wind farms with a combined capacity of up to 954 MW.

“The St-Laurent Energy project represents one of the largest wind projects in North America and the biggest on-shore contract ever signed by REpower Systems,” says REpower Systems’ Herold.

“Québec’s government very sensibly entered the market early and mobilized people to establish a production beachhead in Québec. They are now feeding that market with tenders. Québec could very easily exceed the 10% wind mix that they have targeted. Depending on the nature of the U.S.

market, Québec is extremely well placed to become a renewable energy powerhouse for the Northeast. It is not unforeseeable that Québec would have a 40% wind penetration in its mix,” observes Peter Clibbon, vice president, RES Canada Inc.

Québec Develops Engineering Expertise into an Exportable Commodity. Since the Carillon project of 1960, Hydro-Québec has pursued a policy of outsourcing its engineering needs. This has spawned an engineering consultancy



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industry within the province. Québec has now developed a reputation worldwide as a hub for excellence in engineering services. The province is the home to some of the largest engineering firms in the world.

The role of the Québec government and Hydro-Québec as drivers for this industry can be seen in the histories of many of its now internationally regarded engineering firms. "Hydro-Québec has been wonderful at working with consultants on their major projects so that local companies have gained expertise, which we can then export and employ on projects around the world," believes Dessau's Famery. "We started in the power business by working with Hydro-Québec on the James Bay project in the seventies. Based on that, and further work with Hydro-Québec, we built strong expertise and were able to compete on projects internationally."

Bernard Poulin, president and CEO Groupe SM, another Québec engineering firm that has gone on to make a great impact in power projects worldwide, remembers: "I started the company as a student focusing on soil testing. After four years of knocking on the door of Hydro-Québec, we were given the contract to work on the road for the James Bay Project in 1976. Hydro-Québec was impressed with our work and gradually gave us more responsibility, which allowed us to grow and gain experience as a consultant in both civil and electrical projects."

"Compared to companies that had only worked on small regional projects, Hydro-Québec got us involved in a multitude of specialized expertise that you could only find on a project of that magnitude," Poulin explained. "That gave us the expertise to go elsewhere. What they did and the way they did it was first-class management."

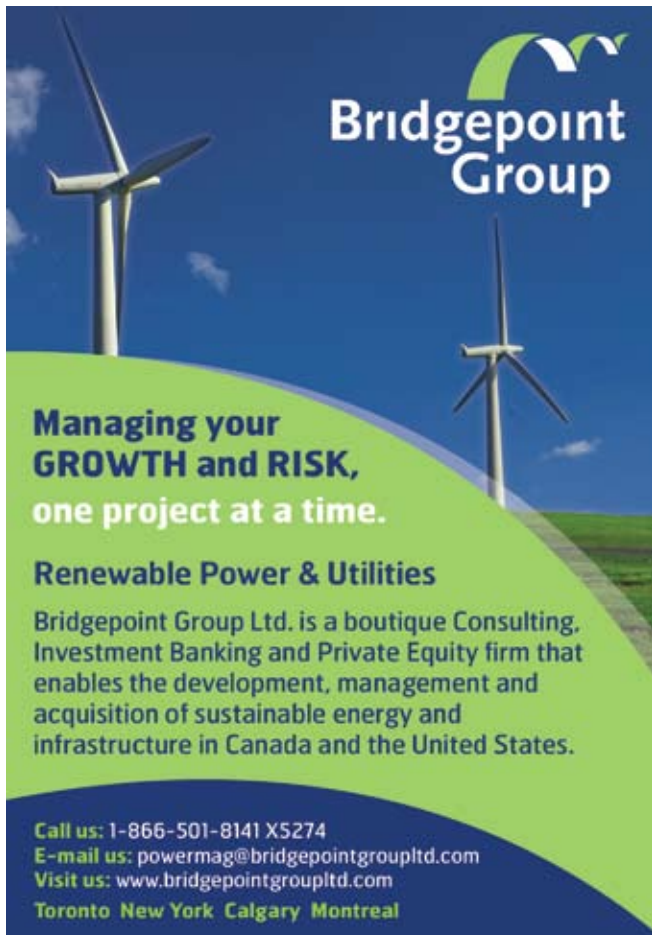
British Columbia Boasts Green Energy

British Columbia (BC) has a population of 4.5 million, an installed capacity of 13,100 MW, and a winter peak of 10,000 MW. Like Ontario and Québec, BC sees a green economy as key to the province's future and, like Québec, it is blessed with a large heritage hydro fleet that provides clean, dispatchable energy, which it can use for trade. BC is now considered the most exciting area in North America for small hydro development and claims a vibrant run-of-river development community.

"We see ourselves as having the potential to include green energy as an important part of our economy. Green energy investments have been taking place for quite a long time in BC. We think we are well positioned to become a clean energy powerhouse in North America," determines Bill Bennett, the BC minister for Energy, Mines and Petroleum Resources. "BC sees about 21% of all the venture capital that comes into the country. Given the size of our province and of our economy, it shows we're an exciting place to be these days."

In April 2010, the Government of British Columbia passed its Clean Energy Act, whose objectives fall under three broad categories: ensuring electricity self-sufficiency at low rates; creating new investments in clean, renewable power and energy security; and harnessing BC's clean-power potential to create jobs in every region.

BC consumers have enjoyed a long history of affordable, principally hydro-based, power supplied by the government-owned monopoly utility, BC Hydro. BC Hydro accounts for 80% of the province's total capacity to generate electricity, mostly from dams on the Peace and Columbia Rivers. These facilities account for 85% of BC Hydro's annual generation; the balance is produced through thermal generation, mostly fueled by natural gas. "BC Hydro is in an enviable po-



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4. Rubber dam. In 2010, Plutonic Power completed the Toba-Montrose run-of-river project, which consists of a 73-MW facility on Montrose Creek and a 123-MW facility on East Toba River. It is the largest source of privately generated renewable power in B.C. and the largest run-of-river project in the province. This photo shows the East Toba Hydroelectric Facility's inflatable rubber dam and intake. *Courtesy: Knight Piesold*



sition; we have 90% hydro from 33 hydroelectric facilities. This is complimented by a few small gas plants and wind, run-of-river hydro, and biomass generation provided through IPPs,” explains Bev Van Ruyven, deputy CEO and executive vice president, BC Hydro.

BC Hydro has indicated that electricity demand is expected to grow by up to 45% over the next 20 years. New demand will be greatest in the Lower Mainland and Vancouver Island regions, which consume about 70% of the province's electricity. As discussed below, a portion of this supply is expected to be provided by IPPs providing clean energy.

Between 1960 and 1984, BC completed six large hydro projects. The province then underwent 16 years of inactivity in power generation development until a political shift in 2001 opened generation opportunities to the private sector. “IPP’s have begun to play an enormous role over the past eight years in all of our programs,” says Van Ruyven. “We have gone from having none eight years ago, to currently having over 100 contracted private partnerships. By 2016 the private sector will provide around 25% of our supply.”

Run-of-River Hydro Expertise. BC is now recognized as a small hydro hub for North America. A 2008 study commissioned by BC Hydro found that there were more than 8,000 sites with the potential to be developed as run-of-river projects in BC. “Going green means that you work with what mother nature gives you. In BC it’s given you rain and mountains. BC is fairly unique in terms of rainfall, and the number of high-head potential projects makes run of river schemes very economical,” says Sam Mottram, manager of power services at Knight Piesold.

Knight Piesold has been identifying potential run-of-river sites in BC since 1979. “We identified 30 sites that no one had looked at because they were so far from the grid. But we came up with a green corridor concept, whereby a cluster of generation would carry the cost of development and make these projects feasible. It was a great idea but just needed a developer with the same vision.”

One such project was the recently commissioned 236-MW Toba Montrose site (Figure 4). This was identified by Knight Piesold and developed by Plutonic Power. Donald McInnes is the founder, vice chair, and CEO of Plutonic Power: “Most people were building where resources coincide with roads and transmission. In BC, this was limited to two or three main places. We didn’t want to be constrained that way.

5. Salmon spawn in the Sechelt. Members of Sechelt First Nation Resource Management Department monitor salmon in Sechelt Creek, near the tailrace for the 16-MW run-of-river Sechelt Creek Generating Station. The success of a manmade 400-meter salmon-spawning channel, created as part of the power project development, has enhanced salmon population in the creek. *Courtesy: Regional Power*



Prior to Plutonic Power, the average project size was around 10 MW. We felt that development in those increments was not going to change the supply problem.” Using Knight Piesold’s green corridor concept, Toba Montrose is just the first in a series of developments that were clustered to make the necessary transmission investments viable.

Regional Power is an IPP that specializes in hydroelectricity and

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has over 240 MW of projects in development. “In spite of the initial financial commitment, a hydro plant boasts technological longevity and economic durability—it is an attractive and lucrative asset in terms of investment. It is green, it is clean, and it ultimately becomes very economical,” says Colin Cooligan, president of Regional Power. His company’s award-winning Sechelt Creek generating station exemplifies the measures being taken by these developers to limit their environmental impact and engage with indigenous communities (Figure 5).

At the Sechelt development, a productive salmon-spawning channel was successfully installed, and the facility is used as a training center for First Nation students who are eager to participate in the industry. David Carter, executive vice president of Regional Power, feels that these measures are vital in order for the industry to meet its potential: “The future for hydro in Canada is fabulous. The forgiveness, efficiency, and timelessness of the technology is unsurpassable. It is the hardest business to enter but by far the most attractive business to be in for the long term.”

Bioenergy Edge. In addition to its drive for additional hydro and wind, bioenergy development is also encouraged in BC due

The Flow of Capital from Oil and Gas

Another energy trend in Alberta is the diversification of its oil and gas companies into the renewable space. “It is not necessarily a case of capital leaving the oil and gas sector, but of companies adding to their diversification,” explains David Williams, managing director of investment banking and head of power and utilities at CIBC. “For example, Suncor and Enbridge have both been making major investments in renewable projects. I think you’ll see more of that sort of investment activity as the returns on these assets warrant the investment and it’s seen as a positive thing to be doing.”

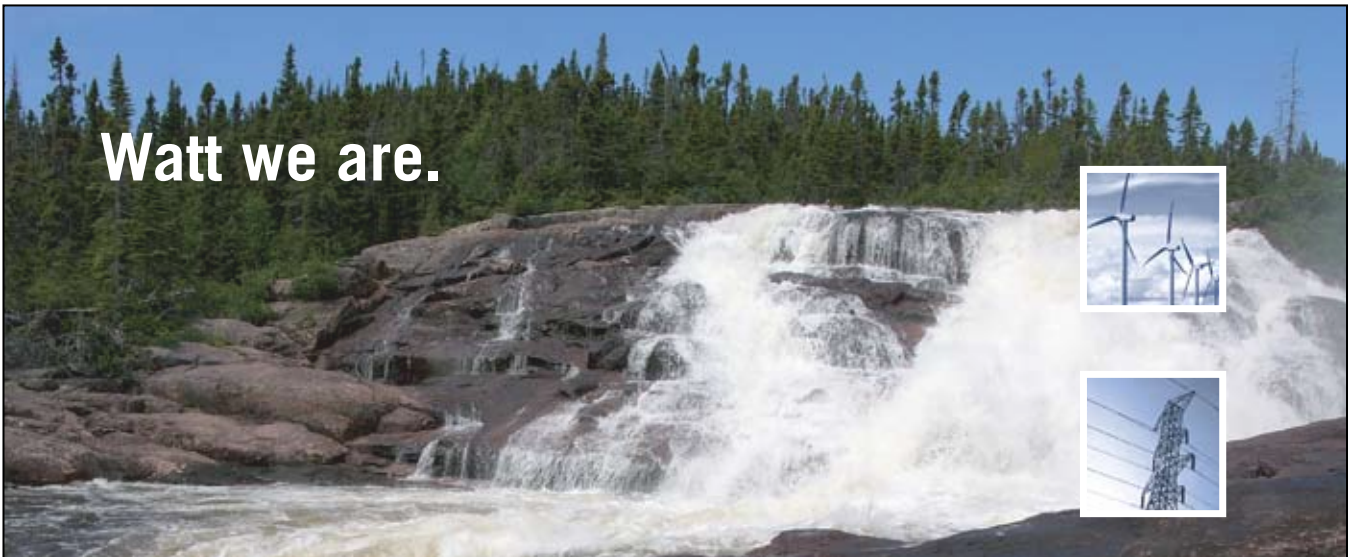
to the potential synergies with its long-established pulp and paper industry. “Power in biofuel is becoming increasingly important in this province and across Canada,” says Ulf Tryggvesson, executive vice president of Pöry (Vancouver) Inc. “At present, it’s an unutilized resource. There are large amounts of biomass that are either being destroyed or landfilled due to the lack of a market for it. BC has the opportunity here to not only address its power generation needs but to also help maintain one of its oldest industries.”

Alberta Backs Fossil Technologies

Alberta has a population of 3.7 million, an installed capacity of 12,900 MW, and a winter peak of 10,300 MW. Since 1996, Alberta

has operated fully competitive wholesale and retail electricity markets. “We operate the only truly open market in Canada. We pay for our electricity as we go, no debt is buried in Crown Corporations, and we are doing it all in a market without the natural advantage of hydroelectricity or other cheap renewables,” explains Ron Liepert, Alberta’s Minister of Energy. “If you have a mindset of free enterprise, I don’t think there’s a better place to invest.”

Alberta’s fossil fuel resources include large reserves of crude oil and natural gas as well as a vast reserve of coal. Coal production in Alberta totaled 32.5 million metric tons in 2008, and total coal reserves in the province could amount to more than 30 billion metric tons. Alberta generates the most

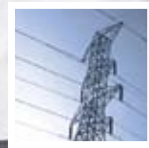


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6. Alberta winds. The Summerview wind facility now has a total installed capacity of 136 MW at Pincher Creek, Alberta. *Courtesy: TransAlta*



conventional thermal energy of any province, and coal-fired generation accounts for over 70% of Alberta's mix, followed by natural gas, hydro, and wind. Although wind development is occurring in Alberta, it is one Canadian province that is not working to seed a renewable energy industry with

the allure of subsidies or preferential tariff rates.

The generation sector in Alberta is dominated by a few private companies. One of these is TransAlta, which operates a range of facilities and continues to broaden its presence (Figure 6). Steve Schnyder is CEO of TransAlta and

the Energy Council of Canada's 2010 Energy Person of the Year. "We are one of the oldest power companies in Canada. We were mostly Alberta-based, but over the last 20 years we have become much more international. The biggest change we have had to embrace has been the deregulation process. From 1996 to 2005 our transformation has revolved around getting through that regulatory change. Now our focus is wholesale generation and marketing across Canada and the Western U.S."

Counting on Capturing Carbon. Alberta has become a global center of excellence in the pursuit of clean solutions for coal and in the drive toward a commercial solution for carbon capture and sequestration. Minister Liepert elaborates: "We have committed to invest C\$2 billion in carbon capture and storage development over 15 years. This has been channelled into four projects, one of which is being applied to coal-fired generation."

"In this day and age, 'carbon' is a bad word, but people predict North America has over a hundred years' of supply potential," explains William Smith, senior vice president of the Energy Sector at Siemens Canada. "We believe that gasification will have a role to play in enabling North America to utilize that coal resource. We have a technology that can



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convert coal into a synthetic gas that can be burned in a turbine, and then the CO₂ can be captured and stored. The issue today is whether we can get the economics right so that it is a feasible cost for jurisdictions. The second issue is where to store the CO₂ that is captured. This represents a significant opportunity for Alberta and Saskatchewan, where it is ideal for storage and for advanced oil recovery.”

“Alberta is one of the best jurisdictions in the world for carbon capture and storage,” believes Brian Vaasjo, president and CEO of

Capital Power, one of the three largest generation and development companies in Alberta. Capital Power is currently constructing a pilot carbon capture and sequestration (CCS) facility at its new Keephills 3 plant: “We have the oilfields to utilize the carbon advanced recovery. We have the natural aquifers, and people are comfortable with the idea of storing carbon beneath the ground here.”

He sees the real drive for this to be the export potential of this technology and expertise as CCS systems improve: “There’s a lot

of sense in developing CCS here, but the real drive is international. Only 15% of our mix is from coal, while in China it’s 80%, India 70%, and U.S. 60%. [Ed.: The U.S. Energy Information Agency reports that coal-fired generation in 2010 accounted for 45% of total U.S. generation.] There’s going to have to be an answer to coal-fired generation.”

Exploring Nuclear Potential. Due to Alberta’s industrial boom, and the potential of carbon pricing making coal less viable as a long-term option, some players see potential for Alberta developing its own nuclear facility. Energy Minister Liepert will not rule this out. “It’s a question of economics. We won’t seed the market to make it happen. Today, in Alberta the private sector has decided that it can’t make it go.”

Despite the current lack of appetite for nuclear power, some market players see a long-term potential for adding it to the mix. “The introduction of nuclear energy makes sense in order to meet the current shortfall and to meet future demand growth linked to additional oil sand development,” says Duncan Hawthorne, president and CEO of Bruce Power. He feels that nuclear suffers from a misconception over its cost, particularly in relation to clean coal: “There is the belief that clean coal is the cheapest or most logical option. I think that people will come to the realization that while nuclear cannot compare with the low rates provided by existing coal facilities, it can compete as an alternative to any new-build coal plant. Therefore, I look at Alberta and Saskatchewan as being on a slow fuse, but that they will inevitably get to the point of considering nuclear. If nuclear is in Alberta, we’re in Alberta,” he says.

Decision Time

With its rich resource base and government policies that promote energy development, Canada is in an enviable position. However, the entire power industry is waiting on certain key decisions, one of the most important being the establishment of a clear carbon price. TransAlta’s Snyder cautions: “We have the time to get it right, but we don’t have time to get it wrong. There are a lot of options coming up. If we take some time to let it all play out, I think that’s the best approach. In our industry, when you make a decision, you’re stuck with it for a long time.”

Canada’s role as a green energy superpower is set to grow as North America’s requirements for clean power continue to increase. Power exports will remain vitally important to Canada’s electricity industry and will make possible the continued, steady investment that it so strongly desires. ■

—**Tom Willatt and Sharon Saylor**
(info@gbreports.com) are with *Global Business Reports*.

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