The Integrated Electric Grid: Maximizing Benefits in an Evolving Energy Landscape



Canadian A Electricity ca Association de

Association canadienne de l'électricité



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Executive Summary

North America is shifting towards a new energy paradigm. Where it was once viewed through the prism of scarcity, some are now beginning to speak of energy in the language of abundance.

The grounds for optimism are understandable. For instance, technological breakthroughs on the production side are unlocking previously inaccessible deposits of oil and natural gas, while advances in conservation and efficiency practices are affording customers greater control over their energy use.

Still, the achievement of North American independence from volatile global energy markets is by no means a foregone conclusion. Economic recovery efforts remain fragile. The supply and delivery infrastructure for our resources is in urgent need of upgrade, while malicious actors persistently seek to threaten its security. And perhaps most importantly, transformative events in the market — such as the North American boom in natural gas production — have overtaken many of the policy structures in place across Canada and the United States. Too much of the framework shaping governments' approach on energy issues is therefore not optimally-suited to addressing the opportunities and challenges at hand.

The Canadian Electricity Association (CEA) believes that the backbone of any strategy to confront and leverage the new energy landscape must be an enhanced North American electricity system. Electricity plays an integral role in the robust Canada-U.S. relationship on energy, which itself is a fundamental pillar of the broader flow of two-way trade that is without compare anywhere in the world. The linkages between the Canadian and U.S. grids — more than three dozen in total — offer several advantages to both countries, such as higher reliability and expanded access to low-emitting resources. These physical interconnections have facilitated steady growth in what has become a continent-wide marketplace for electricity, with supply fulfilling demand in an efficient, cost-effective manner across North America.

From the vantage point of the voice of the Canadian electricity sector, CEA views our vibrant, bilateral electricity relationship — which has long served as a central instrument for economic vitality in both countries — as being an ideal platform from which to launch a renewed push towards a more secure, prosperous and autonomous continental energy posture.

This paper is intended to help guide such efforts. In order to set a proper context, the first section provides an overview of the interconnected and integrated nature of the Canada-U.S. relationship on electricity, and highlights the mutual benefits thereof. The second section identifies four strategic goals to further strengthen the relationship. Under each goal, CEA has offered specific recommendations for joint cooperation and action for policymakers in Canada and the United States to pursue.

RECOMMENDATIONS

1. Plugging the Electric Infrastructure Gap

- Coordinate and cooperate on identifying new infrastructure needs and addressing aging infrastructure on the North American grid, and effectively communicate such needs to the general public.
- Remove regulatory impediments to much-needed electric infrastructure investments.
- Update and enhance the efficiency of permitting procedures for international power line projects.

2. Maximizing Environmental Sustainability

- Ensure that any market-based solution to combat climate change that incorporates the electricity sector recognizes the integrated nature of the North American electricity market, encourages the continued two-way flow in cross-border electricity trade and contains credit provisions for early action taken to reduce emissions.
- Support existing measures that are proven to cost-effectively deliver emission reductions and help enable intermittent renewable technologies.
- Recognize hydropower as a clean, renewable resource across policy programs.
- Maintain support for fostering cleaner ways to use North America's plentiful supplies of natural gas and coal for power generation, including the deployment of carbon capture and storage technology.

3. Maintaining Vigilance on Reliability and Security

- Support the existing framework in place at the North American Electric Reliability Corporation to develop reliability standards (including for cyber security protection) for the North American transmission grid.
- Enhance public-private sector, as well as governmentto-government, coordination and sharing of timely and actionable threat information.
- Address cyber and other security threats in a comprehensive manner across all industry sectors, with a focus on securing the most critical assets from the most urgent challenges.
- Standardize and streamline border-crossing procedures for crews providing assistance to utilities in the other country.

4. Ensuring Free, Fair and Fluid Inter-Jurisdictional Trade

- Remain vigilant in avoiding erecting barriers that may inhibit inter-jurisdictional electricity trade.
- Refrain from imposing unnecessarily burdensome over-the-counter derivatives regulatory requirements on energy end-users, which pose no systemic risk to the marketplace.
- Ensure that policies aimed at stimulating development of clean and alternative energy (such as clean energy standards and reverse auction mechanisms) are inclusive of all North American clean electricity sources, such as hydropower and nuclear, and are adapted to competitive market designs, where appropriate.
- Update and enhance the efficiency of administrative procedures for authorizing exports of electricity across the international border.

A. The U.S.-Canada Electricity Relationship

The trading relationship enjoyed by Canada and the United States is a model of bilateral cooperation. Every day, approximately 300,000 individuals and C\$1.6 billion worth of goods and services move freely across the U.S.-Canada border, making each country the other's most important trading partner.¹ The scope and scale of this two-way trading flow is without compare anywhere in the world.

An integral part of this relationship is energy. Energy serves as the main engine fueling economic activity and prosperity across North America, delivering a wealth of societal benefits and enabling a high quality of life on both sides of the border. Our two countries have long acted as each other's best customers when it comes to the buying and selling of energy commodities. For example, Canada receives the greatest share of U.S. natural gas exports² (with volumes nearly tripling between 2006 and 2012), while providing the U.S. with more crude oil and petroleum products, coal, uranium and natural gas than any other foreign source.³

Canada is the largest supplier to the U.S. of another vital commodity — electricity. Crucial in the day-to-day lives of North Americans, it is so reliable as to be taken for granted. In our homes, offices, factories, ports and stock exchanges, it is instinctively assumed that the lights will turn on with a simple flick of the switch. Likewise, the origin of the electrons being used is rarely considered. The crowds cheering on the Vancouver Canucks might

never contemplate that electricity generated in the U.S. could be illuminating the arena. And the car manufacturer in Michigan may be unaware that electricity from Canadian generators is powering its assembly line.

The movement of electricity between Canada and the United States may go unnoticed by the public. However, this should not be viewed as a cause for concern. Instead, it reflects how routine and reliable a transaction the cross-border exchange of electricity has become in North America. The integration of electricity markets in Canada and the U.S. means supply can fulfill demand in an efficient, cost-effective manner across the continent.

North Americans benefit from a shared system which can generate and transmit electrons across vast distances to ensure a reliable, secure and competitively-priced supply of electricity, 24 hours a day, seven days a week.

The maps in this section offer a clear visual indicator of the extent of the current integration of the electricity systems in Canada and the United States. By interconnecting into each other's networks at over 35 points, the two countries benefit from numerous advantages: a higher level of reliable service for customers through enhanced system stability; efficiencies in system operation; efficiencies in fuel management; opportunities to use power from nearby markets to address local contingencies; and expanded access to low-emitting and competitively-priced resources.



View of transmission lines and a substation in Mactaquac, New Brunswick. The Canadian and U.S. transmission systems are physically interconnected at over 35 points, meaning consumers in both countries enjoy such benefits as enhanced system reliability and greater access to low-emitting, competitively-priced supplies of electricity. *Photo: Courtesy of New Brunswick Power*



Integrated North American Transmission Grid

Map information courtesy of Platts, a division of The McGraw Hill Companies. Reproduction in any form without express permission of Platts is strictly prohibited.

"The bulk power system in North America is one of the largest, most complex, and most robust systems ever created by mankind. Throughout North America, four interconnections with a capacity of over 1 million megawatts of generation and nearly 500,000 miles of high voltage transmission lines all acting in unison, meet the electric needs of more than 340 million people...The electricity being used in this room right now is generated and transmitted in real time over a complex series of lines and stations from as far away as Ontario or Tennessee. As complex as it is, few machines are as robust as the bulk power system."

President & CEO of the North American Electric Reliability Corporation testifying before the U.S. House Energy and Commerce Committee (May 2011)



Major Transmission Interconnections Between Canada and the U.S.

* Construction scheduled for completion in Summer 2013. Source: National Energy Board.

The physical linkages between the Canadian and U.S. grids have likewise enabled steady growth in what has become a robust, continent-wide marketplace for electricity. Electricity trade occurs at a range of points

across and beyond the international border, reflecting the largely north-south nature of the networks in Canadian provinces, as they seamlessly tie into the more dense web of transmission infrastructure in the U.S.



Electricity Exports and Imports Between Canada and the U.S. (2012)

Historically, electricity exports to the U.S. have represented anywhere from five to 10 percent of Canada's total production. The bulk of these exports involve the sale of surplus generation from major hydropower producing provinces such as Québec, British Columbia and Manitoba. More recently, export volumes from Ontario have also risen, making the province the second largest exporter (on both a gross and net basis) for several consecutive years. Data displayed are in gigawatt-hours. Source: National Energy Board, Electricity Exports and Imports, 2012. Retrieved February 21, 2013.

While hydro enjoys a sizeable share of Ontario's supply mix, nuclear energy comprises approximately half of the province's portfolio.

Overall, the vast majority of electrons delivered across the border from Canadian generators to U.S. customers are derived from clean, non-emitting sources.



U.S.-Canada Electricity Trade Volume (1990–2012)

As the pie charts below illustrate, Canada and the U.S. have very different generation mixes. These differences primarily reflect availability of resources, as different geographic regions have access to different fuel inputs.

System integration and cross-border trade enables market participants to take advantage of the supply diversity between the Canadian and U.S. segments of the larger North American grid.

Electricity Generation in the U.S. and Canada by Fuel Type (2011)



Numbers may not sum to 100 percent due to rounding. Source: Energy Information Administration, Electric Power Monthly, 2012; Statistics Canada, Survey 2151, 2012. Retrieved February 21, 2013.

B. Four Strategic Goals for Maximizing the Benefits of Grid Integration

1. Plugging the Electric Infrastructure Gap

TIME FOR A TUNE-UP

It's often said that the North American electricity grid is "the world's largest machine." An immense network of power lines, generation facilities, and related communications systems, it is arguably the most significant achievement in modern engineering. It underpins the economy, national security and public health of the 350 million people it serves on an around-the-clock basis, making it a critical enabler of the quality of life we all enjoy.

Like anything man-made, the grid requires its fair share of maintenance and servicing. In recent years, however, utilities have not always been granted the ability to invest in electric infrastructure in a manner which has kept up with population and demand growth, the proliferation of cyber



One of the electric vehicles (EVs) in BC Hydro's fleet sits parked on the campus of Northwest Community College in Terrace, British Columbia. The province is partnering with Washington, Oregon and California to pave the way for an EV corridor stretching from San Diego, California to Whistler, British Columbia. *Photo: Courtesy* of BC Hydro and Power Authority and physical security threats, advances in technology, or with the evolving expectations of consumers in Canada and the U.S. — who rely more and more on the electricity system to power their means of livelihood and leisure.

INVESTMENT NEEDS BY THE NUMBERS

In Canada, studies have found that upwards of C\$350 billion is needed to refurbish, renew and replace aging assets over the next 20 years.⁴ This translates into an average annual investment requirement of C\$15 billion — the highest in the country's history. And this challenge is by no means unique to Canada. In the United States, the electricity sector is also confronting a daunting task to fund record levels of capital expenditures. Investor-owned utilities alone are projecting annual investment needs in the unprecedented range of US\$85 billion through 2014.⁵

At this juncture in our bilateral partnership, it must be recognized that a modernized electricity system is essential to enabling North Americans to continue enjoying their existing quality of life — and that greater investment is required to cross the threshold leading to economic renewal and North American energy independence.

"[T]here is a strong argument for an increased focus on the investment necessary to build a modernized grid that will deliver electricity that is both affordable and reliable...A number of trends in the power sector will create the need for significant infrastructure investment over the next decade..."

Capitalizing on the Evolving Power Sector: Policies for a Modern and Reliable U.S. Electric Grid, Bipartisan Policy Center (February 2013)

AN IMPORTANT ROLE FOR GOVERNMENTS

Most of the decisions regarding when, where and how to invest in new infrastructure will be made by local authorities and stakeholders most attuned to the needs of specific communities. Nevertheless, governments at all levels in the U.S. and Canada have crucial roles to play.

For starters, **government should assist industry's efforts to improve public understanding of the pressing need for new investments**. Concerns surrounding the expansion of the electricity system — the costs to be incurred, who will pay, and the potential impact on health and safety — are entirely legitimate, and both industry and government have a responsibility to work together to address these concerns. However, there is also a responsibility to ensure that the public benefits provided by the safe, reliable and affordable delivery of electricity are adequately understood in the public square.

Moreover, it is incumbent upon policymakers to ensure that the development of a 21st century power grid is governed by a 21st century regulatory regime. Duplicative, complex and administratively-burdensome "[N]ew and different demands are driving the expansion and adaptation of the transmission grid and the evolution of its supporting institutions. The system can and will respond to the new forces, but effective response [*sic*] will require material changes in the regulatory and policy framework."

The Future of the Electric Grid, Massachusetts Institute of Technology (December 2011)

regulation has historically served as one of the primary barriers to enabling required investments. CEA applauds steps being taken by federal governments in both Canada and the U.S. to enact meaningful reforms, and strongly encourages relevant authorities to sustain efforts to foster a strong regulatory framework — based on appropriate public consultation — that effectively strikes a balance between providing rigorous oversight and supporting much-needed investment actions.

Cutting the Red Tape Delaying International Power Line Projects

International power lines (IPLs) are the electric bridges linking the transmission superhighways crisscrossing our two countries. They serve as key stabilizers of the larger network and as a vital conduit for two-way flows in electricity trade. Where appropriate, they can be a key part of transmission solutions for reducing congestion, improving system reliability and unlocking new sources of renewable energy.

Several IPLs pending completion, though, have suffered serious setbacks in their project timelines. Many of these are attributable to ill-defined and out-of-date parameters around project reviews and scoping periods — particularly under the U.S. framework. These impediments ultimately reduce certainty for proponents and lead to unnecessary and burdensome escalations of administrative costs.

CEA applauds recent initiatives aimed at streamlining the permitting processes around IPL projects. For example, the United States Department of Energy (DOE) included the procedures governing issuance of IPL permits in its regulatory reform plans, developed in response to President Obama's 2011 Executive Order seeking improved federal regulatory review. We look forward to working with DOE and relevant authorities in Canada on updating and enhancing such procedures, which will help proponents, stakeholders and regulators achieve significant efficiencies and savings.

KEEP THE LIGHTS ON, CREATE JOBS

Opening the door to new infrastructure investments will not only augment the North American electricity sector's ability to continue delivering a reliable and affordable power supply, it will also generate significant economic growth and employment opportunities along the way. According to a 2012 study conducted by the Conference Board of Canada, for every C\$100 million invested in power system assets, real GDP is boosted by C\$85.6 million and approximately 1,200 jobs are created.⁶

At a time when challenges to economic recovery persist, the job-creation proposition presented by infrastructure investment activity is too compelling to ignore. It is therefore vital that decision-makers seize the need and the opportunity, so that consumers, workers and employers across the continent can derive the full suite of benefits associated with upgrading our shared electricity system. As U.S. and Canadian authorities increasingly turn their focus towards overcoming the current electric infrastructure deficit, CEA encourages them to act upon these recommendations so that "the world's largest machine" can continue powering our society's growth and well-being.

RECOMMENDATIONS

- Coordinate and cooperate on identifying new infrastructure needs and addressing aging infrastructure on the North American grid, and effectively communicate such needs to the general public.
- Remove regulatory impediments to much-needed electric infrastructure investments.
- Update and enhance the efficiency of permitting procedures for international power line projects.



With a total rated capacity of 5,428 megawatts, the Churchill Falls Generating Station in Newfoundland and Labrador is the second largest underground hydroelectric plant in North America. Each year, Churchill Falls generates approximately one percent of the world's hydroelectric power. *Photo: Courtesy of Nalcor Energy*

2. Maximizing Environmental Sustainability

A LONG LEGACY OF COMBATTING AIR POLLUTION TOGETHER

As Canada and the United States look to usher in a new era of economic prosperity and of autonomy from volatile disruptions in the global energy supply chain, further enhancing protections for our common airshed is top of mind.

And rightly so. The North American electricity sector's environmental performance over the last few decades is more than sufficient to put to rest the outdated, false dichotomy between pursuing economic growth and fulfilling our obligations as responsible environmental stewards. Since the 1970s, both countries have witnessed tremendous expansion in GDP and population, while overall emissions from power plants have dropped appreciably.⁷

Much of this success is attributable to exemplary bilateral cooperation, through such initiatives as the *Canada-United States Air Quality Agreement* signed in 1991, its accompanying Acid Rain and Ozone Annexes, and a subsequent annex on particulate matter currently being negotiated. Building upon this solid foundation of progress will be key to jointly and creatively confronting the challenges to our shared environmental goals.



The Halkirk Wind Project in Alberta. The renewable energy credits associated with this project are purchased by San Francisco-based Pacific Gas & Electric to help fulfill its obligations under California's Renewable Portfolio Standard. *Photo: Courtesy of Capital Power*

PURSUING INCLUSIVE MARKET-BASED SOLUTIONS TO CLIMATE CHANGE

With scientific consensus strengthening around the reality of climate change, proposals for market-based measures to combat the threat are increasing in popularity amongst government officials on both sides of the border.

The Regional Greenhouse Gas Initiative and California's cap-and-trade scheme are, respectively, established and nascent emissions trading programs whose performance is under close observation by governments which may wish to follow suit. British Columbia has implemented a carbon tax regime, while the provinces of Alberta and Québec have fused elements of trading and direct levies in their particular carbon pricing approaches.

As market participants become more familiar with such mechanisms, more widespread adoption across North America may start to hold greater appeal. And as joint steps being taken by California and Québec illustrate, formal linkages between emission reduction programs may also emerge as an attractive option.

Given its current electrical generation mix of approximately 80 percent non-emitting resources, Canada has a unique contribution to make to any initiative seeking improved environmental performance in the electricity sector, including emissions trading schemes. **Only a harmonized, common approach** — **behind which all relevant stakeholders can coalesce** — will ensure the **effectiveness of a sector-wide, market-based system in North America.** Any U.S. regime should seek to accommodate, not exclude, the participation of Canadian entities, and vice versa. In addition, such regimes should encourage sustained two-way flows in cross-border electricity trade and contain credit provisions for early action on reducing emissions.

PLAYING TO OUR EXISTING INTEGRATED STRENGTHS

Alongside the exploration of new tools and approaches to maximize the environmental performance of the international power grid, it is important to continue supporting the creative, effective means for achieving emission reductions that are already in place or under development.



Aerial view of construction of the 60 megawatt Point Tupper Biomass Project in Nova Scotia. The province has legislated a target of deriving 25 percent of its electricity supply from renewable resources (hydro, wind, tidal and biomass) by 2015. *Photo: Courtesy of Nova Scotia Power*

One such example is the cross-border fungibility of environmental compliance instruments. This concept acknowledges the fundamental realities of integrated markets like those in North America and is predicated on the sound premise that emissions reductions in one jurisdiction are advantageous to neighbouring jurisdictions. Innovative real-life examples in this regard include the wind farm in Alberta whose renewable energy credits are purchased by a California-based utility to fulfill its environmental obligations in that state, as well as Ontario's inclusion in its emissions trading program of nitrogen oxides (NO_x) and sulphur dioxide (SO₂) reductions in nearby U.S. states.

Another compelling example is the marriage of wind and water which occurs in many regions across the continent. Often the storage capability of hydropower capacity in Canadian provinces can be used to firm-up the development of wind and other intermittent renewables in adjacent U.S. states. The recent establishment of a long-term power purchase agreement between Manitoba Hydro and Minnesota Power for this exact purpose is an excellent example of how grid integration provides opportunities for achieving a cleaner emissions profile than would otherwise be possible.

This example attests to the diverse ways in which hydropower can contribute to emission reduction efforts. More and more, senior U.S. legislators are promoting hydropower's status as a clean, abundant resource. CEA applauds such efforts and encourages policy programs in both countries to recognize hydropower for its tangible emission reduction benefits.

Finally, in seeking to lower the environmental footprint of the North American grid, it is crucial that U.S. and Canadian governments maintain support for fostering cleaner ways to use North America's plentiful supplies of natural gas and coal for power generation.

The benefits of expanded use of clean-burning natural gas are manifold. Not only does natural gas boast a low greenhouse gas (GHG) and air pollutant emissions profile, its flexibility as a fuel source makes it a preferred option for reliably facilitating the integration of variable energy resources into the system.

With respect to coal, abundant reserves of this resource present North America with an inherent strategic and competitive advantage, both in terms of its affordability and its role in assuring a diverse and comprehensive supply mix. From the John W. Turk Jr. facility in Arkansas to the Genesee 3 power plant in Alberta, supercritical combustion is already showcasing its ability to achieve greater fuel efficiency and reduce emissions from coal unit operations. In Saskatchewan, meanwhile, industry and government are jointly investing in the first fullyintegrated carbon capture and storage (CCS) system for a commercial-scale power plant, set to come online in 2014.

"[T]he [power purchase agreements] will contribute to the 20 percent by 2010 [renewable portfolio standard] goal with the use of flexible compliance, and will also contribute to California's renewable energy goals in the years beyond 2010..."

Pacific Gas & Electric's petition to the California Public Utilities Commission to approve purchase of renewable energy credits associated with three wind projects in Alberta (February 2010)

Federal GHG standards for power plants in both countries are based on assumptions around the long-term effectiveness and viability of CCS technology. As such, it is essential that Canadian and U.S. governments continue to support development and deployment of this breakthrough technology, and formally recognize the significant environmental protection dividends made possible by the installation of cleaner coal and natural gas capacity.

RECOMMENDATIONS

- Ensure that any market-based solution to combat climate change that incorporates the electricity sector recognizes the integrated nature of the North American electricity market, encourages the continued two-way flow in cross-border electricity trade and contains credit provisions for early action taken to reduce emissions.
- Support existing measures that are proven to costeffectively deliver emission reductions and help enable intermittent renewable technologies.
- Recognize hydropower as a clean, renewable resource across policy programs.
- Maintain support for fostering cleaner ways to use North America's plentiful supplies of natural gas and coal for power generation, including the deployment of carbon capture and storage technology.

"This innovative agreement aligns well with our long-term resource strategy to provide our customers with a flexible and diverse energy supply at the lowest cost possible...Our partnership with Manitoba Hydro is an example of two organizations reaching across geographic boundaries to bolster transmission system capacity while further transforming North America's energy landscape."

Minnesota Power announcing a contract for purchase of 250 megawatts of hydroelectric power from Manitoba Hydro (May 2011)



The Boundary Dam Power Station in Estevan, Saskatchewan. Unit 3 at the facility will feature the world's first commercial-scale, fully-integrated carbon capture and storage system in 2014. *Photo: Courtesy of SaskPower*

3. Maintaining Vigilance on Reliability and Security

JOINTLY COMMITTING TO RELIABILITY AND SECURITY EXCELLENCE

Making necessary investments in electric infrastructure and strengthening the environmental performance of grid assets are indispensable steps in the journey towards economic renewal and energy independence in North America. And yet, these enterprises will be in vain if they are not matched with an unfailing commitment to the security and reliability of electric power supply and delivery.

21ST CENTURY THREATS — A NEW FRONTIER

In parallel with ongoing shifts in energy market forces and customer expectations, an increasingly sophisticated landscape of security risks is posing new challenges to fundamental, long-standing assumptions about how to protect "the world's largest machine."

Concern is mounting regarding the vulnerability of the international power grid to evolving threats — whether natural phenomena, such as blasts of charged particles



View of Point Lepreau Nuclear Generating Station in New Brunswick. Canada's response to the 2011 Fukushima accident in Japan was cited by the International Atomic Energy Agency as a model practice for other countries to follow. *Photo: Courtesy of New Brunswick Power*

Further Strengthening the Culture of Nuclear Safety after Fukushima

Among the most impressive examples of the electricity sector's commitment to robust reliability and safety outcomes is the emergency preparedness review undertaken by nuclear operators in response to the March 2011 accident at the Fukushima Daiichi power plant in Japan.

Following the event, nuclear operators in Canada — along with their counterparts in the U.S. — immediately began sharing resources and partnering with regulators to conduct a comprehensive review of the safety of nuclear generating stations' systems and components. In October 2011, the Canadian Nuclear Safety Commission (CNSC) confirmed that nuclear power plants in Canada are fully able to operate safely and have the ability to withstand and respond to credible external events whose probability of occurrence is extremely low. The CNSC's conclusions mirrored those reached by U.S. regulators a few months prior. In addition, the CNSC's response to Fukushima was cited by the International Atomic Energy Agency as a model practice for other regulatory bodies around the world to follow.

With a firm vote of confidence from government regulators in hand, the implementation of post-Fukushima lessons learned and the continuous enhancements to safety margins remain a top priority. Nuclear operators are focused on making every effort to demonstrate readiness for emergencies and to exceed the public's rising expectations for rigour and excellence in bolstering the safety, reliability and security of North America's reactor fleet.

Source: International Atomic Energy Agency, Integrated Regulatory Review Service. "Follow-Up Mission Report to the Government of Canada", March 2012. from the sun, or man-made, particularly those emanating from cyberspace and from malicious actors in foreign nation-states or terrorist organizations.

In North America, voices from across the public and private sectors continue to sound the alarm, warning of the severity of these threats and the perceived lack of sufficient governmental authority to prevent a "cyber 9/11." Failure to act urgently and effectively, they warn, means propagating the grid's exposure to an attack capable of inflicting catastrophic damage and prolonged outages, thereby endangering the health and safety of millions. "Transmission-grid reliability is a North American issue; the reliability relationships with Canada and Mexico must be preserved. Consultation with Canadian and Mexican governments is important for ensuring reliability in the interconnected North American bulk-power market."

Maintaining Reliability in a Competitive U.S. Electricity Industry: Final Report of the Task Force on Electric System Reliability, Secretary of Energy Advisory Board (September 1998)

Expediting Cross-Border Mutual Assistance

Whether wildfires, droughts, hurricanes, cold spells or hot spells, previously uncommon extreme weather trends are becoming much more common - and the immense challenges associated with recovery are growing alongside of them.

Much of the damage caused by severe weather events like Superstorm Sandy is linked to the widespread loss of electric power service. With rising expectations that the effects of climate change will render erratic weather a reality of everyday life, the establishment of a robust public-private sector framework for extreme weather preparedness and response is imperative.

A key element of such a framework is ensuring that utility crews and equipment get to where they are needed following a severe weather event. For many utilities, this means relying on counterparts across the border. During the great ice storm of 1998, assistance from U.S. crews played a pivotal role in getting the lights back on in Québec. Similarly, support from Canadians was crucial to recovery in the U.S. northeast following Superstorm Sandy in 2012, as well as winter storm Nemo in early 2013.

The mutual assistance agreements in place between U.S. and Canadian utilities are mature, with a tradition of reciprocal support stretching back decades. The cultivation of direct relationships among utility personnel and border officials on both sides has helped build trust and simplify exit and entry processes.

However, crews can still experience a measure of unpredictability when crossing the border. For example, en route to providing assistance with electric power restoration in U.S. communities impacted by Superstorm Sandy, one Canadian utility dispatched crews to two separate U.S. Ports of Entry (POEs). For no apparent reason, crews were photographed and fingerprinted at one POE, but not at the other. Such uncertainty can lead to unnecessary delays, which in turn compromise utilities' ability to provide emergency relief on a timely basis.

Standardized, streamlined border-crossing procedures and requirements should be adopted across POEs, in order to grant crews clarity around what specific information they need to provide and what treatment they can expect upon arrival. With this certainty in hand, U.S. utilities — and the customers they serve — can rest assured that the resources and talents of Canadian crews will be effectively and rapidly deployed when they are needed most, and vice versa.



Crews from Ontario-based Hydro One help get the lights back on for residents in Arlington, Virginia on July 4 following the "derecho" that swept across the Midwest and Mid-Atlantic in 2012. The Edison Electric Institute honoured Hydro One with an Emergency Assistance Award in recognition of the company's support to U.S. utilities following the Midwest/Mid-Atlantic "derecho" and Superstorm Sandy. *Photo: Courtesy of Hydro One*

SHARED THREATS REQUIRE A SHARED RESPONSE

Along with partners in the U.S., CEA and its members have been engaging decision-makers in Washington and Ottawa for several years in support of efforts to craft appropriate solutions for securing electric infrastructure. As further legislative and executive actions are contemplated to mitigate cyber and other security risks, CEA believes that workable and effective solutions in a cross-border context must do the following:

Support the existing framework in place at the 1. North American Electric Reliability Corporation (NERC) to develop reliability standards (including for cyber security protection) for the North American transmission grid. The electricity sector is the only critical infrastructure sector already subject to mandatory and enforceable cyber security standards. NERC develops robust reliability standards for all users, owners and operators of the continent-wide grid. In addition to governing other aspects of electric grid operations, these standards provide a solid level of baseline protection against cyber and other security threats. NERC's cyber security standards are continuously being refined, with the fifth iteration having recently been submitted for regulatory approval.

Achieving the highest possible degree of grid security will require governments to seek to build upon, not supplant, the mature and effective architecture already in place at NERC. It will also necessitate allowing the NERC process to operate in a manner consistent with its original design, where standards are developed based on the technical expertise of industry and NERC professionals and in a manner that is respectful of jurisdictional sovereignty, with appropriate oversight from authorities in Canada and the U.S.

"We understand the North American expanse of the interconnected power grid and the need for an international [Electric Reliability Organization]. Thus, we reaffirm our statements... recognizing the importance of a structure that allows the ERO to operate on an international basis. The Commission and its staff reconfirm our commitment to consult regularly with Canadian and Mexican regulators on topics of mutual interest..."

Federal Energy Regulatory Commission decision related to the NERC standards development process (September 2010) 2. Enhance public-private sector, as well as government-to-government, coordination and sharing of timely and actionable threat information. Examples abound of the growing collaboration between the public and private sectors, whether through the development of cyber security capabilities and maturity models or cyber security risk management processes. In Canada, the establishment of a memorandum of understanding between CEA and the Canadian Cyber Incident Response Centre on information and intelligence sharing has been cited by independent government watchdogs as one of the leading milestones in the implementation of a national strategy to enhance critical infrastructure protection.

"As a resident of Wareham, Massachusetts, U.S.A., I would like to extend my sincere thanks for all the help Hydro-Québec crews gave us during our blizzard and severe electrical outage this past weekend! What a great feeling it is to know that we can all come together across borders and cultures to help one another. Your crews were very professional and you were well represented. It's something me and my family will not soon forget!"

Letter to the Editor, Montreal Gazette (February 2013)



Hydro-Québec and National Grid crew members cheer the restoration of power to customers in the U.S. northeast following Superstorm Sandy in 2012. The Edison Electric Institute honoured Hydro-Québec with an Emergency Assistance Award in recognition of the company's support to U.S. utilities following the Midwest/Mid-Atlantic "derecho" and Superstorm Sandy. *Photo: Courtesy of Hydro-Québec*

Such efforts should be deepened and expanded, not only in the industry-government interface, but in government-to-government engagement as well. In this regard, CEA was encouraged by provisions in the Obama Administration's Presidential Policy Directive-21 that accompanied the White House's Executive Order on cyber security in February 2013. These requirements instructed the Department of State to engage foreign governments to strengthen the resilience and security of critical infrastructure. Such prescriptions rightfully reflect the reality that government efforts to boost grid reliability and security cannot succeed in isolation.

3. Address cyber and other security threats in a comprehensive manner across all industry sectors, with a focus on securing the most critical assets from the most urgent challenges. Cyber and other security challenges affect all economic sectors, not just electricity. CEA believes that a framework for addressing critical infrastructure security should encompass all sectors. A sector-specific approach only covers one piece of a much larger initiative and could overlook crucial elements that are needed to address security threats in a comprehensive manner.

The public and private sectors must also work together to identify and satisfy the most pressing needs for securing critical infrastructure through prioritizing the issues and focusing limited resources. Establishing a clear understanding of the roles, responsibilities and tradeoffs involved in addressing security challenges is vital to such efforts.

A sustained innovative and collaborative partnership between industry and government — both in and between Canada and the U.S. — is pivotal to improving our collective understanding of the evolving threats facing the electricity sector and to strengthening our ability to mitigate them responsibly and effectively.

RECOMMENDATIONS

 Support the existing framework in place at the North American Electric Reliability Corporation to develop reliability standards (including for cyber security protection) for the North American transmission grid.



An employee monitors conditions on the electric system in Ontario at the control room of the Independent Electricity System Operator. *Photo: Courtesy of Independent Electricity System Operator*

"Saw workers from [New Brunswick Power] from Canada on a break at Five Guys. I never lost power but thanked them for coming to [Long Island] to help."

"Power's back thanks to some swell fellows from Canada's [New Brunswick Power]!"

Residents of Long Island tweet their thanks to New Brunswick Power utility crews for assisting with power restoration efforts following Superstorm Sandy (November 2012)

- Enhance public-private sector, as well as governmentto-government, coordination and sharing of timely and actionable threat information.
- Address cyber and other security threats in a comprehensive manner across all industry sectors, with a focus on securing the most critical assets from the most urgent challenges.
- Standardize and streamline border-crossing procedures for crews providing assistance to utilities in the other country.

4. Ensuring Free, Fair and Fluid Inter-Jurisdictional Trade

THE NEED FOR MAINTAINING AN OPEN, INCLUSIVE TRADING REGIME

As outlined in the introduction to this paper, electricity is an established and growing part of the larger Canada-U.S. trade relationship. Canada has typically exported upwards of 10 percent of its electricity production to the United States. While imports into Canada have varied over time, these sales nevertheless play a key role in meeting the needs of Canadian customers and maintaining operational balance in the interconnected system.

In short, the market is a borderless one. Supply meets demand north-to-south or south-to-north as conditions require, to the advantage of consumers everywhere. Impediments to the seamless and unrestricted exchange of electrons across international and state borders are few. However, those that do exist can pose significant burdens to market participants. And while such hurdles are limited in number, governments in Canada and the U.S. must remain vigilant to avoid erecting any additional barriers which may inhibit inter-jurisdictional power flows.

Such barriers include restrictive renewable electricity production or purchase obligations, at either the provincial, state or national level. Renewable or clean energy standard (CES) targets, for example, have emerged as a popular policy option through which governments seek to lower the emissions profile of electricity facilities under their jurisdiction.

However, these standards are sometimes configured to exclude non-emitting resources, such as large hydroelectric facilities or nuclear plants, or otherwise eligible energy sources from non-adjacent control areas from their definition of qualifying generation. This, in turn, can adversely impact electricity trade, as it may weaken the option of purchasing clean electricity from another jurisdiction. Such restrictive arrangements are neither conducive to cutting emissions, nor to reducing electric rates and thereby stimulating economic growth.

Thousands of megawatts of non- and low-emitting resources — including hydroelectric, nuclear, wind and biomass — are set to come online across Canada in the next few years. On both sides of the border, sustainable



Situated on the Nelson River, the Kettle Generating Station is the second largest hydroelectric plant in Manitoba. Hydroelectricity comprises more than 60 percent of Canada's overall generation mix and represents the bulk of Canadian power exports to the United States. *Photo: Courtesy of Manitoba Hydro*

Canadian electricity is poised to remain an appealing option for governments seeking to lower their reliance on fossil-fuel based energy systems, electricity retailers needing to fulfill renewable purchase obligations, and customers wishing to reduce their carbon footprints.

As U.S. lawmakers seek to adopt new policies — ranging from CES standards to reverse auction mechanisms to stimulate development of clean and alternative energy, ensuring that these tools are inclusive of all North American clean electricity sources and are adapted to competitive market designs (where appropriate) will be critical to assuring a fulsome transition towards a clean energy economy. "This visit is about exploring the tremendous potential of hydroelectric projects to produce clean, affordable, reliable energy...Rhode Island has some of the highest energy costs in the country, and if we are going to be a competitive place to do business and provide electricity to consumers at a reasonable rate, we must look at alternatives. Lower energy costs will bolster Rhode Island's economy and help us foster a climate of job creation and growth."

Press release from the Office of the Governor of Rhode Island in advance of a visit to the Churchill River hydroelectric facilities in Newfoundland and Labrador (August 2011)

Streamlining Electricity Export Permits and Authorizations

Along with improvements to permitting processes for international power lines (IPLs), CEA urges governments in Canada and the U.S. to continue updating their requirements for authorizing the exportation of electricity across the international border.

In several respects, these procedures have yet to be adjusted to reflect evolutions in power markets that have transpired over the last decade or so. For example, the requirement for an applicant to specify each IPL over which it is requesting the ability to export power is no longer relevant to how the potential reliability impacts of electricity exports are assessed. Continued imposition of such outdated obligations offers no benefits in terms of enhanced regulatory efficiency and flexibility, and merely burdens participants who play a vital role in bringing liquidity into the market.

All the same, CEA is encouraged by recent developments on this front. In proper recognition of the negligible environmental effects associated with the actual exportation of electricity, the National Energy Board (NEB) in Canada will no longer place conditions on electricity permits concerning environmental protection. For its part, alongside administrative procedures governing issuance of IPL permits, the U.S. Department of Energy (DOE) has identified analogous requirements for export authorizations as candidate rules for review under its regulatory reform plans.

CEA appreciates the NEB and DOE's acknowledgement of the need to update and streamline their respective procedures around authorizing electricity exports. We look forward to working with both bodies on improving these procedures and helping proponents, stakeholders and regulators achieve significant efficiencies and savings.

AVOIDING UNINTENDED CONSEQUENCES IN NEW FINANCIAL REGULATIONS

In step with their international commitments, Canadian and U.S. governments are putting in place the building blocks of new regimes for regulating over-the-counter (OTC) derivatives.

To be sure, enhanced oversight and transparency in OTC markets are important objectives. Nevertheless, OTC products serve as valuable tools in managing the commercial risks associated with the electricity sector's core business of providing a reliable, affordable supply of power to consumers throughout North America. **Care must therefore be taken to ensure unnecessarily onerous requirements** — such as posting of margin or collateral, or mandatory clearing through a central exchange — are not imposed on electric utilities, which are end-users of OTC derivatives and pose no systemic risk to the marketplace.

Though there have been some encouraging signs that regulators in Canada and the U.S. are attuned to the unique ways in which end-users transact in OTC markets, concern remains that implementation of various rules will hinder the ability of end-users to employ OTC contracts as a means of hedging against their commercial risks. Especially in trading platforms as integrated as the North American power market, where OTC contracts can involve counterparties on both sides of the border, CEA calls upon relevant authorities to provide end-users with the flexibility they need to manage core business risks and insulate their customers from price volatility.

A vibrant, bilateral electricity trading relationship has served as an enduring feature of the North American economy. Enhancing this relationship will play a central part in realizing the potential for renewed economic vitality and a more secure, independent energy future. Canada and the U.S. must therefore continue to work together to harmonize structures and processes to enable the sustained exchange of electricity across our shared border. "Canada has substantial hydro-electric resources, which have very low emissions, and are available at relatively low cost and with no need for renewable energy subsidies... The amount of Canadian hydro has risen to 8.5 percent of New England's electric consumption...In fact, additional hydro power imports have been a significant contributor to a cleaner New England electricity grid in the last five years."

Massachusetts Clean Energy and Climate Plan for 2020 (December 2010)

RECOMMENDATIONS

- Remain vigilant in avoiding erecting barriers that may inhibit inter-jurisdictional electricity trade.
- Refrain from imposing unnecessarily burdensome over-the-counter derivatives regulatory requirements on energy end-users, which pose no systemic risk to the marketplace.
- Ensure that policies aimed at stimulating development of clean and alternative energy (such as clean energy standards and reverse auction mechanisms) are inclusive of all North American clean electricity sources, such as hydropower and nuclear, and are adapted to competitive market designs, where appropriate.
- Update and enhance the efficiency of administrative procedures for authorizing exports of electricity across the international border.

1	New York
2	Vermont
3	North Dakota/Minnesota*
4	California
5	Michigan

Rankings are by total volume of gross imports and gross exports in megawatt-hours. * Minnesota and North Dakota are considered as a single entity in the lists above due to certain data reporting methods used in National Energy Board Electricity Exports and Imports Statistics.

Canadian Electricity Exports as a Percentage of Total Retail Sales in U.S. States/Regions (2010)

1	Vermont	38%
2	Maine	18%
3	Minnesota & North Dakota	12%
4	New England	10%
5	New York	6%
6	Michigan	6%
7	Montana	2%
8	Washington	2%

While Canadian power exports may constitute only a small percentage of electricity consumption in the United States nation-wide, they are critical to the energy security of numerous states and regions. The adjoining table shows the share of total retail electricity sales in various U.S. jurisdictions represented by exports of Canadian electricity into those areas in 2010.

Sources: National Energy Board, Electricity Exports and Imports, 2010; Energy Information Administration, U.S. States, State Profiles and Energy Estimates, Exports and Imports, 2010.

Top 5 U.S. Importers of Canadian Electricity (2012) Top 5 U.S. Exporters of Electricity to Canada (2012)

Washington
Maine
North Dakota/Minnesota*
Oregon
New York

Source: National Energy Board, Electricity Exports and Imports, 2012. Retrieved February 21, 2013.

Canadian Electricity Association

C. Conclusion

Against the backdrop of transformation and transition in the North American energy landscape, CEA believes that there are numerous opportunities for leveraging the legacy of cooperation and achievement in operating the world's largest integrated power grid, and expanding the suite of benefits which such integration offers to consumers in Canada and the United States. This paper has identified four broad, strategic goals aimed at enhancing the bilateral electricity relationship:

- 1. Plugging the Electric Infrastructure Gap
- 2. Maximizing Environmental Sustainability
- 3. Maintaining Vigilance on Reliability and Security
- 4. Ensuring Free, Fair and Fluid Inter-Jurisdictional Trade



A convoy of utility crews from Hydro-Québec gets ready to cross the border into New York, en route to providing assistance to residents of Long Island following Superstorm Sandy. More than 700 crew members from Canadian utilities contributed to post-Sandy power restoration efforts across the U.S. northeast. *Photo: Courtesy of Hydro-Québec*

CEA looks forward to working with our counterparts in industry and government on both sides of the border to pursue these solutions and to further strengthen the robustness of the North American electricity system as an instrument of economic prosperity.

D. Endnotes

- ¹ "Canada-United States Beyond the Border Action Plan Implementation Report." Government of Canada. December 2012. <u>http://actionplan.gc.ca/sites/default/files/pdfs/</u> <u>beyond_border_report_en_final.pdf</u>
- ² "U.S. Natural Gas Exports by Country." United States Energy Information Administration. Last modified February 28, 2013. <u>http://www.eia.gov/dnav/ng/ng_move_expc_s1_a.htm</u>
- ³ "A Unique and Vital Relationship." Embassy of Canada in the United States. Last modified August 20, 2012. <u>http://www.canadainternational.gc.ca/washington/</u> <u>bilateral_relations_bilaterales/welcome-bienvenue.</u> <u>aspx?lang=eng&view=d</u>
- ⁴ "Shedding Light on the Economic Impact of Investing in Electricity Infrastructure." The Conference Board of Canada. February 2012. <u>http://www.conferenceboard.ca/e-library/abstract.</u> <u>aspx?did=4673</u>

- ⁵ "Electric Power Industry Outlook: 2013 Wall Street Briefing." Edison Electric Institute. February 6, 2013. <u>http://www.eei.org/ourissues/finance/Documents/</u> <u>Wall Street Briefing 2013.pdf</u>
- ⁶ "Shedding Light on the Economic Impact of Investing in Electricity Infrastructure." The Conference Board of Canada.
- ⁷ For example, aggregate U.S. emissions of major air pollutants decreased by 63 percent between 1980–2011, while Gross Domestic Product increased by 128 percent over the same period. "Air Quality Trends." United States Environmental Protection Agency. Last modified November 1, 2012. <u>http://epa.gov/airtrends/aqtrends.html#comparison</u>

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